# THE

# PENNY CYCLOPÆDIA



OF

THE SOCIETY

FOR THE

DIFFUSION OF USEFUL KNOWLEDGE.

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VOLUME XXII.

SIGONIO——STEAM-VESSEL.

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**SIGO'NIO CA'ROLO** was born at Modena, about the year 1520. He was a pupil of Franciscus Portus, who taught him Greek. He afterwards studied medicine and philosophy at Bologna, and he also visited the university of Pavia. In 1546 he was invited back to Modena to fill the chair of Greek literature, which had become vacant by the departure of Portus. In 1552 he accepted the chair of belles-lettres at Venice, where he became acquainted with Panvinio, who, like himself, was a diligent student of antiquity. His reputation having become widely spread by various works on classical antiquity, he had invitations both to Rome and Padua, at which latter place he accepted the chair of eloquence in 1560. At Padua he again met with Robortello, with whom he had already had a dispute on the names of the Romans, and the disputes between these two scholars, being renewed, were carried to such a pitch that the senate of Venice found it prudent to silence the combatants. [ROBORTELLO.]

Sigonio left Padua in the year 1563 for a place in the university of Bologna, where he received a handsome salary, and was made a citizen. His reputation attracted numerous students to Bologna. Roman antiquity was his special subject, and his instruction was characterised both by comprehensiveness and accuracy. He also occupied himself with middle-age history, and with this object he visited the great libraries and collections of Italy. It was at the request of Pope Gregory XIII., in 1578, that he commenced the ecclesiastical history, of which his friend Panvinio had formed the plan. Sigonio having discovered some fragments of Cicero's treatise 'De Consolatione,' undertook to restore the work, which he completed and published as a genuine work of Cicero. The fraud was detected and exposed by Riccoboni, one of his pupils; but Sigonio, instead of confessing the fact, endeavoured to reply to the arguments of his opponent; and so well has he succeeded in imitating the expression and manner of Cicero, that the work 'De Consolatione' long passed for genuine, notwithstanding the criticism of Riccoboni; and Tiraboschi, who maintained this side of the question, was only convinced by seeing some unpublished letters of Sigonio, in which he acknowledges himself to be the author. Sigonio retired to the neighbourhood of Modena, where he died in 1584. His numerous writings were collected by Argellati, Milan, 1732-1737, in 6 vols. folio, to which is prefixed a Life by Muratori. All his works on matters of antiquity are also contained in the 'Thesaurus Antiquitatum Græcarum et Romanarum' of Graevius and Gronovius.

The following, which are among the principal works of Sigonio, will indicate the general character of his labours: 'Regum, Consulum, Dictatorum ac Censorum Romanorum Fasti, una cum Actis Triumphorum à Romulo rege usque ad Tiberium Cæsarem; in fastos et acta triumphorum explicationes,' Modena, 1550, fol.: there is also a second edition of this work, Venice, 1556; 'De Antiquo Jure Civium Romanorum Libri Duo; de Antiquo Jure Italiae Libri Tres; de Antiquo Jure Provinciarum Libri Tres,' Venice, 1560, fol.; 'De Republica Atheniensium Libri Quinque; de Atheniensium et Lacedæmoniorum Temporibus Liber Unus,' Bologna, 1564, 4to.; 'De Judiciis Romanorum Libri Tres,' Bologna, 1574, 4to.; 'De Occidentali Imperio Libri xx., ab anno 281 ad 575,' Bologna, 1577, fol.; 'Historiae Ecclesiasticae Libri xiv.;' this work comes down to the year 311, but it was the intention of the author to continue it to 1580.

Sigonio was one of the great scholars to whom we owe much of our knowledge of antiquity, and particularly of Roman history. His industry was unwearied, and his learning was sound and comprehensive. He wrote the Latin language with ease and correctness, and his style is simple and perspicuous. Modern scholars have often been more indebted to Sigonio than they have been willing to allow, and the results of his labours have been used by one person after another, and sometimes without making any discrimination between what is right and what is wrong. Heineccius was largely indebted to him, as will appear from examining his 'Syntagma.' If we consider what was done before his time, and what he accomplished towards the illustration of Roman antiquity, we shall find few scholars who have so well deserved a lasting reputation. It would require a minute investigation to ascertain how far some of the more recent views of the Roman polity have been suggested by the writings of Sigonio. His remarks on the Agrarian laws, though far from being marked by sufficient clearness and precision, are still worth reading. (*De Antiquo Jure Italiae.*)

**SIGUENZA**, a large town of the province of Guadalaxara in Spain, situated on the declivity of a hill near the source of the river Hénares, in 40° 58′ N. lat. and 2° 57′ W. long. It is the see of a bishop, suffragan of Toledo, and has a university, which was founded in the year 1441. The town is badly built; the streets are narrow and crooked, but clean. Of the numerous ecclesiastical buildings which this town contains, the cathedral is the only one worthy of mention. It was built at the beginning of the fourteenth century, in the pure Gothic style; it contains one nave and three aisles, and measures 330 feet by 112. One of its chapels, that of Santa Catalina, is greatly admired for its large dimensions and the beautiful marble tombs which it contains. Siguenza is the antient Saguntia, mentioned by Pliny (iii. 4) as one of the six towns among the Arevaci in Hispania Tarraconensis. Livy (xxxiv., 19) calls it Seguntia; and in the 'Itinerary' of Antoninus it is mentioned as Segontia. Inscriptions bearing the latter name have been found in the neighbourhood. It was the seat of a contested battle between Pompey and Sertorius. In 1106 Alfonso VI., king of Leon and Castile, wrested it from the Moors, who had occupied it since the beginning of the eighth century. An antient castle which commands the town is the only remain of Mohammedan architecture. The population, according to Miñano (*Diccionario Geográfico, &c.*), was about 30,000 in 1832. The only trade of the place consists in coarse flannels, blankets, and hats, which are exported to Toledo and Guadalaxara.

SIKE or SIECKE, HENRY, an Oriental scholar of some repute, who lived in the latter half of the seventeenth and the beginning of the eighteenth centuries. He was a native of Bremen, and a professor of Oriental languages at Utrecht, and afterwards at Cambridge. It appears that owing to some misdemeanor he was to be subjected to punishment; and in order to escape from this disgrace, he put an end to his life by hanging himself in 1712. The only work of any note which he published is the 'Evangelium Infantiæ Christi, adscriptum Thomæ,' 1697, 8vo., a very curious apocryphal gospel. It is reprinted in Fabricius's 'Codex Apocryphus Novi Testamenti,' tom. i., pp. 127-212. Sike also founded with L. Küster, at Utrecht, the literary periodical called 'Bibliotheca Novorum Librorum,' to which he contributed several papers.

(Saxii *Onomasticon Literarium*, v., 490, &c.)

SIKHS. [HINDUSTAN, p. 233.]

SILBURY HILL. [WILTSHIRE.]

SILCHESTER. [HAMPSHIRE.]

SILENA'CEÆ, a natural order of plants, belonging to the syncarpous group of the Polypetalous subclass of Exogens. This order is a part of the larger order Caryophylleæ [CARYOPHYLLEÆ] of Jussieu, and was originally separated by De Candolle. It has since been adopted by Bartling and Lindley in their systematic works. It differs from the remaining portion of the order Caryophylleæ, which are now called Alsinaceæ, in the possession of a tubular calyx, and petals with claws.

SILE'NE, the name of an extensive genus of plants belonging to the natural order Caryophyllaceæ. It is known by its having a tubular, naked, 5-toothed calyx; 5 bifid unguiculate petals, which are usually crowned in the throat with 5 bifid scales, 10 stamens; 3 styles; capsules 3-celled at the base, ending in 6 teeth at the apex. The species are in general herbaceous, many of them are annual, very few shrubby. Their stems are leafy, jointed, branched, and frequently glutinous below each joint. The calyx and leafstalks are also frequently viscous. The leaves are opposite, simple, and entire. The petals are mostly red and white, sometimes greenish or yellowish. Some of them give off a delicious perfume, especially at night. The extent of this genus is very great, and constant additions are being made to it by the collections of travellers. The greatest proportion are inhabitants of the South of Europe and North of Africa. Don, in Miller's Dictionary, enumerates 256 species of this genus; of these we shall give a few examples of the more common and interesting forms.

*S. acaulis*, stemless Catchfly, or Moss Campion whole plant glabrous, cespitose; leaves linear, ciliated at the base; peduncles solitary, 1-flowered; petals crowned, slightly notched. It is a native of Europe, and is found abundantly on the Alps. It is found on nearly all the Scottish mountains, and also on Snowdon, and the highest hills of Devonshire. Chamisso also gathered it on the islands of the western coast of North America. The flowers are of a beautiful purple colour, and it forms one of the greatest ornaments of our Alpine flora. Several varieties of this plant have been recorded, varying chiefly in the form and existence of parts of the flower.

*S. inflata*, bladder Campion or Catchfly: stems branched; flowers numerous, panicled; calyx inflated, netted; petals deeply cloven, scarcely any crown; leaves ovato-lanceolate. This is a very common plant throughout Europe, and is met with in almost every field and wayside in Great Britain. Like most plants that are widely and largely diffused, many varieties of it have been recorded. This plant has been recommended to be cultivated in the garden on account of its edible properties. The shoots gathered young, when about two inches high, and boiled, are a good substitute for green peas or asparagus. They are thus eaten by the natives of Zante, and in 1685 the inhabitants of Minorca are said to have been saved from famine, occasioned by a swarm of locusts, by using this plant as food.

*S. noctiflora*, night-flowering Catchfly: panicles forked; petals bifid; calyx with long teeth, oblong in fruit, with ten connected ribs; leaves lanceolate, lower ones spathulate; whole plant clammy, pubescent. It is a native of Sweden, Germany, and Great Britain; it resembles very much the common red and white campion (*Lychnis dioica*). It is not a common plant, and is remarkable for opening its flowers at night only, and in warm weather, when they exhale a powerful and delicious scent.

*S. quinquevulnerata*, five-wounded Catchfly: stems branched; leaves lanceolate, lower ones obtuse; calyx very villous, with short teeth; petals roundish, entire, with toothed appendages. The petals of this plant are of a deep crimson with pale edges, giving them the appearance of having been stained with blood in the centre; hence their specific name. It is a native of Spain, France, and Italy, and has been found in the county of Kent in Great Britain. It is frequent in gardens, but loses by cultivation much of the colour of its flowers.

*S. muscipula*, Spanish or Fly-trap Catchfly: plant smoothish, clammy; stem erect; branches alternate, long; lower leaves lanceolate, upper ones linear; flowers panicled; calyx clavate, netted; petals bifid. It is a native of Spain, with intensely red petals. It is exceedingly clammy, so that when flies alight on it they are caught; and hence the name Catchfly, which is given to the whole genus, though few of the species possess the property.

*S. fruticosa*, shrubby Catchfly: stem shrubby at the base, much branched, tufted; flowering stems simple; leaves obovate, dark-green, permanent, ciliated, particularly towards the base; flowers crowded; calyx clavate; petals deeply emarginate, obtuse, with 4-parted appendages. This plant is a native of Sicily and of the island of Cyprus, and grows among rocks. It is frequently cultivated in gardens, and makes a handsome ornament.

*S. compacta*, close-flowered Catchfly plant glabrous, glaucous; stem erect, branched; leaves ovate-cordate, sessile; flowers crowded into dense corymbs; calyx very long; petals entire, obovate, crowned. It is a native of Russia, and very nearly resembles the *S. armeria*, but is distinguished by its entire petals. It is one of the most beautiful of the genus, and deserves a place in every collection of flowers.

In the cultivation of the species of Silene no great art is required. The hardy kinds may be planted in the open border, and the smaller species are well adapted for rock work. The seeds of the hardy annual kinds may be sown in the beginning of the spring, where they are to remain The perennial kinds are best increased by dividing them at the roots in the spring. The greenhouse kinds thrive best in a rich light soil; the cuttings of shrubby species should be placed under a hand-glass.

SILE'NUS (Σειληνός), a Greek deity. The traditions of his birth are various he is said to be son of Pan, of a nymph, of the earth, and to have sprung from the blood of Uranus. He was the instructor of Bacchus, a lawgiver and prophet, sometimes confounded with Bacchus himself, of the family of Satyrs, whom he resembled very much in appearance and habits. He is represented as an old man, bald, with a beard, and depressed nose, sometimes with a tail, at times holding the infant Bacchus in his arms, or with a wine-skin on his shoulders. He has a conspicuous place in the Bacchic chorus, and occurs in various combination with fauns and nymphs. Though endowed with supernatural wisdom, he is of a comic disposition; his whole character is a mixture of jest and earnest; he is harmless, sportive, fond of children, addicted to wine; sometimes he rides on his ass reeling and supported by a satyr; is said to have conducted Bacchus from Thrace to Phrygia; and to have been ensnared by Midas in a garden, and compelled to exert his marvellous power of speech. His discourse was of the second world, of the land of Meropis, and of its strange men, beasts, and plants, of the origin of things and birth of the gods, and he showed the miserable condition of this present life. In all that he uttered was an irony consistent with his motley character. The ass by which he is accompanied has given rise to many conjectures; the Bacchic myths and those of Apollo speak of this animal as sacred to both deities. It may therefore be considered as the link uniting the two worships, and we find accordingly Apollo called the son of Silenus. (Porphyry, *Vit. Pythag.*, p. 10, ed. Rome, 1630.) Attempts have been made by Bochart and others to connect Silenus with the name Shiloh in Scripture, and his ass with that of Balaam. Other imaginary resemblances are noticed by Creuzer (*Symbolik*), founded on the theory that the ass is the symbol of prophecy in the East. The myth of Silenus has been further thought by Creuzer to have reference to cosmogony. He quotes Porphyry (Euseb., *Pr. Ev.*, iii., p. 110, Cologne, 1687) in support of this opinion, and considers Silenus as 'the half-embodied soul of the universe, the struggle of the shapeless into shape, or, to speak physically, the moist breath which, according to the Egyptian and old Ionian philosophies, nourishes the stars.'

This theory is made still further to interpret the connection between Silenus and Bacchus, and the various modes in which he is represented on antient monuments: the arguments on which it rests are however too numerous and intricate to be here entered upon.

The distinction between Sileni and Satyrs does not appear very clearly made out. According to authorities quoted by Greuzer, the Sileni are the older of the two. The terms were certainly not co-extensive; that of Satyr may be considered as the genus. They were mostly represented in the same manner, with beards, tails, and pricked ears like beasts. In the procession of Ptolemy Philadelphus (*Athen.*, v. 197) they were dressed differently from each other, and the Sileni have sometimes a more human form. See Greuzer's 'Symbolik,' and Grüber's 'Worterbuch der Mythologie,' for representations of Silenus; Millin's 'Galérie Mythologique,' and the various works on gems, sculpture, vases, and other monuments of classical antiquity.

SILESIA. This country, which is now divided between Prussia and Austria, was once inhabited by the Lygii and Quadi, who, in the sixth century, were forced to yield to the pressure of a Slavonian tribe from Poland, by which event Silesia became subject to that country. Under the dominion of Poland, the Polish language and manners, which still remain in the eastern parts of the province, and the Christian religion, were introduced. To promote the latter a bishopric was founded in 966, at Schmeger, which was afterwards transferred to Breslau. The country being in course of time divided and subdivided among the descendants of Boleslaus III., king of Poland, numerous small principalities arose. Being weakened by these divisions, and by the dissensions between the princes, it was subdued by the king of Bohemia in the fourteenth century. Under the dominion of Bohemia the doctrines of Huss, Luther, and Calvin gained ground, and their adherents obtained the partial exercise of their religion. With the Polish princes Polish manners and customs disappeared; everything was placed on the same footing as in Germany; trade, manufactures, arts, and sciences flourished. The prosperity of the country would have been greater in former times, had not the Protestants been so much oppressed under the Austrian government. Austria, which obtained possession of Silesia, together with Bohemia, in the early part of the sixteenth century, retained it undisturbed till the death of the emperor Charles VI. in 1740, on which Frederic II. of Prussia revived a dormant claim to the western part of Silesia, which he immediately invaded; and the greater part was ceded to him in 1742, and confirmed to him by the treaties of Dresden, in 1745, and of Hubertsburg, in 1763. Austria retained the smaller portion.

SILESIA (in German, *Schlesien*), the Prussian Province of, is situated between 49° 40′ and 52° 8′ N. lat., and between 14° 25′ and 19° 15′ E. long. It is bounded on the north-west by Brandenburg; on the north-east by Posen; on the east by Poland; on the south-east by Cracow and Galicia; on the south by Austrian Silesia; and on the south-west by Bohemia. Including the county of Glatz, and the Prussian part of Upper Lusatia, its area is 15,600 square miles. The province is 210 miles in length from north-east to south-west, and from 70 to 80 miles in breadth from east to west. The river Oder, which becomes navigable soon after entering the Prussian boundary, divides the province in its whole length into two nearly equal parts, which are very different from each other. That on the left bank, which is called the German side, is mountainous, but has a very fertile soil, which amply rewards the labour of the husbandman, and supplies almost the whole province. That on the right bank, called the Polish side, is very different; it consists chiefly of a sandy and not very fruitful soil. There are however some sandy tracts on the German side, and some rich and productive spots on the Polish side. The country is highest on the south-eastern frontier, and declines more towards the north-western frontier, where it is the lowest.

Where the frontiers of Silesia and Bohemia meet, a mountain-chain rises, which extends southwards to the sources of the Breswa and the Ostrawitza, where it joins the Carpathians, divides the basin of the Oder on the one side from those of the Elbe and Danube on the other, and forms the natural boundary between Silesia and Bohemia and Moravia. This chain, called by the general name of the Sudetic chain, is divided into different parts, bearing different names, as the Isergebirge, the Riesengebirge, the loftiest and wildest part of the whole chain, the Schneekoppe, which is 4950 feet above the level of the sea, the Glatz Mountains, &c. In the interior there are some ranges unconnected with the great chain—the principal of which is the Zobtengebirge, 2318 feet above the level of the sea. On the right side of the Oder, from the part where its course is to the northward, the high land disappears, and those immense plains begin which characterise this part of Europe. The Oder, called by the common people the Ader, that is, 'the vein,' comes from Moravia, and receives all its rivers, with the exception of some on the frontiers. The principal are the Elsa, the Klodnitz, the Slober, and the Bartsch, on the right side; the Oppa, the Neisse, the Ohlau, and the Katzbach, on the left. There are few lakes, and those which are so called are rather large ponds. The largest are the Koschnitz, Moswitz, and Schlawer lakes. The last is however four miles in length, but nowhere above a mile in breadth. The climate varies very much in the different parts of the province. The air on the whole is very mild, except in the mountainous tracts; but in proportion as we approach the southern frontier, the temperature becomes lower, and the winter longer and more severe, which is owing to the elevation of the country, to the extensive forests, and partly to the lofty Carpathians and the winds that come from them.

*Natural Productions.*—The animals are—horses, horned cattle, sheep, goats, swine, game, fish, bees, and domestic poultry. Wolves are found on the Zobtengebirge, otters in the Bober, and sometimes beavers in the Oder. The vegetable products are—corn, pulse, garden vegetables, fruit, flax, tobacco, hops, madder, woad, teazle, and timber. The minerals are copper, lead, cobalt, arsenic, iron, and zinc. This last metal is found in Silesia and in the adjoining republic of Cracow in far greater quantities than in any other country in Europe. Other mineral products are sulphur, marble, alum, lime, and, above all, coal, of which from two millions to two millions and a half tons are annually obtained, which are worth from 100,000*l.* to 130,000*l.* sterling.

Though Silesia is on the whole one of the most fertile and best-cultivated provinces of the Prussian monarchy, and produces much corn, so that in good years it can export a portion to Bohemia, yet, as it is very densely populated, it has not sufficient in unfavourable years for its own consumption, and is obliged to import. The cultivation of potatoes has become much more general of late years.

The manufactures of Silesia are of the greatest importance, and that of linen has existed from a very remote time. It is carried on with little aid from machinery, and chiefly by the country-people, though this branch of industry affords them but a scanty subsistence; it is however their chief occupation. Dieterici says:—'A third part of all the looms at work in the Prussian dominions, viz. 12,799 out of 36,879, is in Silesia. The linen annually manufactured in Silesia is estimated at between eight and nine millions of dollars (1,333,000*l.* to 1,500,000*l.*).' Uncertain as such estimates are, the quantity exported may be assumed to be worth between three and four millions of dollars. Woollen cloths are manufactured in some towns, and cottons at Reichenbach. There are sugar-houses in several places; tanneries at Breslau and Schweidnitz, and breweries and brandy-distilleries in most of the towns. With respect to spinning and weaving, we may observe that machinery is beginning to be introduced into some larger manufactories. The population of the province, which at the end of 1837 was stated at 2,679,473, had increased, at the end of 1840, to 2,868,820. They are mostly Germans, and some Slavonians of Polish origin. About half the inhabitants are Protestants, and the remainder Roman Catholics, besides about 18,000 Jews: all have the free exercise of their religion. The province is divided into the three governments of Breslau, Oppeln, and Liegnitz; and has twenty towns with above 5000 inhabitants, as noted in the statistical table in the article PRUSSIA. All the most important of these towns are described under their respective heads.

AUSTRIAN SILESIA is that part of the province which was retained by Austria in the treaty of Hubertsburg in 1763. It is united with Moravia, with which it forms one province. It is bounded on the north-west, north, and north-east by Prussian Silesia, on the east by Galicia, on the south by Hungary and Moravia, and on the south-west by Moravia. The area is about 1750 square miles, with 430,000 inhabitants, who are partly of German and partly of Slavonian origin. Next to the kingdoms of Lombardy and Venice, it is the most densely peopled part of the Austrian dominions.

The country is mountainous, and on the south-east are the Carpathians (of which the Sigula is 4300 feet high), and on the north-west the Moravian-Silesian chain, a branch of the Sudetes. Near the Carpathians, and about the source of the Oppa and the Mohra, the climate is cold, and the mountains are partly covered with snow till the middle of June. The southern part of the circle of Teschen is not fruitful, the soil being stony; in other parts it is better. The principal rivers are the Oder, with its tributaries the Oelsa and the Oppa; the Vistula (in German, the Weichsel) rises on the north side of the Carpathians from three sources, called the Little, the White, and the Black Vistula; this last rises in the village of Weichsel, at the foot of the Tankowberg, which village gives its name (Weichsel) to the whole river.

The inhabitants have a very good breed of horses, and of oxen, and especially a very improved breed of sheep. They are very skilful and industrious farmers. The manufactures, especially those of linen and woollen cloth, are very important. The exports are linen, thread, woollen cloth, wire, paper, earthenware, cheese, flax, rosoglio, &c. The transit trade is very profitable: the chief articles are Hungarian and Austrian wines, Russia leather, tallow, linseed, and furs; Galician rock-salt, Moldavian oxen, Vienna fancy-goods, &c. [MORAVIA; TESCHEN; TROPPAU.]

SILEX. [SILICIUM.]

SILHET, or SYLHET, is a district of Bengal, lying along its eastern border, on the east side of the Megna, as the lower course of the Brahmapootra is called. Up to the year 1830 it consisted only of what must now be called Silhet Proper, or a country situated between 24° and 25° N. lat., and 91° and 92° 30′ E. long., which, according to the most recent information, contained about 4500 square miles, and a population of 1,083,120, which gives 241 to the square mile. It is about 1300 square miles less than Yorkshire, but more populous, as Yorkshire, in 1831, did not contain more than 235 persons to the square mile. In 1830 the royal family of Kashar, a country east of Silhet, became extinct; and a few years later the raja or sovereign of Jyntea, a country north of Silhet, was obliged to give up his territory to the British, and both countries were annexed to Silhet. These two countries taken together are at least three times as large as Silhet Proper, and the district at present contains about 18,000 square miles, or two-thirds of the area of Ireland. Silhet, in this extent, lies between 24° 10′ and 26° 20′ N. lat., and between 90° and 94° E. long. On the west it borders on Bengal, on the district of Mymansing, and on the mountain-region of the Garrows; on the north on Asam; on the east on Muneepoor, and on the south it is bounded by the unknown region called the Tiperah Mountains or Wilderness. It is only towards Muneepoor that it has a natural boundary, which is formed by the course of the river Barak, where it runs from south to north, east of 93° E. long., and by two of its confluents, the Jeeree, which joins it from the north, and the Tooyaee, or Chikoo, which falls into it from the south.

*Surface and Soil.*—Silhet is naturally divided into two regions. The northern part is a mountain region, which extends along the southern boundary of Asam, and divides that large vale from the valley of the Barak, which river, as far as it drains Silhet, runs through a wide valley that constitutes the low and level portion of Silhet. The mountain region comprehends about two-thirds of the country, or 12,000 square miles, and the plain about one-third.

The *Mountain Region*, of which Silhet now comprehends nearly one-half, extends along the southern border of Asam, and at its most eastern extremity, near 97° E. long. and 28° 40′ N. lat., at the sources of the Lohit river, or Brahmapootra, it is united to the high table-land of Central Asia. Its western extremity comes close to the Brahmapootra, where this river, after leaving Asam, forms its great bend to the south (90° E. long.). The western portion of this extensive mountain region is called the Garrow Mountains, which are considered to extend eastward to the river Patli, which, traversing the mountain region in a southern direction, joins the Soorma near the town of Laour (91° 10′ E. lat.). The most western offset of the Garrow Mountains skirts the banks of the Brahmapootra, between the mouth of the river Lalu and the village of Mahendragandj, a distance of about twelve miles. Along the banks of the river the mountains are merely rocks, from 150 to 200 feet above the level of the river, rising with a steep ascent. They are called the Caribari Rocks, from a small town situated somewhat to the south of their southern termination. But in proceeding farther east, the mountain-mass rises gradually in elevation, and occupies a greater breadth. In 90° 20′ E. long. it has attained a general elevation of more than 2000 feet above the sea-level, and occupies a width of about 50 miles. We are only acquainted with the outer border of this mountain-mass, where it consists of ridges broken by numerous watercourses, and is entirely covered with trees and dense underwood. Some isolated peaks rise 2000 feet above the general level of the mass. According to information collected from the natives, the interior of this elevated region is nearly a level table-land, destitute of trees, and covered only with grass; and this is probable, as it corresponds to the characteristic features of the mountain region farther east. Only the lower portion of the Garrow Mountains is subject to the British, and united to the three divisions of Bengal, Rangpoor, Mymansing, and Silhet. The interior, called Gonaser, or Ganeswara, is occupied by the Garrows, a mountain-tribe which has never been subjected by the princes of Bengal, as the country is only accessible by long and winding mountain-passes, which are so narrow as to be impracticable for horses or other beasts of burden: they are properly only paths over rugged crags, and along steep precipices, and through extremely narrow gorges. From these fastnesses the Garrows make incursions into the adjacent countries, and hence several tracts of some extent along the boundary of their country have been entirely abandoned. They cultivate rice, millet, and cotton, and use as food several plants which grow wild in the forests, as different kinds of arum, caladium, and dioscurias. They cultivate capsicum, onions, and garlic. They keep cows, goats, hogs, and eat cats, dogs, foxes, and snakes. Different kinds of deer are said to be common in Gonaser.

Adjacent to Gonaser on the east, and only separated from it by the river Patli, is the mountain region of the Kasias (Cossyas), which extends eastward to the river Kopili, an affluent of the Deyung, which falls into the Brahmapootra. This mountain region runs above 100 miles east and west, between 91° 10′ and 93° E. long.; and in proceeding eastward it gradually enlarges in breadth from 50 miles to about 70 miles. This portion of the mountain region is much better known than Gonaser, being subject to the British, who have traversed it at two places in passing from Silhet to Asam, and who have erected on it several sanatory stations, among which that of Chirra Punji is very much frequented. The western road leads from Pondua in Silhet, through Chirra Punji, Moiplong, Lombray, and Nungklao, to the banks of the river Kailasi, an affluent of the Brahmapootra, and to the low land of Asam. The traveller, passing by a steep ascent over four ridges, arrives at Chirra Punji, which is 5000 feet above the sea-level. Here begins a table-land, the surface of which is often level, but generally exhibits very gentle slopes, which continues to Nungklao. The most elevated points are at Moiplong (5942 feet) and Lombray (5914 feet). At Nungklao it is only 4550 feet. North of the last-mentioned place it sinks by three wide terraces with steep descents to the plain of Asam. The table-land is entirely destitute of trees and bushes, especially in the southern parts. This sterility, as Fisher thinks, is closely connected with the character of the sandstone-rocks of which the mountain-mass is composed, and with the disturbance of the strata, but more especially the latter; for where the strata are horizontal, there is an absence of vegetation, and where the strata are inclined, symptoms of fertility begin to show themselves. Throughout the ascent from the plains of Silhet to Chirra Punji, the vegetation is only dense on the slopes; and where ledges or steppes occur, it is comparatively barren. The table-land itself is covered with a short turf, and there occur only a few bushes, as raspberries; stunted fir-trees only occur in the glens which are formed by the river-courses—as, for instance, in that of the Bogapani. To the north of this river the aspect of the country changes gradually; and though the elevation is greater, the vegetation increases, and continues to increase, until in the vicinity of Nungklao it becomes abundant, though it does not exhibit that excess which prevails farther to the north, on the lower descent of the table-land towards Asam. This change is attributed to the numerous large granite boulders which are scattered in great abundance over the country. The disintegration of these boulders has largely contributed to the formation of the soil, especially where it has been favoured by the configuration of the surface. But in those tracts where there are no boulders, and the strata preserve their horizontal position, vegetation is deficient. The climate at Chirra Punji is very temperate and pleasant, especially between November and March. Neither snow nor frost occurs; but in December and January hoar-frost is very common. The sky is generally clear, but violent showers frequently occur. The almost continual coolness of the air, and the absence of frost, has pointed out this place as a convalescent station. Near Moiplong however frost occurs even in November, as the thermometer then descends to 21°. Nungklao has a more pleasant climate. The earlier part of the summer is not much warmer at that place than in London, as the thermometer ranges between 65° and 74°.

Cultivation appears only on the southern declivity, and in the neighbourhood of Nungklao, where rice is grown in considerable quantity. On the southern declivity of the mountain-mass many fruits are cultivated, as oranges, plantains, and the areca palm; and much honey and wax is collected. On the northern declivity, where fir-trees cover large tracts of land, European fruit-trees grow, especially apples, pears, and plums, and also strawberries and raspberries. The eastern road traverses the Kasia Mountains, between 92° and 92° 20′ E. long., from the town of Jynteapoor, the capital of the former kingdom of Jyntea, to Raha Choky in Asam, situated where the Deyung unites with the river Kulung. The southern edge of the mountain region, which is only a few miles distant from Jynteapoor, seems to be formed by a ridge which is considerably elevated above the table-land farther north, and which is traversed by the mountain-pass of Mutagul. North of this ridge lies a plain, about 2000 feet above the sea-level, whose surface is undulating, and in some parts hilly, but it is covered only with thick grass, without bushes or trees, except that in a few places, and at great distances from one another, small groves of firs or other trees are met with. It certainly might be used as pasture-ground, especially as the climate is very mild; but the few inhabitants say that they are prevented from keeping cattle by their neighbours, who frequently make predatory incursions into their country. This table-land occupies a width of 50 miles along the road. The northern edge is less distinctly marked, and the descent occupies about twelve miles. The nature of the table-land precludes agriculture; but in the northern districts rice is raised in considerable quantity, particularly in the small glens and on the sides of the valleys, where irrigation is practised, water being brought to the fields through narrow canals, and conveyed over hollows and up heights for short distances by means of trunks of trees and bamboos. Rice and yams are cultivated, and a kind of coarse silk called *mong* is collected on the trees.

That portion of the mountain region which lies east of the Kopili and Deyung rivers, and extends eastward to the river Dooyong and the boundary of Muneepoor, comprehends Upper Kachar, and is called the Kachar Mountains. It is likewise a table-land, the southern edge of which is marked by an elevated range, which continues to run east to 93° 12′ E. long., when it turns north-east and continues in that direction till it approaches 94° E. long., where it again runs east and stretches into an unknown country. Where this range runs north-east it is called the Bura Ail Mountains, and attains a mean elevation of 6000 feet above the sea-level. It is covered with large trees and light underwood. The southern declivity of the Bura Ail Mountains is very little known, but it seems to be certain that this side of the range is intimately connected with the three ridges which traverse the western portion of Muneepoor, and by running north and south unite the mountain region which we are now noticing with the extensive mountain-system of Tiperah. The ridges are called, from west to east, the Keibunda, Kubitshing, and Muneepoor Mountains. These chains and their numerous short offsets render the western portion of Muneepoor a rapid succession of elevated ridges and deep and narrow valleys. The country which lies north of the Bura Ail Mountains, both near the range and to the distance of 10 or 12 miles, is covered with the high offsets of the range, and has an entirely mountainous character. North of this comparatively narrow mountain-tract the surface of the country is hilly. Most of the hills are isolated, but in some places they form ridges. This hilly tract occupies a width of about 20 miles, and it is followed by a plain. Both the hilly and level country are almost entirely covered with forests. The northern edge of the table-land is marked by a range of low hills, and a gentle descent, the greater part of which seems to skirt the southern banks of the Sumoona, an affluent of the Deyung, the country north of that river constituting a portion of the plain of Asam. It is much more thickly inhabited than the table-land of the Kasia Mountains. A very large portion of it is fit for agriculture, and the small progress that both agriculture and population have made is mainly if not exclusively to be attributed to the unsettled state in which the country has been for a long time, under the sway of petty sovereigns, who were never able to defend their subjects against the incursions of the bold tribes who inhabit the mountains, especially the Angamee Nagas. Some large tracts are quite uninhabited, though the vigorous growth of the trees shows the excellent quality of the soil. But along the large rivers and in their neighbourhood cultivated tracts and villages are numerous, and will increase, since the British have compelled the Angamee Nagas to keep quiet. The inhabitants cultivate rice, and in the valleys of the hilly and mountainous part of the country several kinds of coarser grain are grown; there is also a very fine-flavoured kind of purple vetch. About the villages of the more elevated region there are groves of peach-trees in the most luxuriant state, and the apple-tree grows wild and produces a well-tasted fruit. The bay-leaf and a very small kind of orange are also natives of these mountains. Cloth is made of a nettle, which is procurable in great abundance. On the lower hills cotton and chillies are grown as articles of commerce, and in these parts also much wax and honey is collected. The cultivation of the lower and level country resembles that of Asam, being similar in climate and soil, but no part of it is subject to annual inundations.

*The Plain.*—Along the southern base of the mountain region hitherto noticed there is a plain, or rather a vale, for along its southern side the mountain-system of Tiperah rises to a great height. The length of this vale may be about 120 miles, and the width in the western half about 50 miles on an average, but towards the east it narrows to 30 and even 20 miles, until it is shut up by the Keibunda range, which lies near the boundary and within the territories of Muneepoor. As to the configuration of its surface and the capacities of the soil, it may be divided into two portions. A line drawn from Chattac on the Soorma, south-west of Pondua (91° 40′ E. long.), passing in a south by west direction west of Tajpur, through Nubigunj and thence to the hills south-east of Turruf near the Tiperah Mountains, very nearly separates these two tracts. The country west of this line is very low and level, and constitutes properly a portion of the lower portion of the plain of Bengal. It is in most parts marshy, and the whole is subject, like the greater part of Lower Bengal, to periodical inundations of long duration, being in general under water from April to the middle of November. These inundations are partly the effect of the heavy rains which fall during the south-west monsoon, and partly of the immense volume of water which is brought down by the rivers during that season, especially by those which drain the mountain-system of Tiperah, the Manu, Khwa-hi, and Cognati. This lower tract is called Bhatta. The towns and villages, which in some parts, especially to the south, are numerous, are built on mounds of earth; huts, temples, mosques, and sheds for cattle are huddled together. When the inundations are at their height, there are from 8 to 12 feet water on the lower grounds. As soon as they have sufficiently subsided, or in the beginning of November, such lands as are high enough for the purpose are sown with rice and millet; the crop is cut in April. The lands yield only one crop. There appear occasionally a little sursoo and hemp, with some gourds and cucumbers about the huts. The marshes are however filled with cattle, from which profit is derived sufficient to make the occupation of these desolate tracts desirable. Ghee and cheese are made from the milk of buffaloes and cows, and the upper country, which lies farther east, is furnished with young bullocks for the plough. During the inundations the cattle are confined to the sheds and feed on green fodder brought in boats from the jhils or marshy tracts.

From this low country a few tracts of low and level land extend eastward of the line above indicated. They run up for several miles, more especially between the courses of the great rivers, where they form jhils of great depth, which are uncultivable. The remainder of the eastern division has a higher level, and rises gradually towards the mountains on both sides. This country is in general dry, though there are some marshes of small extent. The surface of this division presents great irregularities. It is crossed by several ranges of alluvial formation, which run up into ridges from one to three hundred feet high, and the valleys between rise gently towards each side. The banks of the Soorma and all the mountain rivers are also considerably elevated above the general level; the tracts which lie near the swampy places, and are not much elevated above their level, are under water for some weeks, and yield only one crop. They are sown in January, and the short inundation does not damage the grain. The crops are much more abundant than in the Bhatta. The more elevated parts, which are never inundated, and especially the slopes of the ridges, yield two crops of grain, which are generally good. Some experiments which have been made show that wheat, barley, oats, and potatoes might be raised. All the grains found in the plains of the Ganges are cultivated. Indigo is not cultivated, but an excellent dye very similar to it is obtained from a plant which grows wild on the hills. Poppy, sugar-cane, safflower, sursoo and other plants yielding oil, and also hemp and flax are grown. Orange-trees and the areca are cultivated on the declivities of the Kasia Mountains, and large quantities of the produce are annually sent to Calcutta and other places in Bengal. Areca of inferior quality is found all over Silhet, but it deteriorates in quality towards the east, and in Kachar it wholly disappears. Among other fruits the plantain is particularly fine, the lemon grows wild in the Kasia Mountains, and the apricot and lichi in those of Kachar. It is thought that the tea-plant would succeed in some of the alluvial soils of Kachar or Tiperah.

The Tiperah Mountains, which lie to the south of the plain hitherto noticed, belong to Silhet only so far as a portion of their lower declivities is included within the boundary of the district. We are not acquainted with the interior of this extensive mountain-system. The central parts, between 23° and 24° N. lat. and 91° and 94° E. long., probably attain a great elevation, which may be inferred from the great volume of water brought down by the rivers which fall from the south into the Soorma and Kusiara, as the Delaseri, the Sungai, the Munu, the Khwa-hi, and the Cognati; and from their rapid course. During the rains each of these rivers discharges on an average a volume of about 25,000 cubic feet per second, though none of them are more than 50 yards wide. It is certain that they have a long course, and descend from a very elevated country. The northern portion of this mountain-region, towards Silhet, as well as that which towards the south enters the district of Chittagong, consists of ranges running south and north, divided by wide valleys. Some of these ranges enter the northern plain, as the Banca Mountains, which extend along the western banks of the Delaseri, and the Bokman range in Kachar, which compels the river Barak to change its southern course into a northern one. Immense masses of lava occur even on the northern ranges of the Tiperah Mountains, and it is supposed that this is the termination of the long series of volcanoes which stretch from the island of Java northward through Sumatra, Barren Island, the island of Narcondam, and those of Cheduba and Ramri on the coast of Arracan, where the traces of volcanic agency are lost: they appear again in the Mountains of Tiperah. The southern declivities of the Tiperah Mountains are noted for immense forests of bamboo and large herds of elephants. The northern declivities are also covered with forests of trees and bamboos, from which the inhabitants of the plain derive great profit, but they resort also to these hills to cultivate cotton, which does not grow in the plain. The quantity of cotton which is raised is barely sufficient for domestic consumption. It is short in staple, but the cloths made from it combine warmth with lightness.

*Rivers.*—The largest of the rivers of Silhet is called in the upper part of its course Barak, and in the lower part Soorma. The Barak originates in the mountain region north of the plain of Muneepoor [MUNEEPOOR], near 25° 30′ N. lat. and 94° 20′ E. long., and traverses in a south-west and south by west direction the mountain region which connects the Tiperah Mountains with the Bura Ail range. After a course exceeding a hundred miles, it meets with the Bokman ridge of the Tiperah Mountains, which compels the river to change its southern into a northern course. Flowing in that direction 30 miles, it turns round the northern extremity of the Bokman ridge westward, and thus enters the plain, where it begins to be navigable, a few miles above Lukipoor. It runs westward with numerous windings through the upper plain in one channel for 40 miles, but having passed the northern extremity of the Banca ridge, it begins to divide at Banga. In these parts the name of Soorma begins to prevail. The northern arm, or the Soorma, flows along the southern base of the Kasia Mountains with numerous windings, sometimes approaching the hills and sometimes receding from them, until it reaches the town of Sonamgunj after a course of 90 miles, when it turns southward, and in that direction traversing the lower plain, joins the southern arm after having run 70 miles. The southern arm of the river branching off at Banga bears different names, but in its upper course it is generally known by that of Kusiara, and in the lower by that of Barak or Brak. Its direction through the plain is west-south-west for about 100 miles, when it joins the Soorma, and the united river joins the Megna near Sunerampoor by a more southern course of about 20 miles. These appear to be the principal branches of the river, but both of them divide and subdivide again so frequently, that the whole of the lower plain is traversed by numerous watercourses, all of which join, either singly or united, the Megna between the town of Caribari and that of Sunerampoor, which are more than 100 miles from one another. Nearly all these watercourses are navigable for boats, and greatly facilitate the transport of grain from the upper plain of Silhet to other districts of Bengal. It is observed that these rivers are subject to change their beds in the districts which approach the Megna, which is the case with the Soorma itself below Azmerigunj.

Of the rivers which join the Brahmapootra or Lohit, we shall only mention the Dooyung and the Deyung. The first-mentioned river, which falls into the Brahmapootra west of 94° E. long., probably rises north east of the source of the Barak, but its source has not been ascertained. Its course is nearly due north, and about 30 miles from its mouth it is joined on the left by the river Dhunsiri, which rises in the Bura Ail Mountains, and skirts their northern declivity for more than 30 miles. The Dooyung, as well as the Dhunsiri, is navigable. The Deyung rises in the Bura Ail Mountains near 93° E. long., and after having been joined by some small rivers it becomes navigable about 20 miles below its source at Aloogong (25° 25′ N. lat.), and continues to be navigable to its mouth, with the exception of one place, where a ledge of rocks traverses the bed of the river. The Deyung is joined from the left by the Kopili, and from the east by the Soomeona river, of which the latter is navigable about 30 miles above its mouth. It is not known how far the Kopili is navigable, but this important point will soon be ascertained, as it is supposed that a good road, made between the places where the Kopili and the Jatinga, an affluent of the Barak, become navigable, will establish an easy communication between Asam and the plain of Silhet.

*Climate.*—The climate of the lower plain does not appear to differ in any respect from that of Bengal [BENGAL, vol. iv., p. 230]; but the upper plain has the advantage of earlier rains, which begin to fall in February, and become more abundant in the following months. Owing probably to these rains, the lower plain of Silhet is under water earlier than that of Lower Bengal.

*Productions.*—In the forests of the Tiperah Mountains there are herds of elephants, many of which are annually sent to Calcutta, where however they are reckoned inferior in size and quality to those brought from Chittagong. Among the minerals the chunam, or lime, perhaps is still the most important, as large quantities of it are taken from the lime-hills which skirt the Garrow and Kasia Mountains at Pondua and farther west, whence it is conveyed by water to Calcutta and other places in Bengal. Many years ago coal was discovered in the Garrow and Kasia Mountains, but it was not turned to any profit until the introduction of steam-navigation. It is now known that coal is found on the table-land of the Kasia Mountains at Chirra-Punji and Serarim, and at the base of these mountains near Silhet and Laour. But none of these coal-deposits seem to be extensive. It is however stated that those which occur in the Caribari Hills and along the southern boundaries of Asam, both which localities are within the Garrow Mountains, are not inferior in extent to any in England. Iron-ore is abundant in the Kasia Mountains north of Chirra-Punji, where it is worked, and whence iron is sent to Bengal.

*Inhabitants.*—The inhabitants of Silhet Proper are Bengalis, and hardly distinguishable from that race in the districts farther west. But among them there are also many families of Hindustani and Persian origin, who are distinguished by their features and the stronger make of the body.

The Kacharis form the bulk of the population in Kachar, but they are also found in Asam and Tiperah. They constitute a distinct people, differing in appearance, religion, and customs from the other inhabitants. The antient religion of Kachar is different from Brahmanism. It acknowledges a Supreme Being, or first principle, from which the world and all that it contains is derived. The manifest powers of nature are worshipped, or rather, certain spirits who have authority over them and influence the changes of the seasons. But in modern times Brahmanism has gained footing, and is spreading. The Kacharis have a distinct language, but as it is unwritten, it has been superseded for all purposes of business by the Bengali for many centuries, so that at present the language is not known by many of the Kacharis themselves. The Kacharis are industrious agriculturists.

The Kasias, commonly called Cossyas, call themselves Khyee, and inhabit the mountains, which have obtained their name from this nation. They are an athletic race of mountaineers, fond of martial appearance, and their reputation as warriors is hardly extinct, for their extensive predatory inroads are still remembered in Silhet and Asam. Their religion is limited to certain superstitious practices, and to reverencing and sacrificing to the presiding deities of villages, hills, and similar localities, without the knowledge of a universal and all-pervading intelligence. Brahmanism has made some progress among the Kasias, especially those of Jyntea, but it has not led to the entire abolition of their national superstitions, connected with which was the practice of human sacrifice. The Khyee language is unwritten, and exhibits no affinity to any of the neighbouring languages, some of which, numerous and diversified as they are, contain various indications of a common origin. No great respect is paid by the Kasias to hereditary chiefs, though their rank is readily admitted, but their influence depends more on their personal character and their power to direct the public assemblies without which nothing is determined either in the community collectively or in the several villages. It was reserved to the British government to subdue the martial disposition of this people, and to compel them to discontinue their predatory incursions into Silhet and Asam. Polyandry is said to exist among the Kasias, but if it is still in use, it is far from being general.

The Nagas are another race of mountaineers, consisting of numerous small tribes, which extend from the southern border of the vale of Asam, east of the Kopili river, to the eastern portion of the Tiperah Mountains. On the north-east they appear to be neighbours of the Khamtis. They are generally associated with the Kukis, from whom however they differ essentially in language, customs, and appearance. Though in general tall, well made, and often powerful men, the limbs of the Nagas have not the massive configuration of those of the Kukis and other hill-men. It appears from the features of their face that they belong to the Mongolic race. The Nagas are not a migratory or wandering people, like the hill Kacharis and Kukis, who continually change their locality, and seldom keep their villages more than three years in one spot, whilst the Nagas remain fixed. All their villages are built on the tops of the mountains, and fortified with stockades and a ditch. Like the nations that inhabit the peninsula beyond the Ganges, they eat all kinds of animals, tigers, elephants, hogs, dogs, cats, monkeys, and even serpents. It is certain that the different dialects which are spoken by them differ so much that several tribes living not far from one another can have no intercourse without an interpreter. Several of their tribes are much addicted to plundering. In 1839 some troops were sent by the British against the Angamee Nagas, who inhabit the mountainous country north of the Bura Ail range, and had become very troublesome to the Kacharis who inhabit Upper Kachar.

The Kukis inhabit the Tiperah Mountains. A few families of this race, which are found in Upper Kachar, have been transplanted to that country in modern times. Though short of stature, they seem to be the most powerful of all the mountaineers in that part of the world, and have long been notorious for their attacks on the peaceful inhabitants of the plain, not for the purpose of plundering them, but in order to kill them and carry off their heads. These heads are used in certain ceremonies which are performed at the funerals of their chiefs. In this particular, and also in their features, which approach those of the Chinese and other nations of the Mongol race, they resemble the Garrows, who also, like the Kukis, eat all kinds of animals. But both nations, as well as the Nagas, and the Mugs in Arracan, cannot be induced to take milk or anything made of it. This similarity in customs, and also in their physical character, leads to the conclusion that all these nations belong to the same race of which the Chinese constitute a branch. It is however remarkable that the Garrows are separated from those nations by the Kasias and Kacharis, who differ in the conformation of their bodies, and among whom all the customs just enumerated are unknown. It is nearly certain that the Kukis are cannibals.

*Political Divisions and Towns.*—That portion of Silhet which forms a part of the British possessions contains the district of Silhet, and the two countries of Jyntea and Kachar, which have lately been annexed to it.

1. Silhet comprehends the whole of the lower and a part of the upper plain as far east as the Banca Mountains or the Deloseri river. It seems to contain many small towns, and some of considerable extent. The largest is probably Baniachung, situated in the low plain between the Soorma and Brak rivers. It is the residence of the raja of Baniachung, the greatest land proprietor in Silhet, and is a large place, containing a great population. The town of Azmerigunj, west of Baniachung, on the banks of the Soorma, is a place of considerable inland traffic, with a boat-building establishment for the construction of native craft. The town of Silhet is built on the upper plain, on the banks of the Soorma, and is the seat of the local government. Laour, farther west, at the foot of the Garrows Mountains, carries on a considerable commerce with the Garrows, who bring cotton, wax, and honey, which they exchange for salt and some cotton-cloth and brass ornaments. Lime is sent from this place to Calcutta. Pondua, a small fortress, at the base of the Kasia Mountains north-north-west of Calcutta, is the market for the Kasias, who inhabit the western part of the mountain region. They exchange wax, honey, oranges, areca nuts, cassia, and other products of their country, for cotton stuffs, salt, rice, and other provisions.

2. Jyntea lies north of the upper plain of Silhet, of which a small portion also belongs to it, and it extends northward to the boundary of Asam, where also a part of the low and flat country was subject to its raja, but the greater portion of this country was in the Kasia Mountains, and the Kasias constituted the principal population of the raja's territory. Eastward it extended to the Kopili, or the boundary of Kachar; and on the west it was separated from the mountains inhabited by the Garrows by two smaller countries, called Koiram and Dulla, whose sovereigns however seem to have been dependent in some degree on the raja of Jyntea, as they now are on the British. Jynteapoor, the capital, is built not far from the southern declivity of the Kasia Mountains in the plain, about 20 miles to the north of the town of Silhet. The convalescent station of Chirra Punji is in the territories of the raja of Koiram, and that of Nungklao is in those of the raja of Dulla.

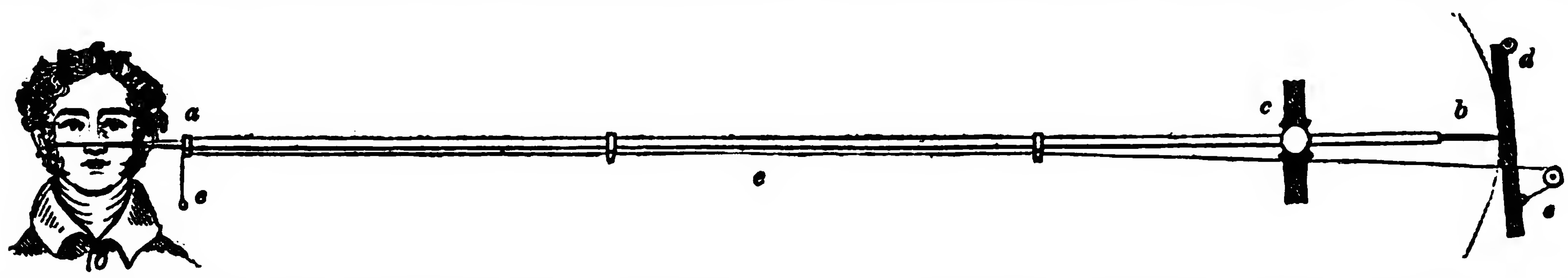
3. Kachar, or Kirumbha, extends over the larger part of the upper plain, and the whole of the mountain region which is east of the Kopili and west of the Dooyong. But within these boundaries are the territories of the Tooleram raja, and the country inhabited by the Angamee Naga tribe, which is quite independent, whilst the Tooleram raja is dependent on the British. The country is chiefly inhabited by Kacharis, among whom many Naga tribes are dispersed, and also a number of Kukis, Bengalis, and fugitives from Muneepoor. Kachpoor, the capital, is on the plain between the banks of the Barak river and the base of the Bura Ail range: it is a poor place. East of it, and south of the pass of Haflong, is the village of Oodarbund, which is much resorted to by the Naga tribes, who exchange cotton, ivory, wax, and chillies, for salt, dried fish, conch shells, beads, and brass ornaments. But the chief part of the cotton collected in these parts is brought in boats to Raha Chocky in Asam.

*History.*—Silhet Proper seems always to have been subject to the sovereign of Bengal, and it passed with that province under the dominion of the British; but it does not appear that any portion of the mountain region, or even Lower Kachar, has ever belonged to any sovereign of Hin dustan. Some centuries ago however the greater part of these countries was included in the empire of Kamroop, which also extended over the greater part of Asam. This empire fell to pieces, and then the kingdoms of Muneepoor, Kachar, and Jyntea were formed. Continual disputes in the reigning families rendered them weak, but the difficulties of entering their country with an army secured them against foreign invasion. The English, after taking possession of Bengal, did not pay attention to these countries, considering this frontier sufficiently defended by the weakness of their neighbours. In 1774 they punished the Kasias of Jyntea for their predatory incursions by taking possession of that country, but restored it to the raja on payment of a fine. The Burmese, taking advantage of disputes in the royal family of Muneepoor, possessed themselves of that country, and at last (1820) declared it to be a part of their empire, and they soon after sent an army from Birma, and another from Asam, to the conquest of Kachar. Upon this the sovereign of that country and the raja of Jyntea placed themselves under the protection of the British. During the war with the Burmese, the possession of these countries was obstinately disputed, but by the peace of Yandaboo (1825) they were given up to the British, who restored them to their legitimate sovereigns. In 1830 the raja of Kachar, Govind Chandra, died, without leaving any issue, and the East India Company took possession of Kachar. A few years afterwards the raja of Jyntea was deprived of his country on account of his crimes and his cruelty, and since that time both countries have been united to Silhet.

(Walter's *Journey across the Pundoa Hills*, in *Asiatic Researches*, vol. xvii.; Pemberton's *Report on the Eastern Frontier of British India;* MacClelland, *On the Difference of Level in Indian Coal-fields*, in *Journal of the Asiatic Society of Bengal*, 1838; Grange's *Narrative of an Expedition into the Naga Territory of Assam*, in *Journal of Asiat. Society of Bengal*, 1839; Fisher's *Memoir of Sylhet, Kachar, and the adjacent Districts*, in *Journal of the Asiatic Soc. of Bengal*, 1840; Wilson's *History of the Burmese War*.)

SILHOUETTE, a name frequently applied to the black profile portraits commonly known simply as *profiles* or *shades*. The latter name indicates the origin of this simple class of pictorial representations, they having been probably suggested by the shadow thrown upon a wall. Beckmann, in his paper on 'Plant Impressions' (*Hist. of Inventions*, English edit. of 1814, vol. iv., p. 621), observes, in reference to such productions and profile portraits, 'If it be true that the extreme boundaries of all things approach or touch each other, one might almost believe that the arts of drawing and engraving on copper must have attained nearly to the highest degree of perfection.' 'At present,' he continues, 'while we have among us a Tischbein, a Haid, and other great artists, whose portraits of the persons whom they honour with their pencil or graver are such striking likenesses that they appear to live, we return again to the commencement of the art of drawing, the paltry outline of a shadow, like the love-sick daughter of Dibutades, and think we ornament our apartments and books with these dark and dismal profiles, and that we can discover by them the talents and disposition of the persons they are supposed to represent.' The name *silhouette* has been said to be derived from Etienne de Silhouette, French minister of finance in 1759. It appears that several parsimonious fashions introduced during his administration, in order, by severe economy, to remedy the evils of a war that had just terminated, were called, after this minister, *à la Silhouette*; and that the name has continued to be applied to one of them,—the use of profiles in shade.

Silhouettes are executed in various ways. One of the simplest is that of tracing the outlines of a shadow thrown on a sheet of paper, and then reducing them to the required size, either by the eye or by means of a pantograph. [PANTOGRAPH, vol. xvii., p. 192.] Another mode is tracing the outline upon a glass supported in a suitable position, and either coated with a solution of gum-arabic in water, in order to enable a lead pencil to mark upon it, or covered with a sheet of very thin tracing-paper. The camera-obscura and camera-lucida are also occasionally used for the purpose. A more certain mode of obtaining an accurate outline is by the use of the machine invented for the purpose by Mr. Schmalcalder, and patented by him in 1806. The principle of this machine is very simple, and may be readily understood by the aid of the annexed diagram. *a b* is an inflexible rod, usually about nine or ten feet long, supported by a ball-and-socket joint at *c*, in such a manner as to leave the ends free to move in any direction. At the end *a*, a




tracer, which is tapered off to a fine point, is attached to the rod, so as to form a continuation of it; while at the opposite end, *b*, a steel point is similarly fixed. The person whose profile is required is seated, in the position indicated in the cut, in a chair having a rest for the back of the head, in order that he may sit perfectly still, while the operator gently passes the side of the tracer, *a*, over his features. By the intervention of the universal joint at *c*, a perfectly similar motion is communicated to the steel point at *b*, although, owing to the pivot being placed nearer to it than to the other end of the rod, it moves in a path smaller than that of the tracer *a*. The pivot *c* being stationary, the steel point at *b* moves in the arc of a circle of which it (the pivot) is the centre, as indicated by the dotted line in the diagram; and therefore, in order to keep the paper always in contact with it, it is fixed on a swinging board, pivoted at *d*, and constantly pressed against the steel point by means of a weight or spring, with a sufficient degree of force to make it act efficiently. The steel point does not come into immediate contact with the white paper, but with a piece of blacked paper placed over it, the pressure of the point transferring a sufficient quantity of the colour to form a distinct line. This part of the operation resembles that of a manifold-writer; and, as in that instrument, several copies may be produced simultaneously, by using a number of pieces of white and blacked paper, laid alternately upon the swinging board. The size of the reduced outline drawn on the paper may be regulated by varying the relative proportions of *a c* and *c b*; this and several other adjustments being effected by apparatus which it is unnecessary here to detail. By means of a cord *e e e*, held in the hand of the operator, the swinging board *d* may be drawn back from the steel point when it is required to move the rod without making a mark upon the paper. As it is desirable to have the tracer *a* of small diameter, it is usually formed of steel, and carefully tempered, to avoid the risk of breakage. Greater accuracy may be attained by substituting for the tracer a thin wire, tightly stretched in a bow, and adjusted so as to coincide perfectly with the axis of the rod. Some friction may be avoided by using a double-swivel joint, instead of the ball-and-socket, at *c;* but whatever kind of pivot be adopted, great care should be taken to have it perfectly accurate, as any defect in it will produce a distorted drawing. When the outline of a profile is obtained by any of the means just described, it requires to be carefully filled in with colour by hand. In some cases, in the use of Schmalcalder's machine, a kind of knife is substituted for the steel point at *b*, and the profile is thus cut out of a piece of thin black paper placed on the swinging board. This machine may also be used for making reduced copies of drawings or prints, by attaching a suitable tracing-point at *a*, and fixing the original drawing on a second swinging board in contact with it; the operator guiding the tracing-point over all the outlines that he wishes to copy. Some profilists display considerable talent in cutting silhouettes by hand, with a pair of scissors, out of pieces of black paper, without the assistance of an outline.

Although silhouettes have no claim to the character of works of art, they frequently convey a very good idea of the person represented; and they may be made even elegant in appearance. Some of the best profilists greatly improve the appearance of their silhouettes by adding the principal markings of the hair and drapery, which, if judiciously done, has a very good effect. Of the great extent to which this kind of portrait has been patronised, some idea may be formed from the fact that Mr. Schmalcalder has made and sold nearly a hundred of his machines.

SILI'CIUM, or SI'LICON, the base of the well-known earth Silica or Flint. By some chemists it is regarded as a metal, and hence the termination of its name in *um*, while others consider it as non-metallic, but more allied to boron, and these adopt the term *Silicon.*

Sir H. Davy, by acting upon Silica with potassium, arrived at the conclusion that it was an oxide, containing a peculiar inflammable base, to which he gave the name of Silicium; the accuracy of this determination has since been demonstrated by Berzelius.

In Davy's experiments the silica yielded its oxygen directly to the potassium. The process of Berzelius was different: he prepared it more advantageously by passing fluosilicic acid into a solution of potash, evaporating the solution to dryness, and heating the residue nearly to redness; this being then heated with about an equal weight of potassium in a green glass tube, the potassium combines with the oxygen of the silica; the resulting mass is of a brown colour, and is to be washed at first with cold water, and afterwards with hot; then heated to redness; and, lastly, digested in dilute hydrofluoric acid, to separate any adhering silica:- the silicon then remains nearly pure.

The properties of silicon are, that it has a dark-brown colour, no lustre, and is a non-conductor of electricity: it is this latter circumstance which has induced many chemists to question or deny the propriety of classing it with the metals. It is insoluble in water, and incombustible in air or in oxygen gas; it neither fuses nor undergoes any other change when heated in the flame of the blow-pipe. Neither the nitric, hydrochloric, sulphuric, nor hydrofluoric acid oxidizes or dissolves it; but a mixture of nitric and hydrofluoric acid dissolves it readily, even cold. When ignited with chlorate of potash, silicon is not acted upon; but if deflagrated with nitrate of potash, the silicon combines with the oxygen of the decomposed acid, and is converted into silica, or silicic acid; and this uniting with the potash of the decomposed nitrate, silicate of potash is formed.

*Oxygen and Silicon* form only one compound, namely, silica, or silicic acid. It may be obtained artificially, but very inconveniently, in the mode just mentioned, of deflagrating silicon with nitrate of potash. Silica exists very largely in nature; it is indeed probably the most abundant of all substances whatever. Many of the forms under which it occurs are described elsewhere. [QUARTZ.] Rock crystal is silica, nearly or quite pure, and flints or white sand are but slightly intermixed with other bodies. It is artificially obtained in a pure form by fusing crystal, sand, or flints, with about four times their weight of carbonate of soda or carbonate of potash; the resulting fused mass is either silicate of soda or silicate of potash; the latter is a deliquescent substance, and when it has become fluid by exposure to the air, has been long known by the name of liquor of flints; when either of these silicates is treated with hydrochloric acid diluted with water, it combines with the alkali, and with any impurity which the sand or flint might contain, such as lime, alumina, or oxide of iron, and precipitates the silica as a hydrate in the state of a colourless gelatinous mass. It possesses the following properties:—

When recently precipitated, and while it retains the state of moist hydrate, it is to a certain extent soluble in water, and still more so in acids, and also in solution of potash or soda. When it has been dried, it is an opaque white powder, inodorous, insipid, and gritty, and then with more difficulty soluble in the alkaline solutions, and scarcely at all so in any other acid than the hydrofluoric. It is infusible by the heat of ordinary furnaces, but by the oxy-hydrogen blow-pipe it is more readily fused than lime or magnesia. Its specific gravity is about 2·7.

It consists of

| | | |
|---|---|---|
| 1 Equivalent of Oxygen | . . | 8 |
| 1 Equivalent of Silicon | . . | 8 |
| Equivalent | . . | 16 |

Although this substance is tasteless, and does not change vegetable blue colours red, and is insoluble in water, except under the peculiar circumstances mentioned, it is nevertheless by many chemists considered as and classed with acids, under the name of *Silicic acid;* and the various compounds which it makes with alkalis and earths, to form glass, are considered as salts. Thus with potash it forms silicate of potash; with soda, silicate of soda; and with oxide of lead, silicate of lead; and these are all constituents of glass. China and porcelain, on the other hand, may be regarded as silicates of alumina and magnesia, and mortar is probably a silicate of lime.

It must be evident from what has been stated, that silica is a substance of the utmost importance in many respects; it enters largely into the constitution of minerals, rocks, and fossils, and is employed in the manufacture of glass, porcelain, pottery, bricks, tiles, and mortar.

The compounds which silicon forms with other elements are comparatively unimportant· we shall mention only a few of them, and those but briefly.

*Chlorine and Silicon* may be made to combine by heating the silicon in chlorine gas, or by passing the gas over silicon heated to redness in a porcelain tube; or, according to Oersted, by passing chlorine gas over a red-hot mixture of finely powdered silica and charcoal.

Chloride of Silicon is composed of

| | | |
|---|---|---|
| 1 Equivalent of Chlorine | . . | 36 |
| 1 Equivalent of Silicon | . . | 8 |
| Equivalent | . . | 44 |

It is a volatile liquid which emits acid fumes; when exposed to moist air, or mixed with water, both are decomposed, and the results are hydrochloric acid and silica.

*Fluorine and Silicon.* [FLUOSILICIC ACID.]

*Metals with Silicon.*—Some of the metals may be combined with silicon: these compounds, which are not important, are termed *Siliciurets.* Some varieties of cast-iron contain nearly 8 per cent. of the siliciuret of that metal.

SILI'CULA (in Botany), a kind of fruit. In its structure it resembles the Siliqua [SILIQUA], and differs in nothing but its figure, which is rounded and much shorter, and in the number of its seeds. It is never more than four times as long as broad, and often much shorter. Examples of it may be seen in the whitlow-grass (*Draba*), in the shepherd's-purse (*Capsella*), and in the horse-radish.

SI'LIQUA (in Botany), a kind of fruit. It is characterised by having one or two cells, with many seeds, dehiscing by two valves, which separate from a central portion called the replum. It is linear in form and is always superior to the calyx and corolla. The seeds are attached to two placentæ, which adhere to the replum, and are *opposite* to the lobes of the stigma. This position of the seeds, being abnormal, can only be explained in two ways: either this fruit is in reality composed of four carpels, two of which have, during the growth of the pistil, become abortive; or the stigmas must be looked upon as the fusion of two halves, one from each side. The dissepiment of the fruit in this case is most probably a spurious one formed by the projecting placentæ. It is sometimes found incomplete, from the edges of the placentæ not meeting; it is then said to be *fenestrate.* This kind of seed-vessel is possessed by a large number of plants belonging to the order Cruciferæ, and examples may be seen in the stock or wall-flower (*Cheiranthus*), in the ladies' smock (*Cardamine*), and in the cabbage, turnip, and mustard. The Linnæan class *Tetradynamia* is divided into two orders, according to the form of its fruit: those plants of the class having a silique are comprised under the order Siliquosa; those having a silicle [SILICULA], under the order Siliculosa.

SI'LIQUA (Megerle), a genus belonging to the *Leguminaria,* Schum., and consisting of those species of *Solen,* Auct., which are furnished with an internal rib—*Solen radiatus* for example. [PYLORIDIANS.]

SILIQUA'RIA. [VERMETUS.]

SILI'STRIA, a sandjak (district) of Bulgaria, in European Turkey, situated between 42° 12′ and 45° 22′ N. lat., and 26° 11′ and 29° 3′ E. long., is one of the most fertile parts of Turkey. This sandjak is bounded on the north by the Danube and Sireth, which separate it from Moldavia and Bessarabia; on the east by the Black Sea; on the south by the sandjaks of Kirk-kilissia and Tchirmen; and it has on the west Rustchuk and Lower Wallachia. It is crossed in the south by the Balkan, which forms Cape Emineh, at the termination of the mountain-range· and by a ramification of less height in a northern direction which terminates on the Black Sea in Cape Calaghriah. From these heights descend the numerous rivers which fertilise the province; the Pravadi, the Buyuk-Campt-

Chik, the Nadir, and the Aidos flow into the Black Sea, into which the Danube empties itself on the northern extremity of the province, after receiving the Dristra, the Taban, and the Karasu. It is chiefly an agricultural country.

SILISTRIA, or *Drystra*, the antient name of which is Dorostero or Durosterum, in 44° 7′ N. lat. and 27° 12′ E. long., 155 miles north-north-east of Constantinople, is the capital of the sandjak which bears the same name. The town is large, and defended by a citadel, which is kept in good order, and surrounded by double walls and ditches. The city itself is surrounded by ditches from twelve to fifteen feet deep, and defended by strong palisades. The fort is situated on the extreme west of the town, which, upon the whole, is ill built; the streets are narrow and crooked, the houses low and dull; even the five mosques and the two public baths partake of the general ugliness. There is however at the eastern extremity of the town a custom-house in a better style of architecture. The large magazines which surround it contain chiefly corn and flour. As it is a fortress built on the northern frontier, in the neighbourhood of the Danube, and is principally of a military character, the commerce has never been flourishing; and although many merchants have lately settled in Silistria, it is not likely that any greater commercial activity will be the consequence. The population amounts to 20,000, the greater part of whom are Greeks.

The environs of the town are rather pleasant, and the numerous vineyards which border the Danube give them a cheering aspect. There are also ruins, which are said to have formed part of the wall raised by the Greek emperors against the incursions of the barbarians.

Silistria has frequently been the theatre of sharp actions between the Russians and the Turks. It was unsuccessfully besieged by the Russians in 1773, and was again attacked by them in 1779, on which latter occasion they suffered a considerable loss. In 1828 General Rosh was obliged to retreat after besieging the town for some months; but it fell into the hands of the Russians in 1829, when Generals Diebitch and Krassowski took it by assault on the 30th of June.

SI'LIUS ITA'LICUS, CAIUS. The place of this poet's birth is unknown. It has sometimes been stated that the name is derived from Italica (near Seville) in Spain, and that this was the birth-place of himself or of his ancestors. But to this conjecture we must oppose the silence of Martial, who frequently mentions Silius without speaking of his Spanish origin. The name also ought in that case, according to analogy, to be Italicensis. Silius was of an illustrious plebeian family. He studied oratory, in which Cicero was his pattern; and he also aspired to make himself a poet on the model of Virgil. He is said to have possessed himself of a country-house that had belonged to Cicero, and of one that had belonged to Virgil. (Martial, *Epig.*, xi. 48.) In the year A.D. 68, in the last year of the reign of Nero, he was consul with M. Valerius Trachalus Turpilianus; and some time after he was governor of the province of Asia, which he is said to have administered in a creditable manner. He was a friend of Vitellius, and appears to be the Silius Italicus who is mentioned by Tacitus (*Hist.*, iii. 65). There was, says Pliny (*Ep.*, iii. 7), a rumour that he had acted the part of an accuser or informer under the reign of Nero; but while he enjoyed the friendship of Vitellius, he conducted himself with prudence. He finally retired to his estate in Campania, where he devoted himself to poetry and philosophy. Silius was fond of objects of art, and he enriched his residence with statues, paintings, and books. When his old age became troubled with infirmities, he hastened his death by starvation, in which he followed the fashion of those times, when suicide was not uncommon. Silius was a Stoic. The time of his death is fixed at A.D. 100, when he is said to have completed his seventy-fifth year. He was married, and had two children. He enjoyed, says Pliny, unmingled happiness to the day of his death, with the exception of the loss of his younger child.

The only extant work of Silius Italicus is an epic poem on the second Punic war, in seventeen books, entitled 'Punica.' This poem, which may be called an historical epic, comprises the chief events of the war from the commencement of the siege of Saguntum (i. 268), to the defeat of Hannibal in Africa and the triumph of Scipio Africanus. [SCIPIO.] The materials of Silius seem to be chiefly taken from Polybius and Livy, and the poem has consequently a kind of historical value. As a work of art, it has been variously estimated, but the judgment of the younger Pliny (*Ep.*, iii. 7) seems to us to be correct: 'Silius wrote with more industry than genius.' His poem is in fact a very laboured composition, and the labour is apparent. Numerous episodes interrupt the continuity of the narrative. Silius falls short of his model, Virgil, in simplicity and clearness; and he endeavours to make up for force and precision by rhetorical ornament and long-drawn description. Instead of making a picture by a few striking touches, he fills it with detail till the whole is trivial. His invention is poor. There are few passages which excite our sympathies. In short, the poem is a rhetorical history in verse. All his contemporaries however did not judge so unfavourably of him. Martial on several occasions speaks very highly of him, and compares him with Virgil (*Ep.*, iv. 14; vi. 64; vii. 63; 'perpetui nunquam moritura volumina Sili;' viii. 66; ix. 86; xi. 49, 51): he also celebrates his eminence as an orator. According to Martial, in an epigram written after Silius had enjoyed the consulate, he did not attempt to imitate Virgil till he had acquired distinction as an advocate. Martial mentions the court of the Centumviri as one of the places in which he practised: Pliny the younger also practised in this court. [PLINY.]

The poems of Silius seem to have been forgotten after his death, if we may judge from the silence of subsequent writers as to them. Sidonius Apollinaris is the only writer who mentions them. Poggio is said to have discovered a MS. of Silius in the library of the convent of St. Gallen, in Switzerland, which was printed at Rome, 1471, folio. Another MS. was afterwards found at Cologne by Ludwig Carrio, from which the text of Silius was improved. It was to supply the loss of the 'Punica' that Petrarca, as it is said, wrote his 'Africa.' It has been conjectured that Petrarca had a copy of Silius, which he made use of, and carefully suppressed. Such conduct would be quite inconsistent with the character of Petrarca, and one would suppose that a comparison of the two poems would soon determine whether there is any foundation for such a statement.

There are numerous editions of Silius. The editio princeps is that of Rome already mentioned. There is an edition by Drakenborch, Utrecht, 1717, and Mitau, 1775; by Ernesti, Leipzig, 1791-2; and by Ruperti, with a preface by Heyne, Göttingen, 1795-98.

There is an English translation by Thomas Ross, London, 1661, 1672, folio; and a French translation by Le Febvre de Villebrune, Paris, 1781, 3 vols. 12mo.

SILIVRI, a seaport of Romania, in European Turkey, in 41° 4′ N. lat. and 28° 13′ E. long., thirty-two miles west of Constantinople, is built in the form of an amphitheatre, on the declivity of a small hill facing the Sea of Marmara. It forms a beautiful object when seen from the sea, and commands a fine prospect of the Sea of Marmara. The top of the hill is crowned by the ruins of a fort, which was built under the Greek empire. The population is 1500 Greeks and 200 Jews. The part of the town below the fort is solely occupied by Turks, who are about 4500. The Turks have several mosques, and a market-place, which is much admired. The harbour admits only small vessels, and is generally filled with fishing-boats, which furnish the inhabitants with a plentiful supply of food. The environs of the town are covered with vineyards and corn-fields. The antient name is Selybria, often written Selymbria. (Steph. Byzant., Σηλυμβρία; Strabo, p. 319, Casaub., Σηλυβρία.) It was a colony of the Megarians.

SILK. The manner in which raw silk is produced has already been described [BOMBYCIDÆ], and its value when wrought and manufactured has also been noticed. [RIBAND.] China was undoubtedly the country in which men first availed themselves of the labours of the silk-worm. Serica (the country of the Seres) was a name by which the Macedonian Greeks designated the country which produced the silk that came overland from the north of China. The author of the 'Periplus of the Erythræan Sea' speaks of silk in Malabar as an article imported from countries farther to the east; from which it may be inferred that the culture of the silk-worm and the manufacture of silk had not been introduced even into India four hundred years after silk was known in Europe. In speaking of the country of the Thinæ, the same author observes that both the raw material and manufactured article were obtained there. The 'Median robes,' spoken of by the Greek writers of the period of the Persian empire, and extolled for their lustrous beauty and brilliancy, were no doubt silken vestments, as Procopius, long afterwards, when silk had been introduced into Europe, states that 'the robes which were formerly called

Median by the Greeks are now called silken.' Aristotle is the first Greek author who mentions the silk-worm (*Nat. Hist.*, v. 19); and he states that silk was first spun in the island of Cos, but the raw material was still an oriental product; and Pliny (xi. 22), in commenting on this passage, states that the silk came from Assyria, and was worked up by the Greek women: it may be remarked that Assyria was, like Media, frequently used in an indefinite sense by antient writers. The probability is that silk was used in Western Asia before it was known to the Greeks; and that it was in use among the Greeks long before they knew whence the substance came or how it was produced. Thus Virgil (*Georg.*, ii. 121) supposes that the Seres carded the silk from leaves; and Dionysius Periegetes also supposed it to be a vegetable product: thus he says,—

> 'Nor flocks nor herds the distant Seres tend;
> But from the flow'rs that in the desert bloom
> Tinctur'd with every varying hue, they cull
> The glossy down, and card it for the loom.'

Pausanias gives more precise information respecting the substance from which the Seres formed their cloths. 'They have,' he says, 'a spinning insect, which is kept in buildings, and produces a fine-spun thread, which is wrapped about its feet' (vi. 26). It was not until the sixth century that the obscurity which enveloped this subject was cleared up. At this time silk was an article of general use among the Romans, and was manufactured for them by the inhabitants of Tyre and Berytus in Phœnicia. The Persians monopolised the supply of the raw material, and guarded their trade with so much jealousy, both by land and sea, that travellers from or to China were not allowed to traverse the Persian dominions; and in the time of Justinian, in consequence of some interference with the trade, they had entirely stopped the importation of silk. The trade in silk was in this unsatisfactory state, when two Nestorian monks of Persia, who had travelled to China, acquainted Justinian with the mode of producing silk, and undertook to return and bring back with them some of the eggs of the silk-worm. They were perfectly successful in their expedition, and a quantity of eggs, secured in a hollow cane, were brought in safety to Constantinople, hatched by the heat of a dunghill, and fed with mulberry-leaves. The monks also taught the subjects of Justinian the art of manufacturing silk.

The breeding of silk-worms in Europe was for six centuries confined to the Greeks of the Lower Empire. In the twelfth century the art was transferred to Sicily; in the thirteenth century the rearing of silk-worms and the manufacture of silk were introduced into Italy, from whence it was successively introduced into Spain and France, and in the fifteenth century the manufacture was established in England.

James I. was extremely solicitous to promote the breeding and rearing of silk-worms in England; and in 1608 issued circular letters, which were addressed to persons of influence throughout the country, recommending the subject to them, and arrangements were made for the distribution of the mulberry in the different counties. Most of the old mulberry-trees found in the neighbourhood of antient mansions at the present day were planted at the above period. The experiment was not successful, in consequence of our climate being unsuited to the silk-worm. James also encouraged the introduction of the silk-worm into the English settlements in America. About a century afterwards (1718) a company was incorporated, which obtained a lease for one hundred and twenty-two years of Chelsea park, where mulberry-trees were extensively planted, and large buildings erected for managing the business of breeding silk-worms. This scheme also failed. An attempt was next made to introduce the silk-worm in the settlements of Georgia and Carolina; the importation of raw silk from these colonies was permitted free of duty, and its production was further encouraged by direct bounties; but the quality of the silk proved indifferent, and after the trade had languished for some time, the hope of deriving any large supply from this quarter was abandoned. About the year 1789 nurseries of mulberry-trees were planted in several states of the American Union; but though the climate is not unfavourable to the rearing of silk-worms, which are found in their natural state in the forests, the high rate of wages is an obstacle to this sort of employment, which is better adapted to the social condition of China, Italy, the South of France, and Malta, where the wages of labour have nearly reached their minimum. The subject however has again recently attracted attention in the American Union; and in 1831 a small quantity of raw silk was exported. The production of raw silk is fast extending in British India, and the quality has been for some years gradually improving. There is every prospect of the English market being in time almost exclusively supplied with silk from our Indian possessions; as labour is not only cheaper than in any part of Europe, but three 'crops' of silk may be taken in the year, while from countries west of India, including Turkey, only one can be obtained. In Graham's 'India,' it is said that in the Deccan the mulberry-trees may be deprived of their leaves six times a year, and that six crops of worms may be obtained with ease in the same period. The Chinese method of rearing silk-worms, and their mode of treating the mulberry-tree (described in Davis's *China*, p. 280), were introduced at St. Helena, under the auspices of the East India Company, but on the expiration of their charter the establishment was given up. Some of the silk produced in France is believed to be better than that of any country in the world. The average price is twenty francs per lb., and the quantity produced exceeds three million lbs. The Italian silk is also highly esteemed; the quantity produced is estimated at from six to seven million lbs. In Russia Peter the Great formed mulberry plantations, and the rearing of silk-worms was strongly encouraged by the Empress Catharine, and at present those who engage in this business obtain many important privileges. In Bavaria and other parts of Germany, with the exception of Saxony, the silk-worm is successfully reared as a commercial object; also in Sweden, where the silk is said to possess some valuable properties not found in that produced in a warmer latitude. The last attempt to introduce the silk-worm in the United Kingdom on a large scale was made in 1835, by a company which commenced its operations by planting 80 acres in the county of Cork with 4000 mulberry-trees; but the design has been abandoned as far as relates to the United Kingdom, and the company has transferred its operations to Malta.

There are several works devoted to details of the management of silk-worms, one of the best of which is that of Count Dandolo, an Italian nobleman: it has been translated into French. There are also works on the same subject in our own language.

It is said that sixteen yards of gros-de-Naples of ordinary quality, or fourteen yards of a superior description, are manufactured out of 1 lb. of reeled silk, to produce which twelve lbs. of cocoons are required. The average weight of a cocoon is from three grains to three grains and a quarter; its average length when reeled off, about three hundred yards. Taking the silk consumed in the United Kingdom in a single year at 5,000,000 lbs. the following are the statistics of production:—

| | | |
|---|---|---|
| Raw silk . . . . . . | 5,000,000 | lbs. |
| 12 lbs. of cocoons to 1 lb. of raw silk . | 60,000,000 | lbs. |
| 30,000 worms to 1 lb. of cocoons, | 18,000,000,000 | worms. |
| 1 oz. of eggs to 100 lbs. of cocoons . | 600,000 | oz. of eggs. |
| 16 lbs. of leaves to 1 lb. of cocoons | 96,000,000 | lbs. of leaves. |
| 100 lbs. of leaves from each tree . | 9,600,000 | trees. |

Silk is obtained from the spider, not the cobweb, but the silky thread which the female spins round her eggs has been woven; the silken fibres of the pinna form a strong and beautiful fabric [MYTILIDÆ]; and some species of moths form cocoons which may be spun as a matter of experiment and curiosity, but not with a view to commercial profit.

The quantities of raw, waste, and thrown silk taken for consumption in the United Kingdom in the following periods was as under:—

| | | Annual average. lbs. |
|---|---|---|
| 1765 to 1767 | (inclusive) . . . . | 715,000 |
| 1785 to 1787 | „ . . . . | 881,000 |
| 1801 to 1812 | „ . . . . | 1,110,000 |
| 1814 to 1822 | „ . . . . | 1,940,902 |
| 1824 to 1835 | „ . . . . | 4,164,444 |
| 1836 to 1840 | „ . . . . | 4,999,791 |

The countries from which we imported raw, waste, and thrown silk, in 1839, were as follows:—

| | Raw Silk. lbs. | Waste, Knubs, and Husks. lbs. | Thrown Silk. lbs. |
|---|---|---|---|
| India . . . | 1,385,932 | 2,012 | .. |
| China . . . | 349,549 | 10,951 | .. |
| Turkey, Syria, and Egypt . | 731,121 | .. | .. |
| Italy . . . | 181,743 | 436,819 | 755 |
| France . . | 1,018,901 | 568,754 | 213,991 |
| Other countries | 79,002 | 23,954 | 10,522 |
| Total . . | 3,746,248 | 1,042,490 | 225,268 |

The duty on raw silk is 1*d.* per lb.; on waste, knubs, and husks, 1*s.* per cwt.; and on thrown silk the following duties are imposed:—5*s.* 2*d.* per lb. on organzine and crape, and 3*s* on tram and singles, dyed; 3*s.* 6*d.* on organzine and crapes, 2*s.* on tram, and 1*s.* 6*d.* on singles, not dyed. It is objected to this duty on foreign-thrown silk that it raises unnecessarily the price of all silk thrown at home. A drawback is allowed on the exportation of foreign-thrown silk: no British-thrown silk is exported. The first silk-throwing mill erected in England was at Derby, in 1718. [Derby.]

Reeling from the cocoons is only performed in countries where the silk is produced. Silk reaches the weaver in three different states, in which it is called singles, tram, and organzine [Riband], the preparation of which is the business of the throwster. In plain silk-weaving the process is much the same as in weaving woollen or linen; but the weaver is assisted by a machine for the even distribution of the warp, which frequently consists of eight thousand separate threads in a breadth of twenty inches. The Jacquard loom, invented by a weaver of Lyon, has been the means of facilitating and cheapening the production of fancy or figured silks to an extraordinary extent. Patterns which required the greatest degree of skill and the most painful labour are produced by this machine by weavers of ordinary skill, and with but little more labour than that required in weaving plain silks. The Jacquard loom has been improved by Mr. Hughes and Mr. Jennings, but at Lyon it has undergone no alteration. The power-loom has been only partially employed in the silk manufacture; and excepting for the commonest goods, it does not possess any great advantage over the hand-loom, as the delicacy of the material to be worked, and the attention which must be given to the process of the weft, frequently render it necessary to stop the machine.

Brocade and damask, the most sumptuous articles of silk manufacture a century ago, are now comparatively unknown. Persian, sarsnet, gros-de-Naples, ducapes, satin, and levantines, are the names given to plain silks, which vary from one another only in texture, quality, or softness. Satin derives its lustre from the great proportion of the threads of the warp being left visible, and the piece being afterwards passed over heated cylinders. Other varieties of silk goods are produced by mechanical arrangements in the loom, such as using different shuttles with threads of various substances, &c. The pile which constitutes the peculiarity of velvet is produced by the insertion of short pieces of silk thread, which cover the surface so entirely as to conceal the interlacings of the warp and woof. The process of weaving velvet is slow, and it is paid for at five times the rate of plain silks. There are several sorts of goods in which silk is employed with woollen materials, as poplins and bombazines. The Chinese, says Mr. Davis (p. 286), make a species of washing silk, called at Canton 'ponge,' which becomes more soft as it is longer used. Their crapes have never yet been perfectly imitated; and they particularly excel in the production of damasks and flowered satins.

The silk manufacture, after its introduction into England in the fifteenth century, remained for a long period one of the least important branches of the national industry. After the revocation of the Edict of Nantes, in 1685, about 50,000 refugees fled to England, a large proportion of whom settled in Spitalfields, and carried on the silk manufacture. At this period foreign silks were freely admitted; and from 1685 to 1692, silks to the value of from 600,000*l.* to 700,000*l.* were annually imported. In 1692 the refugees obtained an exclusive patent for certain articles; and in 1697 parliament prohibited the importation of French and other silk goods; and in 1701 the silk goods of India and China were included in the prohibition. Some inconsiderable relaxation was made in this policy in 1713, but in 1765 the system of prohibition was again fully adopted, and continued in operation until 1824. During this period the state of the manufacture was anything but satisfactory; the manufacturers complaining of the smuggling of foreign silks, parliament vainly endeavouring to exclude them, with constant disputes about wages on the part of the weavers. In 1773 they obtained an act, called the Spitalfields Act, which entitled the Middlesex weavers to demand fixed wages, to be settled by the magistrates. To this act may be attributed the establishment of the silk manufacture in various parts of the country; and having done great mischief, it was repealed in 1824. The changes introduced in 1824 (some of which only came into operation July 5th, 1826), with a view of stimulating the silk manufacture, have been most successful, as the table of the consumption of silk, before and after the duties were reduced, sufficiently proves. Now that silk has become cheaper, and consequently a commoner article of dress, it is less dependent on the caprice of fashion than when it was an expensive luxury. The declared value of silk goods exported since 1820 is shown in the following table:—

| | Annual average. £. |
|---|---|
| 1820 to 1823 (inclusive) . . . . | 369,835 |
| 1824 to 1827 " . . . . | 286,119 |
| 1828 to 1831 " . . . . | 405,961 |
| 1832 to 1835 " . . . . | 693,961 |
| 1836 to 1840 " . . . . | 771,479 |

The declared value of silk manufactures exported in 1839 was 868,118*l.*: of which the United States of America took 410,093*l.*; British North America, 136,750*l.*; Australian settlements, 46,724*l.*; France, 44,628*l.*; British West Indies, 38,467*l.*; Chili, 44,733*l.*; Brazil, 23,117*l.*; other states of Central and Southern America, 49,060*l.*; Germany, 17,135*l.*; East Indies and Ceylon, 14,713*l.*; Holland, 14,306*l.*; Belgium, 10,316*l.*; all other parts, 18,136*l.*

The value of the silk manufactures of Great Britain is estimated at between 6,000,000*l.* and 7,000,000*l.* One-half of the silk factories are in Cheshire, next to which stand Lancashire, Somerset, Derbyshire, and Staffordshire. There are one or more factories in above one-half of the counties of England; one or two factories have been established in Ireland, and a few more in Scotland. They employ altogether in these factories above 30,000 persons, of whom two-thirds are females.

The duty on silk manufactured goods imported from European countries is equivalent to 30 per cent. ad valorem. In 1839 this duty produced 227,438*l.*, and the value of the goods was therefore about 700,000*l.*, nine-tenths of which were from France. The exportation of silk goods from France to England was 3,589,594 lbs. from 1827 to 1838; but the quantity entered at the English custom-house was only 1,875,708 lbs., and there were therefore 1,713,886 lbs. introduced by smuggling, or 48 per cent. of the total quantity entered at the French custom-house for exportation to England. The duty on the legally imported goods averaged 20*s.* 4*d.* per lb.; but if the illegal imports could have been charged also, a duty of 10*s.* 11*d.* would have produced the same revenue. (Table by G. R. Porter, Esq., of the Board of Trade, in the *Report of Committee on Import Duties*.)

The silk manufactures of India are subject to an ad valorem duty of 20 per cent., which, in 1839, produced 19,867*l.* The imports consisted in that year of 503,182 pieces of bandannoes, romals, and silk handkerchiefs, of which only 112,280 paid duty for consumption in this country; and of other articles the greater part were re-exported.

(*Treatise on the Silk Manufacture*, in Lardner's 'Cyclopædia;' Ure's *Philosophy of Manufactures*; *Manual for the Culture of Silk*, prepared by order of the Massachusetts Legislature, Boston, 1832; *Essays on American Silk, with Directions for raising Silk-worms*, Philadelphia, 1830; *Second Report on Commercial Relations between Great Britain and France* (Silk), 1835.)

SILK-WORM. [Bombycidæ.]

SILLIMANITE, a crystallized *silicate of alumina.* It occurs in rhombic prisms imbedded in quartz. Cleavage parallel to the long diagonal. Colour dark brownish-grey or clove-brown. Fracture uneven, splintery. Specific gravity 3·41. Lustre vitreous, nearly adamantine on the face of cleavage. Nearly opaque. Hardness 8·0 to 8·5. Brittle and easily reduced to powder.

It is met with at Saybrook, Connecticut, North America. It was at one time considered to be a variety of anthophyllite, but it is much harder than this mineral, and contains more alumina and less silica and oxide of iron. It more nearly resembles sienite both in form and composition.

It yielded by the analysis of Bowen—

| | |
|---|---|
| Silica . . . . | 42·67 |
| Alumina . . . | 54·11 |
| Oxide of Iron . . | 2·00 |
| Water . . . . | 0·51—99·29 |

SI'LPHIUM (σίλφιον). Antient authors mention this plant and its juice. In the article on LASER, it has been stated that two kinds are described of this substance, which is also called juice of silphium. One kind, from Cyrene, was probably yielded by Thapsia Silphium [LASER], and the other was most likely assafœtida, which has been employed medicinally by Asiatics from very early times, though it has been known by this name in comparative modern times.

Silphium was however remarkable for other properties, and hence has attracted the attention of modern travellers who have recently visited the countries where the silphium is described as growing by the antients. The army of Alexander, in crossing the mountain-range which Arrian calls Caucasus (iii. 28, 10), and which is the same range that he afterwards mentions under the name of Paropamisus (v. 5, 3), met with the Silphium. Arrian says, on the authority of Aristobulus, 'In this part of the Caucasus nothing grows except pines and Silphium, but the country was populous, and fed many sheep and cattle, for the sheep are very fond of the silphium. If a sheep should perceive the silphium from a distance, it runs to it, and feeds on the flower, and digs up the root and eats that also. For this reason in Cyrene they drive the sheep as far as possible from the spots where the silphium grows, and some even fence in such places to prevent the sheep from entering them, if they should approach; for the silphium is worth a good deal to the Cyrenæans.' Burnes, in crossing the Hindu Koosh, and seeing both the men and cattle eating the young parts of the assafœtida plant, supposed that it must be the silphium of Arrian. But as this author describes the country where the silphium grows as abounding in cattle, Dr. Royle had concluded that the Prangos of Mr. Moorcroft was the silphium alluded to, and which is much fed on by sheep and cattle in the present day in Tibet. Mr. Vigne, when travelling in these regions, came to the same conclusion. It is probable therefore that both plants, being umbelliferous, and employed for the same purposes in nearly the same regions, may have contributed to form the accounts which are so brief in antient authors. [LASER; PRANGOS.]

SI'LURES. [BRITANNIA.]

SILURIAN SYSTEM. One considerable group of the fossiliferous primary strata, occurring in remarkable perfection in Wales, especially in the eastern and some of the southern districts, and in some of the adjoining English counties, is thus named by Mr. Murchison in a very splendid work, the fruit of his long investigation of this part of the series of British strata. Under this title we propose to arrange some general views of the present state of our knowledge regarding the history of the lower Palæozoic strata. [GEOLOGY; PRIMARY STRATA; PALÆOZOIC ROCKS; SALIFEROUS SYSTEM.]

When Mr. Murchison commenced his researches in Shropshire and Wales (1831), the principal knowledge we possessed of the succession of the older stratified rocks of Britain, then commonly called grauwacké and transition formations, was based on the still incompletely published labours of Sedgwick in Wales and the district of the English lakes; and so little was known of their fossil contents, that it is believed the first definite notice of this kind was contained in Mr. Phillips's description of a group of slate-rocks in the vicinity of Kirby Lonsdale. (*Geol. Trans.*, 1827.) Now, in consequence principally of the development given to this subject by the appearance of the Silurian researches of Mr. Murchison, and other works to which it has led, we are able to trace in one consecutive history nearly the whole series of mineral depositions and organic combinations of which the ocean was antiently the theatre, from the period of the mica schists to the termination of the carboniferous æra.

In this survey, the Silurian strata form a very conspicuous and interesting portion, and in the district from which the type was originally drawn they appear within distinct and definite limits which seem to insulate them from the older and new rocks, and to justify their claim to the rank of a peculiar system; but in other districts phenomena appear which show that the order of physical changes and organic combinations which characterise the Silurian System, was in operation both before and after the period included in the ages of the four Silurian groups of 'Llandeilo,' 'Caradoc,' 'Wenlock,' and 'Ludlow;' while in other districts these characteristic assemblages do not all clearly appear; and thus we are naturally conducted to a more comprehensive view of the whole of the antient (Palæozoic) formations.

Whatever be the true theory of the origin of the *Granitoid Strata* of gneiss and mica schist (with their many and various quartzose, chloritic, and calcareous accompaniments), it is at least certain, as a general rule, that rocks of this general type are prevalent among the very deepest and oldest deposits from water which retain proof of their watery aggregation, and that they are in this position devoid of the traces of antient life.

Equally certain is the character of the great series of Neptunian rocks which lies upon the mica schist; it is a vast and various mass of strata (principally argillaceous, locally arenaceous or conglomeritic, rarely yielding limestone), in which, though unequally, and in degrees varying with locality, *slaty cleavage* tends to be developed. Organic life has left traces in this series of muddy sediments both of vegetable and animal origin; in the lower and older parts very sparingly, in the upper parts abundantly. If, with Professor Sedgwick and Mr. Murchison, we take the series of these rocks as they appear in Wales and Cumberland, namely—

Silurian, or upper group;
Cambrian, or middle group;
Cumbrian, or lower group;

we shall find in the mineral characters of these groups in the countries named, some diagnostic marks of importance, but they vanish or become equivocal in other regions. In like manner the organic contents seem, in the countries named, to be definitely arranged in zones, so as to mark successive periods there: no organic remains are known in the Cumbrian rocks; they are rare, and confined to a few layers, in the Cambrian deposits; and are very plentiful and general in the Silurian group. The districts in which these peculiarities occur are probably more wide and scattered farther asunder than those in which the original types of mineral structure prevail; but yet it is evident that they are limited in respect of geographical area, and variable in regard to the distinctness and completeness of the terms, even in districts not far removed from the centre of investigation. Let any one who may desire proof of this compare the argillaceous series of Ayrshire, Westmoreland, Pembrokeshire, Tyrone, or Waterford, in which Silurian fossils occur, with the full and varied series of Shropshire, the Berwyn, and Snowdon.

Under these circumstances of difficulty in regard to the right general view of the antient fossiliferous strata, we must consider the series of Silurian rocks and fossils not as the type of this enormous sequence of mineral and organic phenomena, but as one, and perhaps the richest of all the local physical combinations of that antient period, and employ it as a general term of comparison for reducing to order and place many detached and difficult districts in which the strata have local, peculiar, and perhaps exceptional aspects.

Mr. Murchison arranges the Silurian strata in groups, as follows; in a descending order:—

| | Formations. | Divisions. | Thickness in feet. |
|---|---|---|---|
| Upper Silurians | Ludlow rocks . | Upper Ludlow rocks<br>Aymestry limestone<br>Lower Ludlow rocks | 1500 |
| | Wenlock rocks | Wenlock limestone<br>Wenlock shale . | 1000 |
| Lower Silurians | Caradoc rocks . . . . .<br>Llandeilo rocks . . . . . | | very variable |

We shall present a very brief analysis of some of their characters.

*Upper Ludlow Rocks.*

Mineral Character.—Greyish, argillaceous, or calcareous sandstones, very slightly micaceous, decomposing to ashen or rusty-brown colour.

Structure.—Mostly laminated, parallel to the stratification, with joints considerably symmetrical, nearly rectangular to the plane of the beds, as near Ludlow.

Aspect of the Country.—A region rising from beneath the old red-sandstone, often to a considerable and rather continuous escarpment, as near Usk and Ludlow.

Organic Contents.—Polypiaria, 2; Crinoidea rare; Conchifera Plagimyona rather plentiful, 10; Conchifera Mesomyona, 1; Conchifera Brachiopoda, 15; Gasteropoda, 6; Cephalopoda Monothalamacea, 3; Cephalopoda Polythalamacea, 6; Crustacea, 5; Annelida?, 1; Fishes, 7; Doubtful, 3 (in all about 58 species).

Localities.—Ludlow; vicinity of Usk.

*Aymestry Limestone.*

Mineral Character.—Subcrystalline, argillaceous limestone, bluish-grey, or mottled, as near Aymestry.

Structure.—Irregularly laminated, or nodular; with cross joints nearly rectangulated to the plane of stratification.

Aspect of the Country.—Often a slightly prominent terrace on the woody steep escarpment of a hill, capped with Upper Ludlow rocks, as near Ludlow.

Organic Contents.—Polypiaria, 12; Crinoidea rare; Plagimyona, 6; Mesomyona, 2; Brachiopoda, 12; Gasteropoda, 9; Monothalamacea, 1; Polythalamacea, 4; Crustacea, 3 (in all about 49 species).

Localities.—Aymestry; Sedgeley near Dudley, &c.

*Lower Ludlow Rocks.*

Mineral Character.—Argillaceous (called 'Mudstone'), light-grey, dark-grey, or black, but weathering to ashen hues, as in the Wigmore Valley.

Structure.—Partially flaggy, in places the lamination is uneven and nodular. In the lower parts, nodules of black limestone in lines of stratification.

Aspect of the Country.—Toward the base of the steep escarpment of a hill, which may contain the whole Ludlow formation, as in the Wigmore Valley.

Organic Contents.—Polypiaria, 9; Crinoidea rare; Plagimyona, 8; Mesomyona, 2; Brachiopoda, 19; Gasteropoda, 7; Monothalamacea?; Polythalamacea, 27; Crustacea, 3; Annelida, 1; Fishes, 1; Doubtful, 2 (in all about 79 species).

Localities.—Ludlow; Usk.

*Wenlock Limestone.*

Mineral Character.—Grey, bluish, or pinkish crystalline and subcrystalline limestone, arranged in strata of concretionary aspect, separated by much argillaceous matter.

Structure.—As above stated, concretionary in detail, but stratified on a large scale with considerable persistence of the parts. The concretionary structure most remarkable at top and bottom.

Aspect of the Country.—Usually a prominent or terrace-like escarpment, where the beds dip moderately; rising to insulated hills, where contortions prevail, as near Ludlow, Wenlock, Malvern Hills.

Organic Contents.—Polypiaria, 53; Crinoidea, 14; Plagimyona?; Mesomyona, 1; Brachiopoda, 28; Gasteropoda, 8; Monothalamacea, 2; Polythalamacea, 9; Crustacea, 14; Annelida, 1; Doubtful, 2 (in all about 132 species).

Localities.—Dudley; Wenlock; near Usk.

*Wenlock Shale.*

Mineral Character.—Dull argillaceous shale, with concretions of impure argillaceous limestone, much analogous to the argillaceous Ludlow rocks.

Structure.—Laminated, with spheroidal calcareous concretions, especially toward the base.

Aspect of the Country.—Owing to the wasting of the middle beds, this shaly mass is often the line of a valley.

Organic Contents.—Polypiaria, 18; Crinoidea rare; Plagimyona, 1; Mesomyona?; Brachiopoda, 33; Gasteropoda, 4; Monothalamacea?; Polythalamacea, 5; Crustacea, 2; Annelida?; Doubtful, 2 (in all about 65 species). There are marine plants in this deposit, and we have seen them of a vermilion colour.

Locality.—Wigmore Valley.

*Caradoc Sandstone.*

Mineral Character.—Sandstones of various colours, more or less micaceous, sometimes quartzose or conglomeritic, with thin courses of impure limestone, especially in the upper part. (Where altered by igneous action, this sandstone becomes a sort of quartz rock.)

Structure.—Usually laminated. Where altered by heat, the stratification is nearly or quite lost.

Aspect of the Country.—Very characteristic where the strata are indurated by vicinity of trap-rocks: the quartzose masses then assuming very picturesque forms.

Organic Contents.—Polypiaria, 12; Crinoidea rare; Plagimyona, 1; Mesomyona, 3; Brachiopoda, 53; Gasteropoda, 7; Monothalamacea, 3; Polythalamacea, 6; Crustacea, 8; Doubtful, 2 (in all about 95 species).

Mineral Veins.—Green copper-ore (Malachite); thin strings of galena; and in the vicinity of trap true mineral veins occur.

Localities.—Caer Caradoc; May Hill; near Llandeilo.

*Llandeilo Flags.*

Mineral Character.—Hard dark-coloured flags, sometimes slightly micaceous, frequently calcareous.

Structure.—Thinly laminated, parallel to the stratification, with some internal oblique cleavage.

Aspect of the Country.—Not characteristic, the stratification being commonly very highly inclined and the masses very thick.

Organic Contents.—Polypiaria, 4; Crinoidea rare; Plagimyona, 1; Mesomyona?; Brachiopoda, 26; Gasteropoda, 3; Monothalamacea, 1; Polythalamacea, 1; Crustacea, 11 (in all about 47 species).

Mineral Veins.—Occur in the vicinity of trap, as in the Shelve and Corndon district.

Localities.—Near Built; Llandeilo; Pembrokeshire.

Pyrogenous rocks are associated with the Silurian strata in many situations—as the Caradoc Hills, where compact felspar predominates—the Wrekin and Lilleshall Hill, characterised by sienitic rocks—Corndon, full of greenstone. Alterations of stratified rocks by the contact of igneous rocks are common in the Caradoc, Stiperstones, &c. The trap rocks near Welshpool are in places columnar; the Breiddyn Hills are mostly greenstone, and yield elongated dykes in a north-east direction, which traverse the new red-sandstone. Mineral veins (yielding lead-ore) are plentiful in Lower Silurian rocks, in the Shelve district, adjacent to the trap rocks of Corndon, and the altered sandstones of the Stiperstones. 'In a plan of Mr. More's of Linley Hall, the chief proprietor of this district, upwards of 24 are laid down in the district of Shelve alone, excluding the tracts around the Bog and Penally: so that, comprehending the principal portion of the mining-ground, we may say that it contains upwards of 30 metalliferous veins which have been profitably worked.' (Murchison, *Sil. Syst.*, p. 282.)

Volcanic grits, composed of materials derived from igneous action, and subsequently arranged in water, are mentioned by M. Murchison rather frequently. In the Shelve district they are traversed by lead veins; in the Caradoc Hills, they abound, and were noticed as 'allied to greenstone' in the Wrekin by Mr. A. Aikin. They contain organic remains in several places, as near the Corndon Hills.

On reviewing the series of strata comprised in the Silurian System, in the vicinity of Ludlow, Usk, Llandeilo, or Denbighshire, we see them to form in reality one closely associated sequence of oceanic deposits—apparently accumulated with little local disturbance and very slight admixture of organic exuviæ from the land. Volcanic eruptions appear to have rather varied than greatly disturbed this system of operations, though it is evident they contributed no small part of the granular materials of the principally sedimentary strata. The formation of limestone is local:—where coral prevailed, we find the Aymestry and Wenlock limestones, and even the calcareous parts of the Landeilo rocks, to be in a great degree filled with coral. The Brachiopod shell 'Pentamerus' fills some whole beds of limestone (near Aymestry), and where it is deficient the limestone also fails, as in the district of Usk. In their course from Shropshire, northward to Denbighshire, Mr. Bowman (*Reports of the British Association for* 1840-41) has found the general type of the Silurian rocks to vary, and the line of distinction between it and the slaty strata below to be extremely obscure; and similar observations are recorded by M. Murchison in the account which he gives of these rocks in Caermarthenshire and Pembrokeshire.

Mineral character alone will scarcely suffice, anywhere, for any but an arbitrary (and therefore unsatisfactory) boundary-line between the Silurian and Cambrian deposits. It is extremely probable, perhaps we may say it is already proved, that no distinction of higher value can be found on comparing the organic remains of these groups. In Snowdon (supposed to be very low in the Cambrian series of rocks) are shells and corals, which are perhaps the same, but certainly are congeneric with and very similar to 'Silurian' fossils; and there is really as great (if not greater) difference between the Llandeilo and Wenlock rocks, in regard to fossils, than between the Silurian and Cambrian strata.

If we turn to other districts where Silurian fossils occur plentifully (North America, Ireland, Norway), the result appears the same. There is apparently only one great series of organic combinations distinguishable among the fossiliferous strata anterior to the old red-sandstone æra, and it was with a perception of this important truth that Mr. Murchison once proposed for the Silurian strata the title of Protozoic. If instead of this we employ Palæozoic (as suggested by Sedgwick), and adopt the general view advocated in this work [PALÆOZOIC; SALIFEROUS SYSTEM], we shall rank all the fossiliferous strata of the Cumbrian, Cambrian, and Silurian groups as *Lower Palæozoic Strata.*

The lower arbitrary boundary of the Silurian strata being thus softened or erased, we may regard its upper surface as only locally more definite. Certainly in all the region around Wales the separation of the Silurian and old red deposits is somewhat sudden; the colour changes from grey to red; the dull mudstones become micaceous sandstones; the richly fossiliferous Upper Ludlow loses its character in unprolific red marls and grits. What few fossils do occur in these overlaid strata (except near the very bottom) are of quite other types of organization. But these are local truths, depending mainly on the introduction of new sediments *poisonous to marine invertebral life;* and as these sediments are very local, we may find in other countries groups of strata newer than the Silurian, older than the Carboniferous, with fossils intermediate in character and combination to both.

This expectation is in course of fulfilment, but it is not yet fully satisfied. In Devonshire, the Rhine Valley, the Eifel, we find numerous assemblages of such *Middle Palæozoic* fossils, but they do not by any means fill the whole interval between the Silurian and Carboniferous types; nor have we seen in collections from North America, Australia, the Hartz, Brittany, or Russia, all that is desired to fill the void. Ever alive to this most interesting inquiry, the author of the 'Silurian System' is perhaps at this moment adding valuable facts concerning it, the fruit of his continued researches in Russia; and we believe that by further examination of the *lower strata* of the Rhine Valley, and the Harz, some additional data may be gathered.

At present the most important of the discoveries which (however incompletely) represent a *Middle Palæozoic Period,* have been in Devonshire and Cornwall, in the Fichtelgebirge, and in the Eifel and Rhine Valley. The principal of these, at least in regard to the analogies which it offers to the strata of earlier and more recent date, is the district of Devon and Cornwall; from which ten years ago only a small number of fossil species was known, but which has now yielded to numerous inquirers fully 300 distinct and recognisable forms. Of these, according to Mr. Lonsdale, who gives (*Geol. Trans.* 1840) a table of the species which he examined, and to Mr. Murchison and Professor Sedgwick, who enumerate 128 species, a few of these species are found in the Silurian and a few in the Carboniferous rocks. Professor Phillips, in his recent work (*Palæozoic Fossils of Devon and Cornwall*), discusses the relations of 275 species, and arrives at the conclusion that both by numerical valuations of the general combinations of groups of invertebrata, and by specific analogies, the conclusion of the intermediate age of the Devon and Cornwall strata is confirmed. As the differences of the Devonian and Silurian fossils are very much greater than those between the Silurian and Cambrian fossils, it appears probable that the boundary assumed by Mr. Murchison for the upper termination of the Silurian group may remain with but slight alteration. One change contemplated by the author himself we should be glad to see adopted:—there are some fossiliferous bands placed by Mr. Murchison near the base of the old red system, which would better go to the Silurian ranks, since, in respect of the shells which they contain and their mineral composition, they are scarcely distinguishable from Silurian strata.

On considering the distribution of organic remains in the successive stages of the Silurian rocks, it is evident that the greatest variety of species occurs in the lower part of the upper and towards the upper part of the lower Silurian rocks. In other words, the conditions favourable to organic life in the sea were in the earliest period considerable; they arrived at a maximum in the middle part of the period, in the Caradoc sandstone, the Wenlock shale and the Wenlock limestone, and still continued considerable till the Silurian depositions ceased, and were replaced by old red-sandstone nearly devoid of organic remains. Polypiaria, Crinoidea, and Crustacea are most numerous in the principal calcareous rock, Wenlock limestone; Brachiopoda are most plentiful in Caradoc sandstone; Cephalopoda, in the Wenlock shale; fishes, in the upper Ludlow rock.

Mr. Murchison gives the following general recapitulation of organic remains in these strata:—

| | Genera. | Species |
|---|---|---|
| Pisces | 15 | 24 |
| Crustacea | 10 | 37 |
| Annelida | 5 | 6 |
| Mollusca (Heteropoda*) | 1 | 11 |
| (Cephalopoda) | 6 | 41 |
| (Gasteropoda) | 13 | 34 |
| Conchifera (Brachiopoda) | 8 | 107 |
| (Monomyaria) | 1 | 6 |
| (Dimyaria) | 10 | 21 |
| Crinoidea | 5 | 14 |
| Polypiaria | 35 | 65 |
| Doubtful | 6 | 9 |
| | 115 | 375 |

**SILU'RIDÆ**, a family of fishes of the order Malacopterygii, placed by Cuvier, in his 'Règne Animal,' between the *Esocidæ*, or Pike tribe, and the *Salmonidæ*, or family of the Salmons; but in the 'Histoire Naturelle des Poissons,' the present group commences the Malacopterygii. The family *Siluridæ* constitutes a very extensive section of fishes, the species of which are for the most part confined to the fresh waters of warm climates. No group perhaps presents greater diversity of form than the Silurians, and their habits are equally interesting. Their most obvious external characters are, the want of true scales; the skin is generally naked, but in parts protected by large bony plates; the foremost ray of the dorsal and pectoral fins almost always consists of a strong bony ray, often serrated either in front or behind, or on both sides. These fishes moreover frequently are furnished with a small adipose fin on the hinder part of the back, as in the *Salmonidæ*. The mouth is almost always provided with barbules.

The genus *Silurus*, as now restricted, is distinguished by the dorsal fin being very small, without any distinct spine, and situated on the fore part of the back; the anal fin is of great length, extending along the whole belly of the fish, and sometimes joining the tail-fin; the maxillaries and intermaxillaries are furnished with small thick-set curved teeth, and there is a band of similar teeth on the vomer.

The species of this genus are confined to the old world; the only known European species is the *Silurus glanis* (Linn.), a fish of very large size, which is found in the lakes of Switzerland, in the Danube, the Elbe, and all the rivers of Hungary. In Prussia and Sweden it is also found.

The *Silurus glanis* is introduced in several works on the fishes of this country. It has however, says Mr. Yarrell, been suspected that the so-called Silurus, supposed to have been found formerly in some of the Scottish rivers, might have been the burbot.

Cuvier states that this fish is sometimes upwards of six feet in length, and is said to weigh three hundred pounds (French). The body is elongated, and has the hinder part compressed, but towards the head its width gradually increases, and the head itself is depressed and large; its colour is dark-green above, of a pale-green below the lateral line, and yellowish on the belly, and the whole body is covered with dark spots; six barbules surround the mouth, and two of these, which have their origin (one on each side) just above the angle of the mouth, are very long.

Mr. Yarrell observes, 'The Silurus is represented as sluggish in its habits, and a slow swimmer, taking its prey by lying in wait for it, in a manner somewhat similar to the Angler, *Lophius*; hiding itself in holes or soft mud, and apparently depending upon the accidental approach of fishes or other animals, of which its long and numerous barbules may be at the same time the source of attraction to the victims, and the means of warning to the devourer. From its formidable size, it can have but few enemies in the fresh water; and from them, its dark colour, in addition to its habit of secreting itself either in holes or soft mud, would be a sufficient security. In spring, the male and female may be seen together, about the middle of the day, near the banks or edges of the water, but soon return to their usual retreats. The ova, when deposited, are green; and the

* These, in the preceding paragraphs, we have called Monothalamacea.

young are excluded between the sixteenth and nineteenth days.'

'The flesh of the Silurus is white, fat, and agreeable to many persons as food, particularly the part of the fish near the tail; but on account of its being luscious, soft, and difficult to digest, it is not recommended to those who have weak stomachs. In the northern countries of Europe the flesh is preserved by drying, and the fat is used as lard.'

It appears by some statements in the 'Histoire Naturelle des Poissons,' that the present fish is so voracious, that it has been known, in several instances, to devour children; and in one instance the body of a woman was found in one of these fishes.

Several examples of the restricted genus Silurus are found in Asia.

Cuvier separates from the typical Siluri, as a genus, the *Silurus mystus* of Linnæus, and some others, on account of the compressed form of the body, and the dorsal fin having a strong bony spine in front, which is denticulated on the hinder margin. The body is deepest near the middle, but tapers somewhat suddenly towards the extremities. The head is small and depressed, and the eyes are placed low down.

The species upon which Cuvier founds this genus—to which he applies the name *Schilbe*—are found in the Nile, but there are others described in this author's great work on fishes, one of which is found at Senegal and another in India.

Genus *Cetopsis*.—This genus is founded by Agassiz on certain species found in Brazil, which in their affinities approach the genus *Silurus*, but are distinguished by the extremely small size of their eyes.*

Genus *Bagrus*, Cuvier.—The species of this genus are distinguished from those of the genus *Silurus*, as restricted, by their possessing an adipose fin on the hinder part of the back. The body is naked—that is, unprovided with bony plates—and the mouth is provided with barbules, the number of which, varying in different species, has been selected for the minor divisions of the group. Numerous species are found in the Indian and African rivers.

Genus *Pimelodus*, Lacép.—Differs from *Bagrus* in having no teeth on the vomer; the palatines however are often provided with teeth. The species vary much in the number of their barbules, and in the form of the head, which is often protected by a bony plate, and a large bony plate is situated between that on the head and the dorsal spine; similar bony plates on the head however are observable in many of the species of the preceding genus. The species of *Pimelodus* are very numerous, and are found both in the Old and New World. Numerous species are described from North America, others are found in South America, and the rivers of India also furnish numerous examples.

Genus *Phructocephalus*, Agassiz.—This genus contains but one species, an inhabitant of the Brazils; its generic distinction consists in its possessing some incomplete osseous rays enchased in the upper margin of the adipose fin. The head is depressed and covered by a deeply sculptured bony plate; a second bony plate, of a transverse oval form, is situated in front of the first dorsal fin. The branchiostegous rays are nine in number, and the mouth is provided with six barbules.

Genus *Platystoma*, Agassiz, is composed of several South American species of *Siluridæ* which have the muzzle depressed, and are remarkable for the great number of their branchiostegous rays, which amount in some to fifteen in number. Some of the species attain a large size, there being specimens in the Paris Museum as much as five feet in length, and they have been seen of still greater bulk.

Genus *Galeichthys*, Cuv. and Val.—This genus is nearly allied to *Bagrus*, but distinguished by the head being round and unprotected by any distinct bony plate: the branchiostegous rays are six in number. Some possess six barbules, and others have four. One species is found at the Cape of Good Hope, a second is said to be found both in North America and at Rio Janeiro; several species occur in Brazil, and the Ganges also furnishes a species of the present genus.

Genus *Silundia*, Cuv. and Val.—This genus is founded upon a fish from the Ganges, which has the head small and smooth, a very small adipose fin, and a long anal fin. It has but two barbules, and they are very small; the branchiostegous rays are twelve in number; the teeth are longer and less abundant than usual in the *Siluridæ*. The only species known (*Silundia Gangetica*, Cuv. and Val.; *Pimelodus Silundia* of Hamilton) is said to be very common at the mouth of the Ganges, and to be much esteemed for food.

* See the part on Ichthyology of the 'Voyage of MM. Spix and Martius.'

Genus *Arius*, Cuv. and Val.—Contains many species of Siluridæ, allied to the *Bagri*, but distinguished by their palatine teeth forming two distinct and widely separated masses. In some species the teeth are minute and dense, like the pile on velvet, or like the teeth of a carding-machine, and in others the palate is furnished with teeth in the rounded form of paving-stones, instead of having them pointed. Species of this genus are found in the tropical portions of both continents, and also in North America.

Genus *Auchenipterus*, Cuv. and Val.—May be distinguished from other genera which possess the adipose fin by the small size of the head, the very minute size of the teeth, and there being five branchiostegous rays. It evinces an affinity with *Pimelodus* in having no palatine teeth, and in the number and form of the maxillary barbules. The first dorsal is situated very forward, a circumstance which suggested the generic name. The bony shield which covers the upper surface of the head is, in the fishes of this genus, united by a suture with the dilated bony nuchal plates. All the known species are from the tropical portions of South America.

Genus *Trachelyopterus*.—The genus is founded by MM. Cuvier and Valenciennes, upon a small Silurian from Cayenne, in which there is no adipose fin; the teeth are fine, like the pile of velvet, and the palate is destitute of teeth; the barbules are six in number. The head is somewhat short, and protected by a stout bony shield, which is united almost immediately with the dorsal on account of the shortness of the interparietal plate, and almost rudimentary state of the *chevron*, placed generally in front of the spiny rays of the dorsal fin; the pectoral fins are inserted as it were under the throat.

Genus *Hypophthalmus* (Spix), Cuv. and Val.—This genus is composed of but few species, and these are from the tropical portions of South America. The principal characters are:—Mouth destitute of teeth; eyes placed very low down near the angle of the mouth; branchiostegous rays fourteen in number; body furnished with an adipose fin.

Genus *Ageneiosus* (Lacépède), Cuv. and Val.—This genus is thus characterised in the 'Règne Animal:'—Characters the same as in *Pimelodus*, excepting that there are no barbules properly so called. In some, the maxillary bone, instead of being prolonged into a fleshy and flexible barbule, assumes the form of a projecting denticulated horn. In others this bone does not project, but is concealed under the skin; the dorsal and pectoral spines are but little apparent. All the species are from South America.

Genus *Synodontis*, Cuv.—This genus is composed of Silurians found in the Nile and Senegal, which have an adipose fin, the muzzle narrow, and terminated by an ethmoid which supports two small intermaxillary bones armed with bristle-like teeth; the lower jaw composed of two short and slender rami, bearing in front a mass of teeth which are in the form of very slender laminæ and closely packed—each of these teeth is attached to the jaw by a flexible and very slender stalk. The stout bony plate which covers the head is joined to the nuchal plate, and this extends to the first spine of the dorsal fin, which is of very large size, and in this respect resembles the first spine of the pectoral fins. The inferior barbules, and sometimes the maxillary barbules, have small lateral branches.

Genus *Doras*, Lacépède.—The species of this genus are distinguished by the lateral line being armed with bony plates, which are carinated, and terminate in a spine. They have a second adipose dorsal fin, and the foremost spine of the pectoral and anterior dorsal fins is very large and deeply serrated. Osseous plates cover the upper surface of the head and extend to the dorsal fin, and the humoral bone is produced backwards and pointed.

These may be regarded, say the authors of the 'Histoire Naturelle des Poissons,' as the most powerfully armed of all the *Siluridæ*; thus the Spanish colonists in South America have given to them the name *Mata-caïman* (or Crocodile-killer), because it often happens that when they are swallowed by these large reptiles, the œsophagus and pharynx of those animals are so lacerated by the spines of the Silurus as to cause death. Strabo also (p. 824, Casaub.

attributes similar power to certain fishes of the Nile, which he called *choerus* (χοῖρος), and which are supposed by some naturalists to belong to the modern genus *Synodontis*.

The genus *Doras* is divided into two sections on account of the structure of the mouth. In some it is situated at the end of a depressed muzzle, and is provided with two broad bands of delicate teeth, both in the upper and lower jaws. In others the opening of the mouth is situated on the under side of a conical muzzle, and the opening is of a circular form—here the teeth are either wanting or are hardly visible; the maxillary barbules are sometimes furnished with small lateral branches. To the first of these sections belongs the *Silurus costatus* of Linnæus, a species found in the rivers of Guiana.

A species of *Doras*, described by Dr. Hancock, in the fourth volume of the *Zoological Journal*, p. 241, under the name of *D. costatus*, is a native of Demerara, where it is called the *Flat-head Hassar:* it possesses the singular property, says Dr. Hancock, of deserting the water, and travelling over land. 'In these terrestrial excursions large droves of the species are frequently met with during very dry seasons, for it is only at such periods that they are compelled to this dangerous march, which exposes them as a prey to many and such various enemies. When the water is leaving the pool in which they commonly reside, the *Yarrows* (a species of *Esox*, Linn.), as well as the second species of Hassar, to which I shall presently refer, bury themselves in the mud, while all the other fishes perish for want of their natural element, or are picked up by rapacious birds, &c. The *flat-head Hassars*, on the contrary, simultaneously quit the place, and march over land in search of water, travelling for a whole night, as is asserted by the Indians, in search of their object. I have ascertained by trial that they will live many hours out of water, even when exposed to the sun's rays. Their motion over land is described to be somewhat like that of the two-footed lizard. They project themselves forwards on their bony arms by the elastic spring of the tail exerted sideways. Their progress is nearly as fast as a man will leisurely walk. The strong scuta or bands which envelope their body must greatly facilitate their march, in the manner of the plates under the belly in serpents, which are raised and depressed by a voluntary power, in some measure performing the office of feet. It is said that the other species, the *round-head* (*Callichthys littoralis*, Hancock), has not been known to attempt such excursions, although it is capable of living a long time out of its element; but, as I before observed, it buries itself in the mud in the manner of the *Yarrows*, when the water is drying up.

'The Indians say these fishes carry water within them for a supply on their journey. There appears to be some truth in this statement; for I have observed that the bodies of the *Hassars* do not get dry, like those of other fishes, when taken out of the water; and if the moisture be absorbed, or they are wiped dry with a cloth, they have such a power of secretion that they become instantly moist again. Indeed it is scarcely possible to dry the surface while the fish is living.'

Both the species of *Hassar* here mentioned, it appears, make nests in which they lay their eggs in a flattened cluster, and cover them over most carefully. This care does not end here. They remain by the side of the nest till the spawn is hatched, with as much solicitude as a hen guards her eggs; both the male and female *Hassar*, for they are monogamous, steadily watching the spawn, and courageously attacking any assailant. Hence the negroes frequently take them by putting their hands into the water close to the nest; on agitating which, the male *Hassar* springs furiously at them, and is thus captured.

'The *round-head* forms its nest of grass; the *flat-head*, of leaves; both at certain seasons burrow in the bank; they lay their eggs only in wet weather. I have been surprised to observe the sudden appearance of numerous nests in a morning after rain occurs, the spot being indicated by a bunch of froth, which appears on the surface of the water over the nest; below this are the eggs, placed on a bunch of fallen leaves or grass, if it be the littoral species, which they cut and collect together. By what means this is effected seems rather mysterious, as the species are destitute of cutting teeth. It may possibly be by the use of their serrated arms, which form the first ray of the pectoral fins.'

Genus *Callichthys*, Linn.—The species of this genus have the body almost entirely covered by large bony plates, these forming four longitudinal ranges, two on each side: the head is also protected by bony plates; the mouth is but slightly cleft, and provided with four long barbules; the second dorsal has a bony spine in front; the foremost ray of the pectoral fins is strong, but that of the anterior dorsal is comparatively feeble and short. The species of Callichthys appear to be confined to the tropical portions of South America. [CALLICHTHYS.]

Genus *Arges*, Cuv. and Val.—The principal characters of this genus are—teeth bifid at the extremity, and with the points curved inwards; palate destitute of teeth; opening of the mouth large; maxillary barbules two in number; anterior dorsal fin small, and with the front ray feeble; adipose fin long; the other fins with the outer rays prolonged into a filament.

The species which forms the type of this genus (*Arges sabalo*, Cuv. and Val.) is a small fish about eight inches in length, which was brought by Mr. Pentland from Upper Peru, being found in the neighbourhood of the mission of Santa Anna, at a height of from 4500 to 4800 French metres above the level of the sea. The specimen was given to M. Valenciennes, who prized it much, since it threw a light on the affinities of a fish described by Humboldt, under the name *Pimelodus Cyclopum*, relating to which that author has given such an interesting account. The *Pimelodus Cyclopum*, which M. Valenciennes thinks most probably belongs to the present genus, is about four inches in length, and is found in lakes at the height of 3500 metres above the level of the sea. But the most remarkable circumstance relating to these fishes is that they are frequently ejected in the eruptions from the volcanoes of the kingdom of Quito, and in such quantities that the fetid odour arising from their putrefaction was perceived at a great distance, and the putrid fevers which prevailed in those districts were attributed to the miasmata they produce. These fishes sometimes issued from the crater of the volcano, and sometimes from lateral clefts, but constantly at an elevation of from 5000 to 5200 metres above the level of the sea. In a few hours millions are seen to descend from Cotopaxi, with great masses of cold and fresh water.

The genus *Brontes*, Cuv. and Val., is founded upon a fish possessing all the characters of the preceding genus (and which, it appears, like the *Pimelodus*, is thrown out from the volcanoes of Cotopaxi), but which differs in having no adipose fin.

Genus *Astroblepus*, Cuv. and Val., consists of but one species (the *Astroblepus Grixalvii* of Humboldt). This fish possesses all the characters of the genus *Brontes*, having, like it, the head depressed, the eyes directed upwards, a single dorsal fin, the external rays of the fins prolonged into a filament, and four branchiostegous rays, but it possesses no ventral fins. This fish is found at Rio de Palace, near Papayana, where it is known by the name *pescado negro;* it attains about fifteen inches in length.

Genus *Heterobranchus*, Geoff.—Here the head is furnished with a rough bony shield, which is flat and broader than in the other Silurians, on account of the lateral laminæ furnished by the frontals and parietals, which cover the orbital and temporal bones. The operculum is still smaller than in the preceding fishes, and what chiefly distinguishes these fishes from others of the family is, that, besides the ordinary branchiæ, they have an apparatus ramifying like the branches of a tree adhering to the upper branch of the third and fourth branchial rays; the branchiostegous rays vary from eight or nine to fourteen or fifteen in number. The pectoral spine is strong and denticulated, but there is no bony spine to the dorsal fin. The body is elongated and naked, and the dorsal and anal fins are greatly extended in the longitudinal direction. The barbules are eight in number. The species inhabit the rivers of Africa, and some of those of Asia.

In some species the long dorsal fin is supported throughout by rays; these constitute the subgenus *Clarias*, Val.; and in others there is a dorsal fin supported by rays, and a second behind this, which is adipose. To them the term *Heterobranchus* is restricted in the *Histoire Naturelle des Poissons*.

Genus *Saccobranchus*, Cuv. and Val.—This genus is founded upon the *Silurus Singio* of Hamilton's 'Fishes of the Ganges,' which possesses some interesting peculiarities in its internal organization, pointed out by Mr. Wyllie, in the 'Proceedings of the Zoological Society,' for May, 1840.

Genus *Plotosus*, Lacépède, is distinguished by the elongated form of the body and the possession of two dorsal fins, the hindermost being supported by rays as well as the other. The head is protected by a bony plate, the lips are fleshy and pendent, the jaws are furnished with strong and conical teeth, and the vomer with rounded teeth. The species inhabit India.

Genus *Aspredo*, Linn.—The fishes of this genus, says Cuvier, present very singular characters, particularly in the flattening of the head and in the dilatation of the anterior portion of the trunk, which chiefly arises from that of the bones of the shoulder; in the proportionate length of the tail; in the small size of their eyes, which are placed in the upper surface of the head. The intermaxillaries are situated under the ethmoid, directed backwards, and are only furnished with teeth in their hinder margin. But the most striking character consists in there being no power of motion in the operculum, a character which distinguishes the present genus from all other osseous fishes. The branchial opening consists of a simple slit in the skin under the external edge of the head, and the branchiostegous membrane is provided with five rays; the dorsal fin is of moderate size; the anal is long; the tail moderate, and the adipose fin is wanting: the whole of the body is smooth and without bony plates. The species are found in the tropical parts of South America.

Genus *Chaca*, Cuv. and Val., which is the next in succession in the *Histoire des Poissons*, is founded upon the *Platystacus Chaca* of Buchanan Hamilton. It inhabits the rivers of India.

The genus *Sisor* is also founded upon a single species described (under the name *Sisor rhabdophorus*) by the author just mentioned, in his *Fishes of the Ganges*.

Genus *Loricaria*.—Linnæus gave this name to a group of *Siluridæ* distinguished by the head and body being covered throughout by large angular bony plates; they differ moreover from certain other Siluri which have the body protected by plates (such as *Callichthys* and *Doras*), in having the opening of the mouth on the under side of the muzzle, in this respect approaching the genus *Synodontis*. The intermaxillaries are small and suspended beneath the muzzle, and the mandibles are transverse and not united; they are furnished with long and slender teeth, and these are flexible and terminate in a hook. The mouth is encircled by a large, circular, membranous veil; the pharyngeal bones are furnished with numerous teeth rounded like paving-stones. The true opercula are fixed as in *Aspredo*, but two small external plates, which are movable, appear to take their place. The branchiostegous rays are four in number. The first ray of the dorsal, pectoral, and anal fins is in the form of a strong spine.

This genus is subdivided into two subgenera. In the one (*Hypostomus*, Lacép.), there are two dorsal fins; the hinder one is small and provided with but one ray. The labial veil is covered with papillæ, and provided with a small barbule on each side. The belly is not protected by plates. The species are found in the rivers of South America. In the second subgenus, to which Lacépède restricts the term *Loricaria*, there is but one dorsal fin; the labial veil is furnished with several barbules, and sometimes beset with villosities; the belly is protected by plates. The species of this section are also found in South America.

SILVA Y FIGUERO'A, GARCIA DE, was born of illustrious parents at Badajoz, in 1574. At the age of fifteen his father sent him to court, where he entered the household of Philip II. as page. He then joined the Spanish army in Flanders, where he greatly distinguished himself, and obtained the command of a company. Having subsequently shown some talent for diplomacy, he was despatched by Philip III. on an embassy to Shah Abbás, king of Persia, who was willing to conclude a treaty of commerce with Spain. Silva embarked for Goa, where he arrived in 1614; but the governor of that place, who was a Portuguese, fearing lest Silva's mission should lead to an inquiry into the administration of the Spanish possessions in India, threw every impediment in his way, and refused to provide him with a vessel and money to prosecute his journey, as he was ordered to do. Impatient at the delay, Silva embarked on board a native vessel and sailed for Ormuz, which port he entered on the 12th of October, 1617. Thence he sailed to Bandel (Bender Abassi) in the dominions of the Shah, when he was well received. He reached Ispahán on the 18th of April, 1618, by the then usual route of Lar and Shiráz. After a short residence in the latter place, Silva started for Kazwín, or Casbin, where Shah Abbás was then holding his court, who received him with every mark of distinction, but would not hear his message until he had himself returned to Ispahán, where he directed Silva to wait till his arrival. Accordingly, after a stay of two months at Kazwín, the Spanish envoy returned to Ispahán, where Shah Abbás arrived shortly after, in July, 1619. He granted Silva an audience; but though he manifested a wish to conclude a commercial treaty, and to be upon friendly terms with Spain, the Shah refused to subscribe to two conditions stipulated by the ambassador of Philip III., namely, that he should restore some fortresses belonging to Ormuz, which he had lately seized; and that he should exclude all other European nations from trading with his dominions. The negotiations for the treaty being thus suspended, Silva left Ispahán on the 25th of August, 1619, and returned by the same route to Goa, where he landed in November, 1620. From Goa he sailed to Spain, where he died in 1628.

During his residence in Persia Silva wrote an itinerary of his travels, with an account of such events as came within his observation; and a sketch of the manners and customs of the inhabitants of that empire. This work was never printed in the original Spanish, though a French translation appeared in 1667, under the title of 'L'Ambassade de Don Garcias de Silva Figueroa en Perse, contenant la Politique de ce Grand Empire, les Mœurs du Roi Shah Abbas, et une relation exacte de tous les Lieux de la Perse et des Indes où cet Ambassadeur a été l'espace de huit anneés qu'il y a demeuré,' par M. Wicqfort, Paris, 1667, 4to. It is one of the best accounts of Persia that we possess, and is much commended by Chardin. During his residence in Goa Silva also made an abridgment of Spanish history, which appeared at Lisbon soon after his death: 'Breviarium Historiæ Hispanicæ,' Lisbon, 1628, 4to. A Latin letter of his, dated Ispahan, 1619, and addressed to the Marquis of Bedmar, in which he gave a short account of his travels, was also published at Antwerp: 'Garciæ Silva Figueroa, Philippi III. Hispaniarum Indiarumque Regis, ad Persarum Regem Legati, de Rebus Persarum Epistola,' Antw., 1620, 8vo.

SILVER, a metal which has been well known and highly valued from the remotest period—circumstances which are readily explained by the facts of its occurring frequently native, and possessing great lustre and fitness for immediate use without being subjected to any metallurgic process.

*Ores of Silver.*

*Native Silver.*—This occurs crystallized, arborescent, or dendritic, capillary, reticulated, granular, and massive. The primary form of the crystal is a cube. It has no cleavage Fracture hackly. Colour white, but externally often blackish, owing probably to the presence of a little sulphur. Hardness 2·5 to 3. Lustre metallic. Colour pure white, except when tarnished. Streak shining. Opaque. Specific gravity 10·47. Malleable, but commonly less so than pure silver, probably owing to an admixture of other metals. Soluble in nitric acid, and the solution colourless when pure, but blue if copper be present; and if antimony, a white substance, and if gold, a black one remains undissolved. Fuses into malleable globules before the blowpipe.

Native silver is met with in most parts of the world. in the British Isles, Germany, Hungary, in the north of Europe, but especially, and in largest quantity, in Mexico and South America. Silver occurs in mixture or combination with other metals, as already hinted at. The first compound of this nature we shall describe is

*Antimonial Silver. Stibiuret of Silver.*—This occurs in crystals, in grains, and massive.

Primary form of the crystal a right rhombic prism. Cleavage parallel to the terminal plane and short diagonal of the prism. Fracture uneven. Colour silver white, or, when tarnished, yellowish white. Streak silver white. Lustre metallic. Opaque. Slightly malleable. Easily frangible. Hardness 3·5. Specific gravity 9·44 to 9·8.

Before the blow-pipe on charcoal readily melts, with the formation of white antimonial vapour, into a greyish globule, which is not malleable, but eventually pure silver is obtained. It is not totally soluble in nitric acid, oxide of antimony remaining undissolved.

*The Massive Varieties* are amorphous, and have a granular or foliated structure.

Antimonial silver is found in clay-slate at Andreasberg in the Harz; in Baden; near Guadalcanal in Spain; at Salzburg; and at Allemont in France.

The Andreasberg mineral (1), analyzed by Vauquelin, and the Baden (2), by Klaproth, gave the annexed results:—

| | (1) | (2) |
|---|---|---|
| Silver | 78·0 | 84·76 |
| Antimony | 22·0 | 16·24 |
| | 100 | 100 |

*Telluric Silver* occurs in coarse-grained masses. Colour grey. Lustre metallic. Soft. Somewhat malleable. Specific gravity about 8·5. It is dissolved by nitric acid, and when heated, and before the blow-pipe, or charcoal, gives a fused blackish mass, containing specks of metallic silver.

It is found at the silver-mines of Savdinski, in the Altai Mountains, Siberia.

Analysis by Rose—

| | |
|---|---|
| Silver | 62·42 |
| Tellurium | 36·96 |
| Iron | ·24 |
| | 99·62 |

*Native Amalgam* is a compound of silver and mercury. [MERCURY.]

*Auriferous Native Silver* occurs crystallized in cubes, capillary, and disseminated. Colour yellowish white. Specific gravity 14·0 to 17·0. Different varieties gave the annexed results to

| | Fordyce. | Klaproth. | Boussingault. | | | |
|---|---|---|---|---|---|---|
| Silver | 72 | 34 | 15·5 | 17·6 | 26 | 35·07 |
| Gold | 28 | 64 | 84·5 | 82·4 | 74 | 64·93 |
| | 100 | 98 | 100· | 100· | 100 | 100· |

*Arsenical Antimonial Silver*, or rather *Arsenio-ferruginous Antimonial Silver.*—This substance occurs mammillated or in small globular and reniform masses, and sometimes investing other substances. When untarnished it is nearly silver white, but is commonly tarnished yellowish or blackish; its lustre is metallic. It is harder than antimonial silver, but is sectile and brittle. Specific gravity 9·4.

Before the blow-pipe antimony and arsenic are volatilized with the alliaceous smell, and a globule of impure silver remains. Its localities are nearly the same as those of antimonial silver. Klaproth obtained from a specimen from Andreasberg—

| | |
|---|---|
| Silver | 12·75 |
| Antimony | 4·00 |
| Iron | 44·25 |
| Arsenic | 35· |
| | 96 |

The native compounds of silver next to be described are those in which it occurs in combination with the non-metallic elements. It is not found simply combined with oxygen, nor at all with azote, hydrogen, or fluorine.

*Chloride of Silver. Horn Silver. Muriate of Silver. Laxmannite.*—This ore occurs crystallized and massive. Primary form of the crystal a cube. No cleavage. Fracture uneven. Hardness 1·0 to 1·5. Yields to the pressure of the nail. Streak shining. Specific gravity 4·75 to 5·55. Translucent. Opaque. Lustre resinous. Colour grey, yellowish, greenish, and blue of various shades. Malleable and sectile. Fusible in the flame of a candle. Heated with potash by the blow-pipe, yields a globule of metallic silver. Insoluble in nitric acid, but dissolved by ammonia. When rubbed with a piece of moistened zinc, the surface becomes covered with metallic silver.

This ore occurs in various parts of Europe and America, along with others of the same metal. The largest masses, which are of a greenish colour, are brought from Mexico and Peru. It is found in veins, chiefly in primitive rocks.

Two specimens from Peru (1) and from Saxony (2), analyzed by Klaproth, gave—

| | (1) | (2) |
|---|---|---|
| Chlorine | 24 | 21·50 |
| Silver | 76 | 67·75 |
| Oxide of Iron | — | 6·00 |
| Alumina | — | 1·75 |
| Sulphuric acid | — | 0·25 |
| | 100 | 97·25 |

*Buttermilk Silver. Earthy Corneous Silver.*—This is regarded as a variety of the foregoing. It is described as being of a brownish colour, with occasionally a tinge of green or blue. It is opaque, dull, with an earthy fracture, and is soft, sectile, and heavy. It occurs massive, and also investing other substances. It occurs only at Andreasberg in the Harz.

According to Klaproth, it is composed of—

| | |
|---|---|
| Chlorine | 8·28 |
| Silver | 24·64 |
| Alumina | 67·08 |
| | 100 |

*Iodide of Silver. Herreralite.*—Occurs massive in thin plates, which are silver or greyish white, and which become bluish by exposure to the air. Transparent. Translucent. Lustre resinous to adamantine; in thin laminæ flexible and malleable. Melts on charcoal before the blow-pipe, vapour of iodine being evolved, and globules of silver remaining. Found at Abarradon near Mazapil, in the state of Zacatecas, Mexico, in serpentine.

*Sulphuret of Silver. Vitreous Silver. Silver Glance. Henkelite.*—Occurs crystallized and massive. Primary form a cube. Fracture fine-grained and uneven; sometimes small and flat conchoidal. Colour lead-grey; blackish when tarnished. Lustre metallic. Opaque. Hardness 2·0 to 2·5. Malleable. Sectile. Specific gravity about 7·2.

When heated by the blow-pipe, sulphur is expelled and silver remains. It occurs in Saxony, Bohemia, and in great abundance in Mexico. It has been occasionally found in Cornwall, and in most silver-mines.

Analysis, (1) by Klaproth, of a specimen from Freiberg; (2) by Berzelius:—

| | (1) | (2) |
|---|---|---|
| Sulphur | 15 | 12·95 |
| Silver | 85 | 87·05 |
| | 100 | 100 |

*Black Sulphuret of Silver. Earthy Silver Glance.*—Derived from the decomposition of the last mentioned. Occurs massive and pulverulent. Fracture uneven. Colour dark lead-grey, inclining to black. Devoid of lustre, or only feebly glimmering. Somewhat sectile. Streak shining, metallic. It is found in Norway, Siberia, Hungary, &c., usually investing other silver-ores or filling up cavities in them.

*Sulphuret of Silver and Arsenic. Light Red Silver. Proustite.*—Primary form a rhomboid. Colour cochineal to aurora red; streak lighter. Lustre adamantine. Translucent to transparent. Specific gravity 5·5 to 5·6.

It is found at Joachimsthal, Johanngeorgenstadt, Annaberg, &c.

Rose's analysis (1) and Proust's (2) give the following as the composition of a specimen from Joachimsthal:—

| (1) | | (2) | |
|---|---|---|---|
| Sulphur | 19·51 | Sulphuret of Silver | 74·35 |
| Silver | 64·67 | Sulphuret of Arsenic | 25· |
| Arsenic | 15·09 | | |
| Antimony | 00·69 | | 99·25 |
| | 99·96 | | |

*Sulphuret of Silver and Antimony. Ruby Silver. Dark Red Silver. Braardite.*—Occurs crystallized and massive. Primary form a rhomboid. Cleavage parallel to the primary planes, usually indistinct. Fracture conchoidal. Colour, by reflected light, from lead-grey to iron-black; by transmitted light, from brilliant to dark red. Lustre adamantine. Translucent. Opaque. Hardness 2·0 to 2·5. Extremely brittle. Streak red. Specific gravity 5·8 to 5·9.

*Massive Varieties.*—Structure granular, compact, lamellar, dendritic, amorphous.

It is found in many parts of Europe and America, as Germany, Norway, Mexico and Peru, and also in Cornwall.

According to Bonsdorff, a specimen from Andreasberg yielded by analysis—

| | |
|---|---|
| Sulphur | 16·609 |
| Silver | 58·949 |
| Antimony | 22·846 |
| | 98·404 |

*Sulphuret of Silver and Antimony. Miargyrite.*—Occurs crystallized. Primary form an oblique rhombic prism. Cleavage imperfect. Fracture uneven. Colour iron-black in mass; but in thin fragments deep red by transmitted light. Nearly opaque. Lustre bright metallic. Hardness 2·0 to 2·5. Very sectile. Streak dark red. Surfaces of the crystals usually striated. Specific gravity 5·2 to 5·4.

It is found with argentiferous arsenical pyrites at Braunsdorft, near Freiberg, Saxony.

According to Rose, it yielded—

| | |
|---|---|
| Sulphur | 21·95 |
| Silver | 36·40 |
| Antimony | 39·14 |
| Copper | 1·06 |
| Iron | 0·62 |
| | 99·17 |

*Sulphuret of Silver and a little Iron. Biegsamer Silberglanz.*—Occurs crystalline and massive. Crystals small and tabular. Cleavage parallel to the terminal planes. Colour nearly black. Lustre metallic. Very soft. Readily separable into thin flexible laminæ.

Found only in Hungary and at Freiberg.

According to Wollaston, this mineral (which is extremely rare) consists of sulphuret of silver with a little iron.

*Sulphuret of Silver and Iron. Sternbergite. Flexible Sulphuret of Silver.*—Occurs crystallized. Primary form a right rhombic prism. Cleavage parallel to the terminal plane, distinct. Laminæ very flexible. Colour dark-brown, often with a blue tarnish. Streak black. Lustre metallic. Hardness 1·0 to 1·5. Specific gravity 4·2 to 4·25.

It is found at Johanngeorgenstadt, Schneeberg, and Joachimstahl in Bohemia, with other silver-ores.

A specimen from the last-mentioned locality yielded, according to the analysis of Zippe—

| | |
|---|---|
| Sulphur | 30 |
| Silver | 33·2 |
| Iron | 36· |
| | 99·2 |

*Brittle Sulphuret of Silver, Antimony, and Iron. Brittle Silver Glance.*—Occurs crystallized. Primary form a right rhombic prism. Crystals commonly macled. Fracture usually conchoidal, with a shining metallic lustre. Colour dark grey or iron-grey. Hardness 2·0 to 3. Specific gravity 5·9 to 6·4.

It is found in Saxony, Bohemia, Hungary, Siberia, and Mexico.

Analysis of a specimen from Frieberg by

| | Klaproth. | Rose. |
|---|---|---|
| Sulphur | 12 | 16·42 |
| Silver | 66·5 | 68·54 |
| Antimony | 10· | 14·68 |
| Iron | 5· | 0·00 |
| Copper | 0·5 | 0·64 |
| | 98·5 | 100·28 |

*Sulphuret of Silver and Copper. Silberkupferglanz.*—Occurs massive. Compact. Fracture brilliant, granular, flat conchoidal. Colour dark lead-grey. Streak shining. Lustre metallic. Opaque. Soft. Specific gravity 6·25.

Found at Schlangenberg, near Colivan in Siberia.

Analysis by Stromeyer:—

| | |
|---|---|
| Sulphur | 15·96 |
| Silver | 52·87 |
| Copper | 30·83 |
| Iron | 00·34 |
| | 100 |

*Sulphuret of Silver, Antimony, and Copper. Romelite. Mine d'Argent grise Antimoniale.*—Occurs crystallized. Primary form a right rhombic prism. Cleavage parallel to the lateral planes. Colour nearly silver-white. Lustre shining. metallic. Opaque. Hardness 2 to 2·5. Extremely brittle. Specific gravity 5·5 to 5·6.

It consists principally of sulphur and the metals above named, but in proportions not yet determined.

*Sulphuret of Silver, Arsenic, Antimony, and Copper. Polybasite. Brittle Silver.*—Occurs crystallized. Primary form a right rhombic prism. Cleavage imperfect. Fracture uneven. Colour iron-black. Lustre metallic. Translucent. Opaque. Hardness 2·0 to 2·5. Specific gravity 6·269.

Occurs in Bohemia, Saxony, and other parts of Europe; and in Mexico and Peru.

Analysis (1) of a specimen from Mexico by Rose, and (2) from Freiberg by Brandes:—

| | (1) | (2) |
|---|---|---|
| Sulphur | 17·04 | 19·40 |
| Silver | 64·29 | 65·50 |
| Arsenic | 3·74 | 3·30 |
| Antimony | 5·09 | 0·00 |
| Copper | 9·93 | 3·75 |
| Iron | 0·06 | 5·46 |
| | 100·15 | 97·41 |

*Sulphuret of Silver, Iron, Copper, Bismuth, and Lead. Bismuthic Silver.*—Occurs in acicular crystals and massive. Fracture uneven. Colour, when first broken, lead-grey, but liable to tarnish.

*Massive Varieties* disseminated, amorphous. Fracture fine-grained, uneven. Lustre metallic. Opaque. Soft. Sectile and brittle.

It is found accompanying pyrites and galena at Schappach in the valley of Kinzig, Baden.

Analysis by Klaproth:—

| | |
|---|---|
| Sulphur | 16·3 |
| Silver | 15·0 |
| Iron | 4·3 |
| Copper | 0·9 |
| Bismuth | 27· |
| Lead | 33· |
| | 96·5 |

*Seleniuret of Silver. Selensilver.*—Occurs crystallized. Primary form a cube. Occurs in thin plates. Hardness between gypsum and calcspar. Flexible. Specific gravity 8·0. Colour iron-black; streak the same, but brighter. Occurs at Tilkerode in the Harz, associated with seleniuret of lead.

Analysis by G. Rose:—

| | |
|---|---|
| Selenium | 24·05 |
| Silver | 65·56 |
| Seleniuret of lead, with a little iron | 6·79 |
| | 96·40 |

*Seleniuret of Silver and Copper. Eukairite.*—Occurs massive. Structure granular. Colour grey. Lustre shining. Disposed in films on calcareous spar.

Found in a copper-mine at Skrickerum in Smaland, Sweden.

Analysis by Berzelius:—

| | |
|---|---|
| Selenium | 26· |
| Silver | 38·93 |
| Copper | 23·05 |
| Earthy matter | 8·90 |
| Carbonic acid and loss | 3·12 |
| | 100. |

*Carbonate of Silver and Antimony. Selbite.*—Occurs massive and disseminated. Fracture uneven. Colour greyish-black. Structure fine granular. Lustre metallic. Opaque. Soft. Brittle. Heavy.

Found at Altwolfach in the Black Forest.

Analysis by Selb:—

| | |
|---|---|
| Carbonic acid | 12 |
| Silver | 72·6 |
| Oxide of antimony and a trace of copper | 15·5 |
| | 100·1 |

This analysis cannot however be correct, if the ore contain carbonate of silver.

*Arseniate of Silver and Iron. Gansekothig-erz; Goosedung Silver-ore.*—Occurs massive. Mammillated. Fracture conchoidal; sometimes earthy, and mixed with cobaltore. Colour yellow or pale green. Streak white. Lustre resinous.

Found chiefly in the mines of Clausthal in the Harz; and also in Cornwall, and at Allemont in France.

It does not appear to have been accurately analyzed.

Having now mentioned the principal minerals which contain silver, it is to be observed that few of them are largely worked as ores: the principal are native silver, chloride of silver, and sulphuret of silver. The first, when the quantity is considerable, is separable by mere fusion; the chloride and the sulphuret are obtained by amalgamation with mercury; the sulphuret being first converted into a chloride by treatment with common salt, &c. A considerable quantity of silver is also procured from the lead-ore of this country by cupellation.

*Properties of Silver.*

The properties of silver are, that it has a purer white colour than any other metal; it has great brilliancy, and is susceptible of a very high polish. Its specific gravity is about 10·4 when cast, and 10·5 to 10·6 when stamped or rolled. It is sufficiently soft to be cut with a knife. It is very malleable and ductile, so that it may be beaten into leaves about 1-10,000th of an inch in thickness, and drawn into wire much finer than a human hair. It does not rust or oxidize by exposure to the air, but when the air contains sulphureous vapours it tarnishes, becoming first yellowish and afterwards black. Three metals only, viz. iron, copper, and platinum, exceed silver in tenacity; a wire 0·787 of a line in diameter supports rather more than 187 pounds without breaking. When exposed to a bright red heat silver melts, which, according to Daniell, is equivalent to 1873° of Fahrenheit; on fusion its appearance is extremely brilliant, and during this it absorbs oxygen from the air to the amount of about 22 times its volume, and this it gives out either by cooling or by being poured into water. When leaf-silver or fine silver-wire is heated by voltaic electricity, it burns with a fine green flame; if intensely heated in the open fire, it boils, and a portion is vaporized.

*Oxygen and Silver* combine to form three compounds, viz. suboxide, protoxide, and peroxide.

*Protoxide of Silver* is prepared by oxidizing and dissolving the metal in dilute nitric acid; when lime or barytes water, or solution of potash or soda, is added to the solution of nitrate of silver, a precipitate is formed, which is the protoxide of silver, composed of

| | |
|---|---|
| One equivalent of oxgyen . . | 8 |
| One equivalent of silver . | 108 |
| Equivalent . | 116 |

The properties of this oxide are, that it is of a brownish colour, inodorous, tastless, very slightly if at all soluble in water; it is decomposed by the action of light, being reduced to metallic silver and oxygen gas, and the same effect is produced by heat. It is insoluble in the alkalis or alkaline earths in general, but is rapidly and largely dissolved by ammonia. Nitric, acetic, sulphuric, and some other acids combine with it readily, but it is decomposed by hydrochloric acid, the results being chloride of silver and water. It gives a yellow colour to glass and porcelain. This is the oxide which is the basis of all the common salts of silver.

*Suboxide of Silver* was first procured by Faraday, by the partial decomposition of the protoxide; when the ammoniacal solution of this is exposed to the air, its surface becomes covered with a pellicle or dark film, which is the suboxide in question; it is probably owing to the decomposition of a portion of the ammonia, which in this case yields hydrogen to a part of the oxygen of the protoxide of silver.

According to Wöhler, it may be obtained also by subjecting citrate of silver to a temperature of 212°.

Suboxide of silver appears to be a di-oxide, composed of—

| | |
|---|---|
| One equivalent of oxygen . . | 8 |
| Two equivalents of silver . . | 216 |
| Equivalent . | 224 |

It does not readily, if at all, form salts with acids.

*Peroxide of Silver* has been stated to be obtained by electrizing a weak solution of silver. It separates at the positive pole in the state of minute acicular crystals.

Sulphuric and phosphoric acid decompose it with formation of respective salts of the protoxide, and by ammonia it is acted upon and decomposed with great energy.

It appears to be a binoxide, composed of

| | |
|---|---|
| Two equivalents of oxygen . | 16 |
| One equivalent of silver . . | 108 |
| Equivalent . | 124 |

*Chlorine and Silver* readily combine, and the compound, as already mentioned, forms one of ore of silver.

It may be artificially formed in several ways, first by heating the metal in a finely divided state in the gas, or by adding any soluble chloride, as common salt, to nitrate or any soluble salt of silver, except the hyposulphite.

When recently precipitated, or if kept from the action of light, chloride of silver is perfectly white, but by exposure to daylight it becomes slowly bluish-white, and eventually almost black. The direct rays of the sun produce this effect almost instantaneously; on this property is founded its use in photozenic drawing: the exact nature of the change which takes place does not appear to have been satisfactorily determined. This chloride is quite insoluble in water, either cold or hot; the stronger acids take it up sparingly, and it is precipitated from them by dilution; it is dissolved however to some extent by hyposulphurous acid, and readily and largely by ammonia. It is decomposed by hydrosulphuric acids, and soluble sulphurets, which immediately blacken it by converting it into sulphuret of silver; it is also decomposed by hydrogen gas, and by iron and zinc when put into contact with it and water. By mere heat it undergoes no change except fusion, and when it has solidified on cooling, it has the appearance of horn; hence the name of *horn silver* for the native chloride.

It is composed of—

| | |
|---|---|
| One equivalent of chlorine . . | 36 |
| One equivalent of silver . | 108 |
| Equivalent · | 144 |

Chloride of silver is largely and advantageously used both in qualitative and quantitative analyses, to determine the presence and quantity of chlorine, chlorides, and hydrochlorates.

*Fluorine and Silver* may be combined to form fluoride of silver. It is an uncrystallizable soluble compound; when heated it fuses; and at a higher temperature and exposed to the air it is slowly reduced.

It is composed of

| | |
|---|---|
| One equivalent of fluorine . . | 18 |
| One equivalent of silver . . | 108 |
| Equivalent . | 126 |

*Sulphur and Silver* form sulphuret of silver; this compound has been already noticed as existing in nature and constituting the *vitreous silver-ore*. It may be prepared by direct action, as by heating alternate layers of silver and sulphur; thus obtained, it is a soft malleable dark-coloured compound; it may be procured also by decomposing solution of nitrate or of ammoniuret of silver by hydrosulphuric acid, hydrosulphates, or soluble sulphurets. It is insoluble in water, ammonia, or other alkalis or acids, except nitric acid, which decomposes and is decomposed by it with the formation of sulphate of silver.

It is composed of—

| | |
|---|---|
| One equivalent of sulphur . | 16 |
| One equivalent of silver . . | 108 |
| Equivalent . | 124 |

*Phosphorus and Silver.*—The sesubstances combine when heated together; and form a white brittle compound; when fused and exposed to the air, it loses phosphorus. It may be formed either by projecting phosphorus on red-hot silver, or by heating a mixture of silver filings, phosphoric acid, and charcoal.

It is composed of

| | |
|---|---|
| One equivalent of phosphorus . | 16 |
| One equivalent of silver . . | 108 |
| Equivalent . | 124 |

*Iodine and Silver* readily combine when hydriodic acid or iodide of potassium is added to a solution of nitrate of silver. The iodide of silver formed is precipitated of a greenish-yellow colour: it is insoluble in water or ammonia, and decomposed when heated with potash; when fused, it acquires a red colour, and is discoloured by light; in the invention of the Daguerreotype, a film of this compound, on the surface of a polished plate of silver, is the substance that receives the impressions of light. It is decomposed by concentrated nitric or sulphuric acid.

It is composed of

| | |
|---|---|
| One equivalent of iodine . | 126 |
| One equivalent of silver . . | 108 |
| Equivalent . | 234 |

The compounds containing oxide of silver consist of the ammoniuret and the oxisalts of silver: we shall first mention the

*Ammoniuret of Silver.*—Protoxide of silver dissolves with great readiness in ammonia, and by careful operation the substance discovered by Berthollet, and called *fulminating silver*, is obtained. It should be prepared only in very small quantity at a time, on account of the facility and violence with which it explodes; in exploding it forms water, sets free azotic gas, and metallic silver, remains; it is procured by adding a small quantity of solution of ammonia to oxide of silver; a portion is dissolved, and a black powder, which is the fulminating ammoniuret of silver remains; it may be also formed by adding solution of potash from the ammonio-nitrate of silver; a very gentle heat or slight friction causes it to explode, sometimes even before it is dry. Its exact composition has not been determined.

We come now to the compounds of the oxacids and oxide of silver, or the oxisalts of silver; it is the protoxide only which enters into combination with acids; at least they are the only well known compounds. The first we shall mention is

*Nitrate of Silver.*—This is one of the most important salts of silver. It is generally prepared by adding the metal to the diluted acid, in which case the silver is oxidized by decomposing a portion of the nitric acid, and that which remains undecomposed dissolves the oxide formed. It may also be prepared, but less advantageously, by dissolving the protoxide of silver in the dilute acid; in this case no nitric oxide is evolved, for no nitric acid is decomposed. The solution is colourless, and by evaporation colourless crystals are readily obtained, the primary form of which is a right rhombic prism. Nitrate of silver has a bitter metallic taste, is soluble in about its own weight of water at 60°, and in half its weight of boiling water; the solution is neutral to litmus-paper. Cold alcohol dissolves only a little of this salt, but when boiling takes up a considerable quantity of it, the greater part of which separates on cooling.

By the action of light, especially when in contact with organic matter, nitrate of silver is rendered of a dark colour, and is then insoluble in water. When moderately heated, nitrate of silver fuses, and being then cast in a mould in small cylindrical sticks, it constitutes the argenti nitras of the Pharmacopœia, commonly called *lunar caustic;* if the heat applied be too great, the salt is decomposed, oxide of silver being left, which, if still more strongly heated, gives metallic silver. When sulphur, phosphorus, or charcoal is mixed with nitrate of silver, and struck on an anvil, detonation ensues, and metallic silver is obtained; the experiment should be made on very small quantities. Nitrate of silver is decomposed by simply placing charcoal or phosphorus in its solution, metallic silver being deposited in the crystalline state; the same effect is produced by several metals, and more especially copper, which is used in silver-refining for precipitating the silver from the nitrate in a pure state.

*Chlorate of Silver* may be obtained by dissolving protoxide of silver in chloric acid; the solution yields small rhombic crystals, which are soluble in four parts of water at 60°. This salt is not applied to any use.

Nitrate of silver is decomposed by sulphuric and phosphoric acids, and their soluble salts, sulphate and phosphate of silver, are thrown down. Potash and soda and the alkaline earths precipitate protoxide of silver; ammonia produces the same effect, but when added in excess, redissolves the oxide at first precipitated. Hydrosulphuric acid, hydrosulphates, and soluble sulphurets occasion the formation and precipitation of black sulphuret of silver.

Chlorine partially, and soluble chlorides and hydrochloric acid and hydrochlorates, perfectly, decompose nitrate of silver, chloride of silver being precipitated. It is on this account that nitrate of silver is employed, and with great accuracy, in both qualitative and quantitative analyses.

Nitrate of silver is composed of

| | |
|---|---|
| One equivalent of nitric acid . | 54 |
| One equivalent of protoxide of silver | 116 |
| Equivalent . | 170 |

Besides the uses already named, nitrate of silver is employed by precipitation with carbonate of soda, &c. for writing on linen; it is commonly called indelible ink.

*Carbonate of Silver* is prepared by adding a solution of carbonate of potash, or of soda, to one of nitrate of silver. It is a white substance, insoluble in water, but dissolved by ammonia, and decomposed by acids; it is blackened by exposure to light, and readily decomposed by heat. It is probably composed of

| | |
|---|---|
| One equivalent of carbonic acid . | 22 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . | 138 |

*Sulphate of Silver.*—This salt may be formed by boiling finely divided silver in strong sulphuric acid, by dissolving the protoxide in dilute sulphuric acid, or by adding a solution of sulphate of soda to one of nitrate of silver, when it is thrown down as a crystalline precipitate.

Sulphate of silver is a colourless salt, soluble in about 90 parts of water at 60°; a saturated boiling solution deposits crystals on cooling, which are prismatic and anhydrous; when strongly heated, the acid is expelled, and metallic silver remains. It is sometimes employed as a chemical re-agent, and is composed of

| | |
|---|---|
| One equivalent of sulphuric acid . | 40 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . | 156 |

It is decomposed by chlorides and sulphurets, in the same manner as the nitrate of silver.

*Sulphite of Silver* may be obtained by adding sulphite of potash to a solution of nitrate of silver, or by digesting oxide of silver in a solution of the acid. It has the form of crystalline grains, and, unlike most other salts of silver, is stated to retain its whiteness when exposed to light. It is composed of

| | |
|---|---|
| One equivalent of sulphurous acid . | 32 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . . | 148 |

*Hyposulphate of Silver* is prepared by digesting carbonate of silver in hyposulphuric acid. It crystallizes in prisms.

*Hyposulphite of Silver.*—It is obtained by gradually adding a weak solution of nitrate of silver to a dilute one of hyposulphite of soda. It is a precipitate of a grey colour, and the supernatant liquor is stated by Herschel, who has particularly examined this salt, to be remarkably sweet, without any metallic flavour. It is also formed when chloride of silver is dissolved in a hyposulphite. This salt is very liable to spontaneous decomposition, and becomes black owing to the formation of sulphuret of silver. The hyposulphites have been advantageously employed in removing of the unchanged salt of silver in photogenic drawings. Hyposulphite of silver is composed of

| | |
|---|---|
| One equivalent of hyposulphurous acid | 48 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . . | 164 |

*Phosphate of Silver.*—This is prepared by adding a solution of the common neutral phosphate of soda to one of nitrate of silver; a yellow precipitate is formed, which is quickly discoloured by exposure to light; becomes brown when heated, but regains its yellow tint on cooling; and when strongly heated, it melts. It is soluble in nitric and phosphoric acid. It is a subsesquiphosphate, composed of

| | |
|---|---|
| 1 equivalent of phosphoric acid . | 36 |
| 1½ equivalent of oxide of silver . | 174 |
| Equivalent . . | 210 |

*Pyrophosphate of Silver* is obtained by heating neutral phosphate of soda so as to expel its water, and adding a solution of it to one of nitrate of silver. This precipitate is of a white colour. Like the preceding, it is composed of one equivalent each of acid and base.

We shall mention the properties of a few of the salts formed by the combination of the vegetable acids with oxide of silver.

*Acetate of Silver.*—It may be prepared by dissolving oxide of silver in acetic acid, or, as it is a salt of slight solubility, in water, by decomposing nitrate of silver with acetate of soda, when it is thrown down as a crystalline flocculent precipitate. It is a colourless salt, sparingly soluble in water, and decomposed at a red heat. It is occasionally used as a chemical re-agent. It consists of

| | |
|---|---|
| One equivalent of acetic acid . | 51 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . . | 167 |

*Benzoate of Silver* may be obtained either by digesting moist oxide of silver in a solution of benzoic acid, or by adding a benzoate to it. It is a white anhydrous compound.

*Citrate of Silver* is formed by adding a citrate to nitrate of silver. It is an insoluble white powder, which blackens by exposure to light, and detonates slightly when heated. It is composed of

| | |
|---|---|
| One equivalent of citric acid . | 56 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . . | 172 |

*Oxalate of Silver* is precipitated when oxalic acid or an oxalate is added to nitrate of silver. It is insoluble in water, white, and rendered black by exposure to light. It detonates slightly when struck on an anvil. It is soluble in nitric acid, and decomposed by hydrochloric acid. It is probably composed of

| | |
|---|---|
| One equivalent of oxalic acid . . | 36 |
| One equivalent of oxide of silver . | 116 |
| Equivalent . . | 152 |

*Cyanide of Silver* is prepared by adding hydrocyanic acid to a solution of nitrate of silver; the hydrogen of the acid uniting with the oxygen of the oxide of silver, water is formed, and the cyanogen and silver combine, and form cyanide of silver, which is precipitated. It is colourless, insoluble in water or solution of potash or soda, but readily taken up by ammonia. Nitric and sulphuric acid act but slightly upon it, unless concentrated and heated; hydrochloric acid decomposes it, and hydrocyanic acid and chloride of silver result, and this is one of the methods of procuring the last-mentioned acid, adopted in the London Pharmacopœia. It is decomposed by hydrosulphuric acid, by which sulphuret of silver and hydrocyanic acid are obtained. It is composed of

| | |
|---|---|
| One equivalent of cyanogen | 26 |
| One equivalent of silver | 108 |
| Equivalent | 134 |

*Ferrocyanide of Silver* is obtained when ferrocyanide of potassium is added to nitrate of silver. It is a white insoluble substance.

*Cyanate of Silver* is formed when cyanate of potash is added to nitrate of silver. It is a white powder, slightly soluble in hot water, and also in ammonia. It blackens when heated, and burns with deflagration, and there are produced di cyanide of silver, cyanic acid, carbonic acid, and azotic gas.

*Fulminate of Silver. Fulminating Silver.*—This very explosive compound is formed by dissolving 60 grains of silver in half an ounce of nitric acid of specific gravity 1·38; to the solution are to be added two ounces of alcohol of specific gravity 0·88, and the mixture is to be heated in a capacious flask; a white flocculent precipitate soon begins to appear, and when ebullition commences, the flask is to be removed from the heat; the effervescence still continues, and when it has ceased, the product is to be collected on a filter, washed with cold water, and dried at a temperature not exceeding 100° Fahrenheit.

Fulminate of silver is a greyish-white crystalline powder. It becomes darker by exposure to light; it dissolves in about 40 parts of boiling water, and separates, as the solution cools, in minute crystals. In the quantity even of a half grain it detonates violently, either by the action of heat, electricity, strong sulphuric acid, or friction. When placed on one flint, and slightly touched with another, explosion also takes place. It has been known to detonate with great violence when a little has remained between a stopper and the neck of a bottle, on screwing in the stopper. It should be preserved therefore in small portions, in paper, in a wide-mouthed corked vial. It is composed of

| | |
|---|---|
| One equivalent of fulminic acid | 68 |
| Two equivalents of oxide of silver | 232 |
| Equivalent | 300 |

*Alloys of Silver.*—Little or nothing is known respecting the alloys of silver with the following metals:—Potassium, sodium, and the metals of the alkaline earths; manganese, cadmium, nickel, uranium, tellurium, titanium, cerium, chromium, and vanadium.

Iron and silver combine with difficulty. They separate on cooling, the iron retaining about one-eightieth of silver, and the silver about one-thirtieth of iron. According to Faraday and Stodart, steel containing about one five-hundredth of silver forms a good alloy for cutting instruments. Iron and silver form a bluish-white granular alloy; tin and silver, a white, hard, brittle alloy. When cobalt and silver are fused together, they separate during cooling, each retaining a portion of the other. Lead and silver give a dull brittle alloy; antimony and silver, a white brittle alloy; arsenic and silver form a grey, brittle, granular compound, containing about 14 per cent. of the former metal. Bismuth and silver give a yellowish-white, brittle, lamellar alloy; molybdenum forms a compact, brittle, grey, granular compound with silver; and tungsten, a brown, slightly malleable button; copper and silver readily combine, and the silver is rendered harder by it without much deterioration of colour; the standard silver of this country is composed of 11·10 silver and 0·90 copper. Mercury and silver amalgamate readily, and this compound is sometimes employed for plating, but this operation is now being most advantageously carried on by precipitation by means of voltaic electricity.

*Properties of the Salts of Silver.*—The solutions of the salts of silver are recognised by the following, among other properties which have been occasionally mentioned:—

They give a white precipitate, insoluble in water or in dilute acids, but readily in ammonia, by chlorides and hydrochlorates; the precipitate becomes black by exposure to the light.

Metallic silver is precipitated by copper and the solution of protosulphate of iron; black sulphuret, by hydrosulphuric acid and hydrosulphates. A yellow precipitate by arsenious acid and phosphate of soda; a red-brown, by arseniates; a crimson, by chromates; and white, by the ferrocyanide of potassium.

With respect to the uses of silver it is scarcely requisite to say anything, as they are well known in its application to coin and the formation of vessels of great beauty and durability.

SILVER, PRODUCTION AND CONSUMPTION. Silver-ores are found chiefly in veins which traverse the primary and the older of the secondary stratified rocks, but especially the former; and also the unstratified rocks, such as granite and porphyry, which are associated with the above. Some of the richest mines in South America are situated in primary strata; also in limestone and in grauwacke, and in still more secondary strata. In some of the mines of Peru, and in those of Kongsberg in Norway and Freiburg in Saxony, silver has been discovered in masses weighing from 100 to 800 lbs. In the mines of Europe the veins are numerous and slender; in some of the mines in the Harz Mountains and in the Hungarian mines the veins occur in a small number of spots, and are of considerable dimensions. In three of the richest districts of Mexico there is only one principal vein, which is worked in different places. One of these veins, in the district of Guanaxuato, is from 130 to 148 feet wide, and it has been traced and worked to an extent of nearly eight miles.

In Mexico there were 500 mining establishments, called *Reales*, at the time of Humboldt's visit, and from 3000 to 4000 veins or masses were worked. The most common ores are the sulphuret of silver, antimonial silver, and muriate of silver.

The average richness of all the ores in Mexico is from 3 to 4 ounces per quintal of 102 lbs. In one of the Mexican mines a working of one hundred feet in length yielded in six months 432,274 lbs. troy of silver, equal in value to about 1,000,000*l.* In Chili some of the mines yield only 8 oz. in 5000 lbs. of ore; but in the rich mine of Copiapo, discovered in 1832, the ore frequently contains 60 or 70 per cent. of silver. The average produce of the mines in Saxony is from three to four ounces in the quintal. The lead-mines of Craven in Yorkshire contained 230 ounces per ton; and those of Cardiganshire, worked in the reign of Charles I., yielded 80 ounces. The average proportion of the lead-mines of the north of England is 12 ounces per ton. Even when the proportion of silver is so low as eight ounces, or one grain per ¼ lb., it has been found profitable to separate it.

The pure metal is separated from the ore by various processes; by mechanical division, roastings to separate the sulphur and other volatile matter, and melting at different stages of purification, with the addition of fluxes of various sorts. Refining is performed by amalgamation with quicksilver, the two metals being afterwards separated by distilling off the quicksilver.

The produce of the Mexican mines averaged annually 4,800,000*l.* from 1793 to 1803, of which nineteen-twentieths were silver. In the first ten years of the present century the average annual value was about 5,000,000*l.*, the quantity of pure silver annually produced in that time being 1,440,650 troy lbs. The mines of Potosi in Peru are the most famous in South America. [POTOSI.] The produce of the Chilian mines in 1832 was about 1,000,000 ounces. At the commencement of the present century Humboldt estimated the annual produce of the silver-mines of Chili, Peru, Buenos Ayres, and New Grenada, at nearly 700,000 lbs. troy, valued at 2,074,476*l.* sterling.

The annual average of both gold and silver coined in the different mints of Spanish America was estimated, in 1810, at 8 millions sterling, namely, in Mexico 24 millions of dollars; Lima, 6 millions; Potosi, 4½ millions; Santa Fé and Santiago, each 1¼ million; and Popayan and Guatemala, nearly 1 million. The proportion of silver to gold coined at all these mints was stated as 30 to 1; but the proportion of silver to gold produced from all the American mines was as 62 to 1; and from the mines of all countries as 52 to 1. In a work published at Paris in 1807 by M. Brongniart, the value of the gold and silver brought annually into circulation from all parts of the world was estimated at nearly 46 millions of dollars; of which 36 were from the mines of Spanish America, 4½ from those of Portuguese America, and 5½ from the mines of the Old World. (*Report of Bullion Committee*, 1810.)

The most productive mines in Europe are those in Saxony, Austria, Hungary, Norway, Russia, and Spain. The mines in Saxony have been worked since the tenth century. The average annual produce of all the European mines in the last twenty years of the eighteenth century did not exceed 600,000*l.* in value. In the early part of the thirteenth century the mines of Schneeberg in Saxony are said to have yielded 600,000*l.* annually; but taking the average of all the mines of late years, the annual produce does not, according to the estimate of Mr. Jacob, exceed 400,000 lbs., or 100,000*l.* in value. The mines of Chemnitz and Kremnitz in Hungary have been worked about a thousand years. Those of the Tyrol have long ceased to be productive. The mine of Kongsberg in Norway was probably the richest in Europe during the middle of the last century. It yielded 649,270 lbs. troy, value nearly 2,000,000*l.*, in the forty years from 1728 to 1768. The silver of Russia is obtained from the refining of stream gold found in the Ural Mountains, and from lead-ores. Silver-mines were worked in Spain from a very early period by the Phœnicians, Carthaginians, Romans, and Moors; but they are now abandoned as unprofitable.

Native silver and several of the other varieties of the ores are met with in some of the Cornish copper-mines, and silver is extracted from the ore of English lead; but with these exceptions, and very small quantities which are occasionally found of this metal, silver cannot be considered as constituting one of the mineral treasures of the United Kingdom. A vein of silver-ore and the sulphuret was worked in Stirlingshire during the latter part of the last century, and from 40,000*l.* to 50,000*l.* were obtained, when the vein was lost. In 1607 a silver-mine was worked in Linlithgowshire.

The silver-mines of Asia have ceased to be very productive in modern times. There are mines in Armenia, but none are known to exist in Persia, nor in any part of the East India Company's possessions. Silver-mines are worked in China; and Mr. Davis remarks (*Chinese*) that the great quantities of silver brought to Lintin for many years past, to be exchanged for opium and exported to India, prove that there must be abundant sources in the empire. Silver is not obtained in any part of Africa.

Gold and silver appear to have been in request from the earliest ages. Abraham was rich in silver and in gold. He bought a field for a burial-place, for which he paid 400 shekels of silver, delivered 'by weight, according to the currency of the merchants.' (*Genesis*, xxii., 14-16.) Joseph, his great-grandson, was sold by his brethren for twenty pieces of silver (*Genesis*, xxxviii., 29); and when aftewards they went to Egypt to purchase corn, they brought 'silver in their sacks' mouth.' (*Genesis*, xlv., 22.) In the book of Job (xlii., 11-12), we read of silver passing from hand to hand as money. The writer of that book was acquainted with the fact that silver was found in veins and gold in particles, though the country in which he lived did not produce the precious metals. It is said (1 *Kings*, x.) that in the days of Solomon silver was nothing accounted of, and that 'the king made silver to be as stones in Jerusalem.' Darius Hystaspes, king of Persia, annually collected 9880 talents of silver, besides gold, as tribute from Asia and Africa; subsequently tribute came in also from the islands of the Mediterranean and from Europe as far west as Thessaly. Herodotus states (iii. 96) that the gold and silver were melted and poured into earthen vessels, and that the earthen vessels were then removed, which left the metal in a solid mass: when any was wanted, a piece was broken off as the occasion required. Silver was coined at Rome 266 B.C., before gold had been so employed. [COIN.]

For further information on the production and uses of the precious metals, the reader may refer to Mr. Jacob's elaborate 'History of the Consumption of the Precious Metals,' 2 vols. (1831). Chapter ii. contains an account of the mines of the antients, and their modes of mining and smelting. Chapter x. is an inquiry into the production of the precious metals during the middle ages, from the dissolution of the Western Empire to the discovery of America. Another chapter is on the produce of the mines at the epoch of this discovery; also one from this period to the opening of the mines of Potosi, in 1564; and two other chapters, one on the produce of gold and silver from 1700 to 1809, and the other extending the inquiry from 1809 to 1829, complete this part of the subject. The investigations of Humboldt, and the personal inquiries of Mr. H. G. Ward (*Mexico in* 1827), with the scattered notices of other writers, are collected and arranged by Mr. Jacob, whose work must always be valuable for reference in all questions relating to the history of prices. Several chapters of the work are devoted to this topic in connection with the increased supply of the precious metals after the discovery of America, and the rise of prices which occurred in Europe in the sixteenth century. The gold and silver coin in Europe, in 1492, Mr. Jacob estimates at 34,000,000*l.*, which was increased in the course of the next 112 years by 138,000,000*l.*, making the total gold and silver currency in 1599, allowing for abrasion, &c., 172,000,000*l.* In book i., chapter xi., of the 'Wealth of Nations,' there is a 'Digression concerning the Variations in the Value of Silver during the course of the Four last Centuries.'

The proportional value of gold to silver was 12 and 10 to 1 from the Anglo-Saxon times to the discovery of America: it is at present 14·28 to 1. In antient Greece the proportion varied from 15 and 10 to 1, and in Rome from 12 and 7 to 1. Herodotus (iii. 95) estimates it at 13 to 1. Since the discovery of America the proportion throughout the world has been 17 and 14 to 1. (Kelly's *Cambist.*)

Mr. Jacob gives the amount of silver coined in each reign from the time of James I.:—

| | | £ |
|---|---|---|
| James I. . . | (22 years) | 1,807,277 |
| Charles I. and the Commonwealth . | (35 years) | 9,776,544 |
| Charles II. . . | (22 years) | 3,722,180 |
| James II. . . | ( 4 years) | 2,115,115* |
| William and Mary, and William III. | (12 years) | 7,093,074 |
| Anne . . . | (13 years) | 618,212 |
| George I. . . | (13 years) | 233,045 |
| George II. . . | (33 years) | 304,360 |
| George III. from 1760 to 1809 . | (49 years) | 63,419 |
| 1809 to 1820 . | (11 years) | 6,933,346 |

The last new silver coinage for the United Kingdom was commenced in 1816, since which time the quantity of silver coined in each year has been as follows:—

| Years. | Amount Coined. | Years. | Amount Coined. |
|---|---|---|---|
| 1816 | £ 1,805,251 | 1829 | 108,259 |
| 1817 | 2,436,297 | 1830 | 151 |
| 1818 | 576,279 | 1831 | 33,696 |
| 1819 | 1,672,272 | 1832 | 145 |
| 1820 | 847,717 | 1833 | 145 |
| 1821 | 433,686 | 1834 | 432,775 |
| 1822 | 31,430 | 1835 | 146,665 |
| 1823 | 285,271 | 1836 | 497,719 |
| 1824 | 282,070 | 1837 | 75,385 |
| 1825 | 417,535 | 1838 | 174,042 |
| 1826 | 608,605 | 1839 | 390,654 |
| 1827 | 33,019 | 1840 | 207,900 |
| 1828 | 16,288 | | |
| | | Total | £ 11,108,265 |

The weight of silver coined, and the number and denomination of each coin issued from 1816 to 1840 inclusive, were as follows, according to a parliamentary paper (*Sess.* 1841):—

| | Weight. lbs. | Number. | Value. £ |
|---|---|---|---|
| Crowns . | 140,144 | 1,849,905 | 462,476 |
| Half-crowns . | 1,190,876 | 31,438,434 | 3,929,804 |
| Shillings . | 1,540,080 | 101,645,280 | 5,082,264 |
| Sixpences . | 441,852 | 58,324,595 | 1,458,114 |
| Fourpences . | 52,140 | 10,325,320 | 177,062 |
| Maunday money:— | | | |
| Fourpences . | 306 | 60,720 | 1,012 |
| Threepences . | 270 | 71,368 | 892 |
| Twopences . | 225 | 89,100 | 742 |
| Pence . | 272 | 215,424 | 897 |

The seignorage, or the difference between the price at which bullion is purchased and the mint price of the coin at 5*s.* 6*d.* an ounce, amounted to 616,747*l.* on the above. The Maunday money is coined for the purpose of being distributed by the Lord Almoner in Whitehall Chapel on Maunday Thursday.

When silver is issued for coin, it is always alloyed with

* Including £1,596,799 base money coined for Ireland.

copper: the maximum of hardness is produced by one-fifth of copper. One lb. of standard silver of the English coinage contains 11 oz. 2 dwts. of pure silver and 18 dwts. alloy, or 925 parts of pure silver in 1000 parts of standard silver. [MONEY.] For purposes connected with the manufacture of various articles of use and ornament the alloy is greater. At Birmingham rolled sheets are made which do not contain more than 3 or 4 dwts. of silver to each lb. of the inferior metal

The rolling of silver in contact with the inferior metals is performed by powerful flatting-mills. A bar of copper is made quite smooth and clear on one of its surfaces, and is then sprinkled over with glass of borax, and there is laid upon it a plate of fine silver, and the two are carefully bound together by wire. The mass is then exposed to a full red heat, which melts the borax and causes the silver to adhere to the copper. The ingot is now passed through a rolling-press and formed into a plate, both the silver and copper extending uniformly during the whole process, at the conclusion of which they are inseparably joined. The art of silver-plating was introduced at Sheffield about the middle of the last century. Another mode of plating is called 'silvering,' when an amalgam of silver and mercury is well rubbed upon the surface of the copper; by the application of heat the mercury is driven off, and the silver remains behind, adhering firmly to the copper, and capable of being highly polished.

Mr. Jacob estimates the annual consumption of silver in the United Kingdom at 3,282,046 oz., valued at 820,521*l*. The consumption for watch-cases is about 506,000 oz. annually: 100,000, each weighing on an average 2½ oz., are stamped annually at the London Assay-office; 60,000, each weighing 2 oz., are stamped at Birmingham; and 80,000, of the same weight, are stamped at the other assay-offices in the kingdom. About 900,000 oz. are used by coach-makers, harness-makers, and saddlers' ironmongers. In articles of small size, such as thimbles, of which hundreds of thousands are annually made; chains for watch-guards, pencil-cases, necks of smelling-bottles, locks of pocket-books, instrument cases, and portfolios, and small portions to handles of penknives and razors, the silver used is under the weight which subjects it to the stamp-duty of 1*s*. 6*d*. an oz., but a very considerable quantity of silver is employed in these minor objects. Leaf-silver for gilding is made two and a half times thinner than gold, and the gold-beaters require a considerable quantity of the metal for this purpose. Some articles are 'washed' with silver. Mr. Jacob distributes the total consumption as follows:—

| | |
|---|---|
| That paying duty . . . | 1,275,316 oz. |
| That used in watch-cases . . | 506,740 |
| That used in plating . . | 900,000 |
| That for other minor purposes . | 500,000 |
| | 3,282,046 |

The value of the stock of silver in the hands of the manufacturers and dealers is estimated by the same authority at 3,280,000*l*. The value of ornaments and utensils of the precious metals in Europe and America, if brought to the crucible, Mr. Jacob values at 400,000,000*l*., or one fourth more than the value of the coined metals. The annual consumption of gold and silver in Europe and America for ornamental purposes he states to be nearly 6,000,000*l*., that of Great Britain being valued at 2,457,000*l*. In M'Culloch's 'Dictionary of Commerce,' it is stated that Mr. Jacob's calculations are generally too high. Silver forms by far the largest proportion of the value of domestic utensils in which either of the two precious metals are used. In England the gold currency is of much higher relative value than that of silver [CURRENCY]; but in most other countries this is not the case. The coinage of silver and gold in France is estimated at 100,000,000*l*., a very large proportion of which is of silver. Since the peace, the number of silversmiths and persons engaged in working silver and gold into articles of ornament and use has greatly increased on the Continent; and the increase of the same class is probably also considerable in the United Kingdom. See the articles ANDES, CHILE, MEXICO, PERU, POTOSI, for an account of the South American mines; AUSTRIA, HUNGARY, SAXONY, &c., for those of Europe.

(Jacob's *Inquiry into the Production and Consumption of the Precious Metals*, 2 vols., London, 1831; Humboldt's *New Spain; Personal Researches*, &c.; Ward's *Mexico*, &c.)

SILVER, *Medical Properties of*. In a purely metallic state silver has no action on the animal frame, and the only salt much used is the nitrate, termed also *lunar caustic*. This is always fused in proper moulds, from which it is turned out in the form of cylinders, about three inches long, and the eighth of an inch in diameter. They are at first white, but quickly become of a dark grey or black colour, from combining with organic matter in the air. To prevent this the cylinders are generally wrapped up in blue paper. When nitrate of silver is brought in contact with any part of the human frame, it causes first a white mark, which gradually changes to blue, purple, and at last to black. This occurs more rapidly if moisture be present; and is owing to a chemical combination of the metal with the albumen and fibrin of the animal tissues. If the part be wetted, and the caustic applied several times at short intervals, vesication results. Nitrate of silver acts therefore locally as an *irritant* and *corrosive*. When taken internally in small doses for a considerable time, such as six or twelve months, it is absorbed and deposited in various parts of the body, and when it is deposited in the *rete mucosum* of the skin it causes discolorations, which in most cases prove permanent. It has been employed frequently with success, but often with failure, in the treatment of epilepsy, chorea, and some forms of *angina pectoris*, as well as morbid sensibility of the stomach. Larger doses can be borne when it is administered in the form of pill than in solution. The pills should be made with mucilage and sugar, but not with bread-crumb, as the common salt, or chloride of sodium, decomposes the nitrate and renders it inert. In cases of poisoning by nitrate of silver, common salt is a ready and effectual remedy. The liability of nitrate of silver to produce discolorations of the skin in persons taking it internally constitutes a serious objection to its employment, and there appears little necessity for giving it, since any case of epilepsy likely to be benefited by it will generally receive equal good from the use of *oxide of zinc*, without the risk of stains or other inconvenience. It has been suggested that the use of nitric acid internally as well as externally may remove the discolorations; but it is better not to incur the chance of causing them, than trust to the remote chance of removing them by such an expedient.

The external employment of this agent is not liable to any objection when used cautiously, while its advantages are very great. It is the most powerful *direct antiphlogistic* agent known. All subacute inflammations in any part to which it can be immediately applied will subside under its influence. In inflammations not merely of the skin, but of mucous membranes when they occur in parts which are accessible, its influence is great, and speedily manifested. Many of the cases of croup which in an advanced stage are unmanageable, begin in the back part of the throat (fauces), and if these parts are freely touched with a pencil dipped in a strong solution of nitrate of silver, the farther downward progress of the inflammation may be arrested. The same treatment is applicable to the erythematous inflammation which frequently begins either externally, and spreads through the mouth or nose to the fauces, and thence down the œsophagus, or originates in the fauces, leading to very serious results. Erysipelatous inflammation occurring in any part of the body may be effectually limited by nitrate of silver. For this purpose a complete circle should be formed round the inflamed part, but on the sound skin. For this case the solid cylinder, moistened at the end, is best. The circle must be perfect, or the morbid action may extend, escaping at the smallest breach. Chronic inflammation, and even ulceration of the eyes, may be removed by nitrate of silver applied in different forms. Old indolent ulcers are stimulated to a healthy action by its use; and many cutaneous diseases removed by it. Recent burns have the severe pain often very much mitigated by it; but it must not in any of these cases be applied to too large a surface at once, as ill effects have followed such a practice. To specify all the uses of nitrate of silver would be impossible here, but one more deserves to be extensively known. It is the best application to chilblains, especially at first; but even after they break, it disposes them to heal.

When a solution of nitrate of silver is made, distilled water should invariably be used. The neglect of this rule causes many of the solutions applied to the eye to be not only useless, but hurtful. Oxide of silver has been recently strongly recommended as an antispasmodic, and not liable to the objections which attach to the nitrate.

**SILVER, GERMAN.** [TUTENAG.]

**SILVER-GRAIN.** In making a horizontal section of the trunk of any tree, a number of straight lines will be seen radiating from the central pith through the wood to the bark. These rays are called by botanists medullary rays or plates, and by persons who work on wood *silver-grain*. They are composed entirely of cellular tissue, which is of a compressed form, and thence called muriform, and often do not consist of more than a single layer of cells, although in some trees, as Aristolochias, the layers are very numerous. In longitudinal sections of the stem they give it a remarkable satiny lustre, which constitutes the great beauty of some woods, as the plane and the sycamore. The great variety that is seen in the character of different woods appears to depend on the nature of the silver-grain, for the woody and vascular tissues do not present sufficient difference to constitute any obvious peculiarity. Thus in the cultivated cherry the plates are thin, and their adhesion to the bark slight, so that a section of this wood has a pale, smooth, homogeneous appearance: but in the wild cherry the silver-grain is much thicker; it adheres closely to the bark, and is arranged with great irregularity, so that this wood when cut has a deeper colour, and a twisted, knotted, irregular appearance. In the two species of oak the same kind of differences are observable. In Quercus sessiliflora the rays are thin and distant from each other, so that when a wedge is driven into the end of the trunk the plates of wood do not readily break into each other; but in Quercus pedunculata the rays are hard, and are so close together that the wood may be split up without any difficulty. [STEM.]

**SILVIC ACID**, a substance which with pinic acid [PINIC ACID] constitutes the greater portion of colophony, or common rosin. When this substance is digested in cold alcohol of specific gravity 0·833, the pinic acid dissolves, but the silvic acid remains insoluble in alcohol until it is boiled; on cooling, it separates in crystals of considerable size, the form of which, according to Unverdorben, is a rhombic prism terminated by four facets, but Laurent represents it as an acute rhomboid, the edges of which are usually serrated.

Silvic acid melts below 212°; is insoluble in water, but dissolves readily in hot alcohol and in æther, and is precepitated by water; it is soluble also in all proportions in the volatile and fixed oils. Concentrated sulphuric acid dissolves and water precipitates it from the acid; by the action of nitric acid it is converted into another resinous acid when it has been precipitated from alcohol by water; ammonia dissolves this acid readily, and the silvate of ammonia formed, as well as that of potash and of soda, is soluble in water; most silvates are however insoluble in it, but many of them are dissolved by alcohol and by æther; the silvate of magnesia especially is taken up by alcohol; the silvates of silver and lead are colourless and insoluble in water.

Silvic acid may be regarded as an oxide of oil of turpentine; its composition, as stated by the chemists above named, is as follows: it will be observed that there is no great difference between them, but they do not agree as to its constitution:—

| | Unverdorben. | Laurent. | Equivalents. | | | |
|---|---|---|---|---|---|---|
| Hydrogen | 10·36 | 9·7 | or 40 | = | 40 | 10·2 |
| Carbon | 79·28 | 79·7 | „ 52 | = | 312 | 79·6 |
| Oxygen | 10·36 | 10·6 | „ 5 | = | 40 | 10·2 |
| | 100· | 100· | | | 392 | 100· |

**SIMARU'BA** is the bark of the root of the Simaruba amara (Aublet), S. officinalis (of Dec. and 'Pharm. Lond.'), a tall tree, native of Guayana, and also of Jamaica, if the tree found in that island be not a distinct species. It is imported in bales containing pieces a foot or more in length, tolerably broad, and generally formed into rolls the whole length of the piece. Externally it is rough, warty, and has a dirty-yellow cuticle marked with transverse ridges; the epidermis below this is of a whitish-yellow colour. Internally smooth, with a greyish yellow colour. It is devoid of odour, but intensely bitter. Its chief constituents are *quassite*, resin, a volatile oil having an odour like benzoin, ulmin, mucilage, and some salts. It is tonic and demulcent in small doses, and therefore useful in the later stages of dysentery, but in larger doses it is emetic. The bark of the root of Simaruba versicolor (St. Hilaire) is very like that above described, and is used externally by the Brazilians as a wash to ill-conditioned ulcers, and to destroy vermin; but if taken internally it causes stupor and other narcotic symptoms; it should therefore be carefully distinguished from the former.

**SIMARUBA'CEÆ**, a natural order of plants belonging to the gynobasic group of polypetalous Exogens. The plants of this order are trees or shrubs, with alternate exstipulate usually compound leaves, and mostly without dots. The flowers are whitish-green or purple, on axillary or terminal peduncles, hermaphrodite, or occasionally unisexual. The calyx is 4 or 5 parted; petals four to five, twisted in æstivation; stamens twice as many as the petals, arising from the back of an hypogynous scale; ovary 4 to 5 lobed; style simple; stigma 4 or 5 lobed; fruit a drupe; seeds pendulous, exalbuminous, with a superior short radicle drawn back within thick cotyledons. With one exception they are all natives of Africa, India, and tropical America. This order was formerly included under Rutaceæ, but their differences from that order appear to many of sufficient importance to constitute a separate family. A. de Jussieu says, 'They are known from all Rutaceous plants by the coexistence of these characters, namely, ovaries with but one ovule, indehiscent drupes, exalbuminous seeds, a membranous integument of the embryo, and by the radicle being retracted within thick cotyledons.'

The plants of this order are all intensely bitter. The Quassia on this account is used in medicine. [QUASSIA.] Simaruba versicolor is so bitter that no insects will attack it; and when all other specimens of plants in dried collections have been attacked by *Ptini*, &c., specimens of this plant have been left untouched. The Brazilians use an infusion of this plant in brandy as a remedy against the bites of serpents.

**Quassia amara.**

*a*, branch, showing flowers and compound leaves: *b*, flower; *c*, stamens separated, attached to hypogynous scale; *d*, stamens surrounding ovary; *e*, ovary seated on a stalk, to which the stamens are attached.

**SIMBIRSK**, a government of Asiatic Russia, is situated between 52° and 57° N. lat., and between 42° 20′ and 50° 20′ E. long. It is bounded on the north by Kasan, on the east by Orenburg, on the south by Saratow and Pensa, and on the west by Nischnei Novgorod. The area is 24,000 square miles. The surface is in general an undulating plain, but on the right bank of the Volga there is a range of hills, composed of clay, marl, limestone, and freestone, which rise to the height of 400 feet. The principal river of this government is the Volga, which enters it from Kasan, about the middle of the northern frontier, and runs in a direction nearly south to Stavropol, where it turns to the east; and there, after being joined by the Sok, coming from Orenburg, it makes a semicircular bend, and at Samara turns due west, in which direction it proceeds as far as the town of Sysran, when it again turns to the south. It is at this bend that the eminences on the Volga are highest, though they accompany the river in its whole course from north to south. Beyond the bend the surface of the country becomes flat, and assumes a character resembling that of the Steppe. All the rivers belong to the system of the Volga, which receives on the right the Ousa and the Sysran, and on the left the Tcheremchan, the Sok after its junction with the Kandoustcha, and the Samara. The Sviaga, running parallel to the Volga from south to north, joins that river in the government of Kasan; and the Soura, which is navigable in spring, coming from Pensa, traverses the western part of the government, and joins the Volga in the government of Nischnei Novgorod. The lakes and rivers are 560 in number, but they are all small. The climate is generally healthy; but the winter is very cold, and the summer very hot. The Volga is usually frozen for five months in the year.

The soil is generally fertile, consisting of a good black mould, which requires no manure. It is pretty carefully cultivated, and produces more corn than is wanted for the home consumption: the principal species of grain are rye, wheat, and spelt; but there are likewise oats, barley, millet, and buckwheat. The inhabitants cultivate also the poppy, peas, lentils, flax, much hemp, tobacco, and some potatoes. Horticulture is in a very backward state: none but the most ordinary kinds of culinary vegetables are grown, and the fruit is of bad quality. In the northern parts of the government there are extensive forests; but in the south they scarcely suffice for the supply of the inhabitants. Though there are good pastures, the breeding of cattle is not much attended to, except among the Calmucks, in the steppe of the circle of Slavrepel. The rich Calmucks have one hundred horses, as many oxen, and four hundred sheep. The Tartars apply to agriculture with great success. Game is pretty abundant, but the fur-bearing animals are scarce. The fisheries of various kinds in the Volga are productive. The minerals are alabaster, sulphur, and limestone; but neither salt nor metals, except some iron.

The population amounts to 1,200,000, of whom about 1,080,000, are Russians and Cossacks: the remainder may be estimated as, Tartars 60,000, Tcheremisses 40,000, Mordwins 4000, Tchuswasches 5000, Calmucks 8000, and Kissilbasches 2000. These numbers are of course only approximative. Not only the Russians, but most of the Tcheremisses, the Tchuswasches, and the Mordwins, profess the Greek religion: some few are still adherents to Shamanism, and the Tartars and Kissilbasches are Mohammedans.

Though agriculture is the chief occupation of the inhabitants, there are some manufactures, both in the country and in the towns; they are woollen cloths, blankets, carpets, sail-cloth, leather, and some of silk and nankeen. Glasswares, soap, and candles are also manufactured; and there are many brandy-distilleries. A great improvement in the manufactures has been made of late years. The exports consist of horses, oxen, hemp, apples, water-melons, in good years corn, fish, tallow, leather, raw hides, and millstones. The principal trading towns are Simbirsk and Samara. The schools in this government are under the university of Kasan; but they are very few, and only a small proportion of the inhabitants receive any education. The government endeavours to remedy this want by establishing every year some new schools.

SIMBIRSK, the capital of the government, is situated near the junction of the Sviaga and the Volga, on the right bank of the latter river. It stands on an eminence which commands a fine view of the Volga and over an immense extent of country uninterrupted by forests. The town is not regularly built, but there are some broad and straight streets. Almost all the houses are of wood, but neat and convenient within. The churches, 16 in number, are all of stone, except one, which is of wood. There are two monasteries, a gymnasium, and manufactories of candles and soap, and some tanneries. The town is in a very fertile plain, and on one side there are gardens and orchards. The population amounts to 13,500, who are in general in easy circumstances; but even the higher classes are without intellectual resources. Of the other towns the most considerable are the following:—1, Sysran, on the river of the same name, not far from its conflux with the Volga, has 7000 inhabitants (Schnitzler says 9800); 2, Samara, on the Volga, beyond the bend which it makes here, is a trading town, with 5000 inhabitants, which was built in 1591 as a defence against the Calmucks; 3, Stavropol, the chief town of the Calmucks, on the right bank of the Volga, was built expressly for these people, on their conversion to Christianity, about the year 1737. In the centre is a kind of fort, surrounded with palisades, which is the residence of the chief of the Calmucks. The Russian or Cossack garrison is in the upper town. The merchants reside together in a slobod, and the citizens in the lower town.

SIMEON STYLITES. [MONACHISM.]

SIMEON SETH (Συμεὼν Σήθ), or SIMEON SETHUS, or Simeon the Son of Seth, the author of several Greek works still extant, lived at Constantinople towards the end of the eleventh century. He held there the office of πρωτοβεστάρχης, or 'Master of the Wardrobe,' in the palace o. Antiochus, from whence originated his title *Magister Antiochiae*, and this gave occasion to the false opinion that he was born at Antioch. His office appears to have given him the charge of the imperial jewels, which were kept in the palace named after the Eunuch Antiochus, who was consul A.D. 431. (Du Cange, *Glossar. Med. et Inf. Græcit.*, tom. i., p. 194, ed. Lugd., 1688, and *Constantinop. Christ.*, lib. ii., cap. 16, § 5, p. 168, ed Lutet. Paris., 1680.) Having taken the part of the unfortunate patrician Dalassenus against the usurper Michael of Paphlagonia, the latter banished him from Constantinople, A.D. 1038. He retired to Thrace, and founded on Mount Olympus a monastery, in which he composed several works, and peaceably ended his days. (Georg. Cedreni *Histor. Compend.*, p. 737, ed. Paris, 1647.) Sometime after the foundation of this monastery, Michael Dukas having ascended the throne, A.D. 1071, Simeon Seth dedicated to him his work entitled Σύνταγμα περὶ Τροφῶν Δυνάμεων, 'Syntagma de Cibariorum Facultate.' This contains an alphabetical list of eatable things and their properties, according to the opinions of Greek, Persian, Agarenian (or Arabian), and Indian physicians; and is the more valuable as at that time the trade with the East, and the seeking after foreign and costly articles of food at Constantinople, were very extensive. It is compiled chiefly from the treatise of Michael Psellus on the same subject, and shows us that the Greeks were beginning already to learn Materia Medica from the Arabians, to whom in return they imparted their theories. Simeon Seth also goes through the medicines then in use in alphabetical order, and he explains their mode of action according to the elementary qualities of Galen, and their different degrees. He says that Asparagus had been for some time introduced as an article of food (p. 6, ed. Gyrald.), and that it possesses great medicinal virtues. He is the first who speaks of yellow Amber (ἄμπαρ) which comes from a town in India, and which is the best; and also of Ambergris, which is an animal production, coming from fish (p. 8). Apricots (βερίκοκκα), he says, are indigestible and produce poorness of blood (p. 9). His work contains the first description of Camphor, which he says is the resin of a very large Indian tree; that it is cold and dry in the third degree; and that it is used with much advantage in acute diseases, especially in inflammations (p. 35). He is also the first who speaks of Musk, of which the best is of a yellow colour, and comes from a town to the east of Khorasan; the black musk comes from India: the properties attributed to this medicine are the same as those given to it in the present day (p. 41). The best Cinnamon comes from Mosul (p. 32). This work was first published, Basil., 1538, Gr. and Lat., 8vo., ed. Lilius Greg. Gyraldus, ap. Mich. Isingrinium. The Latin translation was improved and published separately, Basil., 1561, 8vo., ed. Domin. Monthesaurus, ap. Pet. Pernam. The last and best edition was published Paris, 1658, Gr. and Lat., 8vo., ed. Mart. Bogdan, ap. Dion. Bechet et Lud. Billanium.

Another of his works, entitled 'Σύνοψις καὶ Ἀπάνθισμα Φυσικῶν τε καὶ Φιλοσόφων Δογμάτων,' 'Compendium et Flores Naturalium et Philosophorum Placitorum,' is still in MS. in several European libraries. A long account of it (extracted from Allatius, 'De Simeonum Scriptis') is given by Fabricius (*Biblioth. Gr.*, tom. xi., p. 323-326, ed. Harles).

But Simeon Seth is better known in the history of literature than in that of medicine, as having translated from the Arabic into Greek the work known under the name of 'Pilpay's Fables,' in which 'fifteen moral and political sentences' (says Gibbon, *Decline and Fall*, chap. 42) 'are illustrated in a series of apologues; but the composition is intricate, the narrative prolix, and the precept obvious and barren.' An account of the history, translations, and editions of this antient and curious work is given under BIDPAI. (See also Fabricius, *loco cit.*; and Milman's note to Gibbon, vol. vii., p. 310.) He is also said to have translated from the Persian a fabulous history of Alexander the Greek, which at present exists, says

Warton (*Hist. of English Poetry*, vol. i., p. 129), under the adopted name of Callisthenes, and is no uncommon manuscript in good libraries. It is entitled Βίος Ἀλεξάνδρου τοῦ Μακεδόνος καὶ Πράξεις, 'De Vita et Rebus Gestis Alexandri Macedonis;' and a long passage from the beginning of the work is quoted by Abr. Berkel in the notes to Stephanus Byzantinus (*in v.* Βουκεφάλεια), and by Fabricius, *Biblioth. Gr.*, tom. xiv., p. 148-150 (ed. Vet.). This fabulous narrative is full (as might be expected) of prodigies and extravagancies, some specimens of which are given by Warton. Of all the romances on the subject of Alexander the Great, this by Simeon Seth was for some centuries the best known and the most esteemed; and it was most probably (says he) very soon afterwards translated from the Greek into Latin, and at length from thence into French, Italian, and German. The Latin translation was printed at Colon. Argentorat., 1489; perhaps before, for in the Bodleian Library there is an edition in 4to., without date, supposed to have been printed at Oxford, by Fred. Corsellis, about the year 1468. It is said to have been made by one Æsopus, or by Julius Valerius; supposititious names, which seem to have been forged by the artifice or introduced through the ignorance of scribes and librarians. This Latin translation however is of high antiquity in the middle age of learning; for it is quoted by Gyraldus Cambrensis, who flourished about the year 1190. It was translated into German by John Hartlieb Moller, a German physician, at the command of Albert, duke of Bavaria, and published at August. Vindel., fol., 1478. Scaliger also mentions (*Epist. ad Casaubon.*, 113, 115) a translation from the Latin into Hebrew by one who adopted the name of Joseph Gorionides, called Pseudo Gorionides.

SIMEON OF DURHAM, an English historical writer who lived about the beginning of the eleventh century. He was a teacher of mathematics at Oxford, and was afterwards precentor in Durham cathedral. He wrote a history of the kings of England from 616 to 1130, for which he was at great pains to collect materials, especially in the North of England, where the Danes had established themselves. The work was continued to 1156 by John, prior of Hexham. Simeon of Durham is supposed to have died soon after 1130, when his history terminates. This work is included in Twysden's 'Anglicanæ Historiæ Scriptores Decem.' Simeon also wrote a history of Durham cathedral, which was published in 1732: 'Historia Ecclesiæ Dunhelmensis, cui præmittitur T. R. Disquisitio de Auctore hujus Libelli; edidit T. Bedford,' Lond., 1732, 8vo.

SIMFEROPOL, the seat of the Russian government of Taurida, is situated in 45° 12′ N. lat. and 24° 8′ E. long., on an elevated plateau on the river Salgir. Simferopol is a modern town. There was indeed on this spot, in the time of the Khans, a place called Akmetschet (the white church), and sometimes called Sultan Serai, but it was of little importance, and now forms a small part of Simferopol, under the name of the Tartar quarter. The antient capital of the Khans was Baktschiserai, but it is confined to a small space in a rocky valley. The Russians, who love everything spacious and open, left that town to the Tartars, and built at Simferopol a capital according to their own taste, with immensely long and broad streets, in which horse-races might be held without interrupting the usual traffic. Being near the centre of the peninsula, it is well calculated for the seat of government. There are many pretty houses, with iron roofs painted green and adorned with many columns, like all the new Russian towns. Besides the government offices there are a Russian church, a pretty German church, one Greek and one Armenian church, four Tartar chapels, a gymnasium, and a seminary for Tartar schoolmasters. The population, about 6900 inhabitants, is a medley of Russians, Tartars, Armenians, Greeks, and 40 or 50 German families. There is here a very good botanic garden, or more properly speaking, a nursery where all kinds of useful plants, shrubs, and trees are cultivated, and sent to various parts of the empire. The town has no manufactures, and has only an inconsiderable trade by land, and scarcely any by sea. The immediate vicinity of the town does not produce much fruit or culinary vegetables. During the hot season fevers are very prevalent, and the water is very indifferent. Usewoloiski (as quoted by Hassel in 1821) makes the number of inhabitants 20,000; we imagine this is a misprint for 2000, for Stein in the same year gives 1800, and no subsequent account that we have seen states it above 6000. (Hassel; Hörschelmann; Kohl, *Reise in Süd Russland*, 1841.)

SI'MIADÆ, the name of a quadrumanous family of mammals. [APE; ATELES; BABOON; CHEIROPODA; CHIMPANZEE; HYLOBATES; LAGOTHRIX; MYCETES; NASALIS; ORANG-UTAN; QUADRUMANA; SAKIS; SAPAJOUS; SEMNOPITHECUS, &c.]

These animals were known at a very early period. The *Kophim* of the Scriptures (1 *Kings*, x. 22; 2 *Chron.*, ix. 21), the *Ceph* of the Ethiopians, the *Keibi* and *Kubbi* of the Persians, the κῆβοι of the Greeks, and *Cephi* of the Romans, were clearly apes. They are to be traced in some of the earliest paintings of the Egyptians. (Rosellini, &c.)

In the garden of the Zoological Society of London, among a great variety of the *Simiadæ*, three of the forms which approach nearest to the human race may now (Sept., 1841) be studied; for three Chimpanzees (two males and a female), an Orang-Utan, and a Gibbon (*Hylobates agilis*)—the two latter females—are all living at the menagerie in the Regent's Park.

The *Cephi* exhibited by Pompey (Pliny, *Nat. Hist.*, viii. 19), as well as those shown by Cæsar, appear to have been Ethiopian apes; and in the Greek name inscribed near the quadrumanous animals, in the Prænestine pavement, the oriental origin of the word is apparent. It is remarkable that the name *Cebus* [SAPAJOUS] is applied by modern zoologists to a genus of monkeys which could not have been known to the antients; for the *Cebi* of our present catalogues are exclusively American.

FOSSIL SIMIADÆ.

Remains of *Simiadæ* have been discovered and described from the tertiary formations of India, France, England, and Brazil. These fossils are illustrative of four of the existing types of quadrumanous, or rather Simious form. Thus we have *Semnopithecus* from India; *Hylobates* from the south of France; *Macacus* from Suffolk; and *Callithrix*, peculiar to America, found in Brazil. Nor is it unworthy of remark, that we here have evidence that so high a quadrumanous form as the Gibbon, a genus in which the skull is even more approximated to that of man than it is in the Chimpanzee, was living upon our globe with the Palæothere, Elephants, and other Pachyderms. We say that the skull of the Gibbon comes nearest to that of man; because, though the cranium of the young Chimpanzee approaches that of the human subject, it is far removed from it when the permanent teeth are developed.

From these evidences we have also proof that *Simiadæ* lived in our island during the Eocene period; whilst the presence of fossil vegetables, abundant in the London clay at Sheppy, and the remains of serpents in the same locality, show the degree of heat that must have prevailed here during that period, when *Simiadæ* were co-existent with tropical fruits and Boa Constrictors.

But Dr. Lund's observations relating to the extinct quadrumanous form detailed in his 'View of the Fauna of Brazil,' previous to the last geological revolution, require special notice. He states that it is certain that the family of *Simiadæ* was in existence in those antient times to which the fossils described by him belong; and he found an animal of that family of gigantic size, a character belonging to the organization of the period which he illustrates. He describes it as considerably exceeding the largest Oran-Utan or Chimpanzee yet seen; from these, as well as from the long-armed apes (*Hylobates*), he holds it to have been generically distinct. As it equally differs from the *Simiadæ* now living in the locality where it was discovered, he proposes a generic distinction for it under the name of *Protopithecus*, and the specific appellation of *Protopithecus Brasiliensis*.

As connected with this discovery, Dr. Lund records a tradition existing very generally over a considerable extent of the interior highlands, especially in the northern and western portions of the province of S. Paul and the Sertão of S. Francisco. According to this tradition, that district is still inhabited by a very large ape, to which the Indians, from whom the report comes, have given the name of *Caypore*, or *Dweller in the Wood*. This *Caypore* is said to be of man's stature, but with the whole body and part of its face covered with long curly hair; its colour brown, with the exception of a white mark on the belly immediately above the navel. It is represented as climbing trees with great facility, but most frequently going on the ground, where it walks upright like a man. In youth it is held to be a quiet inoffensive animal, living upon fruits, on which it feeds with teeth formed like those of the human race; but as it advances in age, its character is denounced as rapacious and blood-thirsty. Then it chooses birds and small quadrupeds; large canine teeth project from its mouth, and it becomes formidable to man. Its skin is supposed to be impenetrable to ball, with the exception of the white mark on the belly. It is an object of dread to the natives, who shun its haunts, which are betrayed by the *Caypore's* extraordinary footmark ending in a heel both before and behind, so that it is impossible to know in what direction the animal is gone.

Upon this tradition Dr. Lund remarks, that it is easy to trace in it the childish embellishments of a savage race; and he finds in the alleged double heel the meaning that the forepart of the foot is not broader than the hind and that the impressions of the toes are not distinguishable. As to the white spot in the belly, he remarks, that all the long-haired apes now found in Brazil have the central part of the belly very thinly covered with hair, so that when the hair is of a dark colour and the skin light, an effect is produced during the act of respiration as if there were a white spot on the stomach. The impenetrability of its hide, he observes, may seem fabulous, but he states that he is acquainted with a species of this family, the *Guigo* (*Mycetes crinicaudus*, Lund), which has this property This undescribed animal, he adds (which constitutes a remarkable link between *Mycetes* and *Cebus*, inasmuch as it combines the vocal organs of the former with the perfectly hairy tail of the latter), is provided with a skin clothed with such long and felted hair as to be shot-proof on the back and sides. It would seem, says Dr. Lund, to be well aware of its shield; for instead of seeking safety in flight, like other *Simiadæ*, when danger approaches it rolls itself up in a ball, so as to cover the least protected part, and thus defies the shot of the hunter.

Dr. Lund further remarks that he has introduced this tradition, less on account of its zoological interest, than for the striking coincidence it displays in many points with the stories related of the Pongo of Borneo. He asks, if no such animal exists in the district where the tradition is current, whence did it take its origin? Did the Indians receive it from their forefathers? May this tradition be considered one more testimony in favour of the Asiatic origin of the first inhabitants of America? In the Sertão of S. Francisco the tradition is coupled with additions which though, he remarks, they weaken its zoological interest, impart to it another, as betraying the only trace he had met with in that district of a belief in fairy existence. According to the native of Sertão, the Caypore is lord of the wild hogs, and when one of them has been shot, his enraged voice may be heard in the distance, when the hunter quits his game to save himself by flight. The Caypore is said to have been beheld in the centre of a herd of swine riding on the largest, and indeed has been described as an ape above and a hog below.

SIMILAR, SIMILAR FIGURES (Geometry). Similarity, resemblance, or likeness, means sameness in some, if not in all, particulars. In geometry, the word refers to a sameness of one particular kind. The two most important notions which the view of a figure will give, are those of *size* and *shape*, ideas which have no connection whatsoever with each other. Figures of different sizes may have the same shape, and figures of different shapes may have the same size. In the latter case they are called by Euclid *equal*, in the former *similar* (similar figures, ὅμοια σχήματα). The first term [Equal; Relation], in Euclid's first use of it, includes united sameness, both of size and shape; but he soon drops the former notion, and, reserving equal to signify sameness of size only, introduces the word similar to denote sameness of form: so that the equality of the fundamental definition is the subsequent combined equality and similarity of the sixth book.

Similarity of form, or, as we shall now technically say, similarity, is a conception which is better defined by things than by words; being in fact one of our fundamental ideas of figure. A drawing, a map, a model, severally appeal to a known idea of similarity, derived from, it may be, or at least nourished by, the constant occurrence in nature and art of objects which have a general, though not a perfectly mathematical, similarity. The rudest nations understand a picture or a map almost instantly. It is not necessary to do more in the way of definition, and we must proceed to point out the mathematical tests of similarity. We may observe indeed that errors or monstrosities of size are always more bearable than those of form, so much more do our conceptions of objects depend upon the latter than the former. A painter is even obliged to diminish the size of the minor parts of his picture a little, to give room for the more important objects: but no one ever thought of making a change of form, however slight, in one object, for the sake of its effect on any other. The giant of Rabelais, with whole nations carrying on the business of life inside his mouth, is not so monstrous as it would have been to take the ground on which a nation might dwell, England, France, or Spain, invest it with the intellect and habits of a human being, and make it move, talk, and reason: the more tasteful fiction of Swift is not only bearable and conceivable, but has actually made many a simple person think it was meant to be taken as a true history.

Granting then a perfect notion of similarity, we now ask in what way it is to be ascertained whether two figures are similar or not. To simplify the question, let them be plane figures, say two maps of England of different sizes, but made on the same projection. It is obvious, in the first place, that the lines of one figure must not only be related to one another in length in the same manner as in the other, but also in position. Let us drop for the present all the curved lines of the coast, &c., and consider only the dots which represent the towns. Join every such pair of dots by straight lines: then it is plain that similarity of form requires that any two lines in the first should not only be in the same proportion, as to length, with the two corresponding lines in the second, but that the first pair should incline at the same angle to each other as the second. Thus, if LY be the line which joins London and York, and FC that which joins Falmouth and Chester, it is requisite that LY should be to FC in the same proportion in the one map that it is in the other; and if FC produced meet LY produced in O, the angle COY in one map must be the same as in the other. Hence, if there should be 100 towns, which are therefore joined two and two by 4950 straight lines, giving about 12 millions and a quarter of pairs of lines, it is clear that we must have the means of verifying $12\frac{1}{4}$ millions of proportions, and as many angular agreements. But if it be only assumed that similarity is a possible thing, it is easily shown that this large number is reducible to twice 98. For let it be granted that $l\,y$ on the smaller map is to represent LY on the larger. Lay down $f$ and $c$ in their proper places on the smaller map, each with reference to $l$ and $y$, by comparison with the larger map: then $f$ and $c$ are in their proper places with reference to each other. For if not, one of them at least must be altered, which would disturb the correctness of it with respect to $l$ and $y$. Either then there is no such thing as perfect similarity, or else it may be entirely obtained by comparison with $l$ and $y$ only.

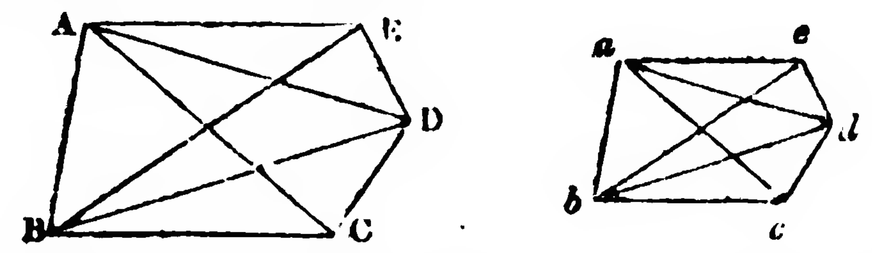
We have hitherto supposed that both circumstances must be looked to; proper lengths and proper angles; truth of linear proportion and truth of relative direction. But it is one of the first things which the student of geometry learns (in reference to this subject), that the attainment of correctness in either secures that of the other. If the smaller map be made true in *all* its relative lengths, it must be true in all its directions; if it be made true in *all* its directions, it must be true in all its relative lengths. The foundation of this simplifying theorem rests on three propositions of the sixth book of Euclid, as follows:—

1. The angles of a triangle (any two, of course) alone are enough to determine its form: or, as Euclid would express it, two triangles which have two angles of the one equal to two angles of the other, each to each, have the third angles equal, and all the sides of one in the same proportion to the corresponding sides of the other.

2. The proportions of the sides of a triangle (those of two of them to the third) are alone enough to determine its form. or if two triangles have the ratios of two sides to the third in one, the same as the corresponding ratios in the other, the angles of the one are severally the same as those of the other.

3. One angle and the proportion of the containing sides are sufficient to determine the form of a triangle: or, if two triangles have one angle of the first equal to one of the second, and the sides about those angles proportional, the remaining angles are equal, each to each, and the sides about equal angles are proportional.

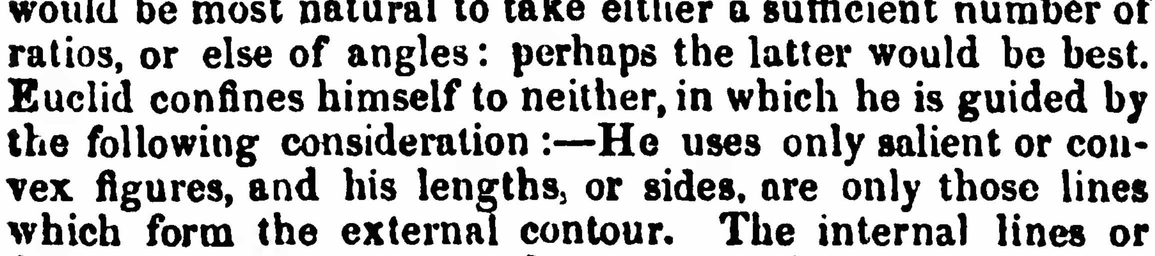
From these propositions it is easy to show the truth of all that has been asserted about the conditions of similarity, and the result is, that any number of points are placed similarly with any other number of points, when, any two being taken in the first, and the corresponding two in the second, say A, B, and $a$, $b$, any third point C of the first gives a triangle ABC, which is related to the corresponding triangle $abc$ of the second, in the manner described in either of the three preceding propositions. For instance, let there be five points in each figure:



In the triangles BAE and $bae$, let the angles AEB and EBA be severally equal to $aeb$ and $eba$. In the triangles ADB and $adb$ let DA : AB :: $da$ : $ab$, and DB : BA :: $db$ : $ba$. In the triangles ACB and $acb$ let the angles ABC and $abc$ be equal, and AB : BC :: $ab$ : $bc$. These conditions being fulfilled, it can be shown that the figures are similar in form. There is no angle in one but is equal to its corresponding angle in the other; no proportion of any two lines in one but is the same as that of the corresponding line in the other. Every conception necessary to the complete notion of similarity is formed, and the one figure, in common language, is the *same* as the other in *figure*, but perhaps on a different scale.

The number of ways in which the conditions of similarity can be expressed might be varied almost without limit; if there be $n$ points, they are twice $(n-2)$ in number. It would be most natural to take either a sufficient number of ratios, or else of angles: perhaps the latter would be best. Euclid confines himself to neither, in which he is guided by the following consideration:—He uses only salient or convex figures, and his lengths, or sides, are only those lines which form the external contour. The internal lines or diagonals he rarely considers, except in the four-sided figure. He lays it down as the definition of similarity, that all the angles of the one figure (meaning only angles made by the sides of the contour) are equal to those of the other, each to each, and that the sides about those angles are proportional. This gives $2n$ conditions in an $n$-sided figure, and consequently four redundancies, two of which are easily detected. In the above pentagons, for instance, if the angles at A, E, D, C, be severally equal to these at $a$, $e$, $d$, $c$, there is no occasion to say that that at B must be equal to that at $b$, for it is a necessary consequence: also, if BA : AE :: $ba$ : $ae$, and so on up to DC : CB :: $dc$ : $cb$, there is no occasion to lay it down as a condition that CB : BA :: $cb$ : $ba$, for it is again a consequence. These points being noted, the definition of Euclid is admirably adapted for his object, which is, in this as in every other case, to proceed straight to the establishment of his propositions, without casting one thought upon the connection of his preliminaries with natural geometry.

Let us now suppose two similar curvilinear figures, and to simplify the question, take two arcs AB and $ab$. Having already detected the test of similarity of position with reference to any number of points, it will be easy to settle the conditions under which the arc AB is altogether similar to $ab$. By hypothesis, A and B are the points corresponding to $a$ and $b$. Join A, B, and $a$, $b$; and in the arc AB take any point P. Make the angle $bap$ equal to BAP, and $abp$ equal to ABP; and let $ap$ and $bp$ meet in $p$. Then, if the curves be similar, $p$ must be on the arc $ab$; for every point on AB is to have a corresponding point on $ab$. Hence the definition of similarity is as follows:—Two curves are similar when for every polygon which can be inscribed in the first, a similar polygon can be inscribed in the second.



It is easily shown that if on two lines, A and $a$, be described a first pair of polygons, P and $p$, and a second pair, Q and $q$, the proportion of the first and second pairs is the same, or P : $p$ :: Q : $q$. The simplest similar polygons are squares; consequently, any similar polygons described on A and $a$ are to one another in the proportion of the squares on A and $a$. This is also true if for the polygons we substitute similar curves; and it must be proved by the method of exhaustions [GEOMETRY, p. 154], or by the theory of limits applied to the proposition, that any curve may be approached in magnitude by a polygon within any degree of nearness.

The theory of similar solids resembles that of similar polygons, but it is necessary to commence with three points instead of two. Let A, B, C, and $a$, $b$, $c$, be two sets of three points each, and let the triangles ABC and $abc$ be similar: let them also be placed so that the sides of one are parallel to those of the other. If then any number of similar pyramids be described on ABC and $abc$, the vertices of these pyramids will be the corners of similar solids. If P and $p$ be the vertices of one pair, then the pyramids PABC and $pabc$ are similar if the vertices P and $p$ be on the same side of ABC and $abc$ [SYMMETRY], and one of the triangles, say PAB, be similar to its corresponding triangle $pab$, and so placed that the angle of the planes PAB and CAB is the same as that of the planes $pab$ and $cab$. The simplest similar solids are cubes; and any similar solids described on two straight lines are in the same proportion as the cubes on those lines. Similar curve surfaces are those which are such that every solid which can be inscribed in one has another similar to it, capable of being inscribed in the other.

It is worthy of notice that the great contested point of geometry [PARALLELS] would lose that character if it were agreed that the notion of form being independent of size, is as necessary as that of two straight lines being incapable of enclosing a space; so that whatever form can exist of any one size, a similar form must exist of every other. There can be no question that this universal idea of similarity involves as much as this, and no more; that in the passage from one size to another, all lines alter their lengths in the same proportion, and all angles remain the same. It is the subsequent mathematical treatment of these conditions which first points out that either of them follows from the other. If the whole of this notion be admissible, so in any thing less; that is, the admission implies it to be granted that whatever figure may be described upon any one line, another figure having the same angles may be described upon any other line. If then we take a triangle ABC, and any other line $ab$, there can be drawn upon $ab$ a triangle having angles equal to those of $abc$. This can only be done by drawing two lines from $a$ and $b$, making angles with $ab$ equal to BAC and ABC. These two lines must then meet in some point $c$, and the angle $acb$ will be equal to ACB. If then two triangles have two angles of one equal to two angles of the other, each to each, the third angle of the one must be equal to the third angle of the other; and this much being established, it is well known that the ordinary theory of parallels follows. The preceding assumption is not without resemblance to that required in the methods of Legendre. [PARALLELS.]

**SI'MILE** is admirably defined by Johnson to be 'a comparison by which anything is illustrated or aggrandised,' a definition which has been often neglected by poets. A Metaphor differs from a Simile in expression, inasmuch as a metaphor is a comparison without the words indicating the resemblance, and a simile is a comparison where the objects compared are kept as distinct in expression as in thought. Dr. Thomas Brown has well said, 'The metaphor expresses with rapidity the analogy as it rises in immediate suggestion, and identifies it, as it were, with the object or emotion which it describes; the simile presents not the analogy merely, but the two analogous objects, and traces their resemblances to each other with the formality of regular comparison. The metaphor, therefore, is the figure of passion; the simile the figure of calm description.' (*Lectures*, XXXV.) The metaphor is only a bolder and more elliptical simile. When we speak of the rudeness of a man, and say 'Mr. Jones is as rude as a bear,' we use a simile, for the rudeness of the two are kept distinct but likened; when we say 'that *bear* Mr. Jones,' we use a metaphor, the points of resemblance being confounded in the identification of rudeness with a bear. So, 'brave as a lion' is a simile—the 'lion Achilles' a metaphor. Where the resemblance is obvious, it may be more forcibly and as intelligibly expressed by a simple metaphor; but when the resemblance is not so obvious, it requires fuller elucidation, and then it must be expressed by a simile. Similes therefore, from their tendency to detail, are usually misplaced in passionate poetry, but metaphors constitute the very language of passion; for the mind, when moved, catches at every slight association to express itself, but never dwells on them with the deliberateness of a comparison.

Poets should never forget that similes are not used for their own sake, but for the sake of 'illustrating or aggrandising' the object or emotion they would express: hence an important but overlooked canon of criticism. Metaphors may be indefinite, for they are themselves the expressions of strong but indefinite emotions; but similes must be uniformly definite, clear, and correct, otherwise they are useless; for the simile is used to illustrate, by a known object, one unknown or indescribable: hence the necessity for its being intelligible. Moreover, images addressed to the eye must be such as are visually clear. These rules are continually violated by minor poets, but there are few cases of such violation in the greater poets, and even there the exceptions prove the rule.

(Brown's *Lectures on the Philosophy of the Mind;* Kames's *Elements of Criticism;* Bishop Lowth's *Lectures on Hebrew Poetry;* Hegel's *Vorlesungen über die Æsthetik;* Solger's *Æsthetik.*)

SIMMENTHAL. [BERN.]

SI'MMIAS was a native of Thebes, and is said to have been a disciple of Philolaus. He was a friend of Socrates (Plat., *Crito*, p. 45, B), and is introduced by Plato as one of the speakers in his 'Phædon.' (Diogenes Laertius (ii. 16, 124) mentions the titles of twenty-three dialogues which were in his time attributed to Simmias (Suidas, *v.* Σιμμίας), but none of his works have come down to us.

A second SIMMIAS, a grammarian, was a native of Rhodes, and probably lived about the year 300 B.C. He is said to have written a work on languages, consisting of three books, and a collection of miscellaneous poems, consisting of four books. (Suidas, *v.* Σιμμίας; Strabo, xiv., p. 655.) Some of his poems, which however are of little value, are contained in the 'Anthologia Græca.' (Compare Athen., vii., p. 327; xi., p. 472 and 491.)

A third SIMMIAS, who lived about the commencement of the Olympiads, wrote a work called Ἀρχαιολογία τῶν Σαμίων, of which nothing has come down to us. Suidas confounds this historian with Simmias the grammarian.

SIMNEL, LAMBERT. [HENRY VII.]

SI'MOIS, River. [TROAD.]

SIMON MACCABAEUS, or MATTHES, surnamed Thasi, was the second son of Mattathias, and brother of Judas Maccabaeus and Jonathan Apphus. Mattathias, when dying, recommended him to his brethren as their counsellor (1 *Macc.*, ii. 3). He distinguished himself on several occasions during the lives of Judas and Jonathan. (1 *Macc.*, v. 17; x. 74; 2 *Macc.*, viii. 22; xiv. 17). Under the latter he was made, by Antiochus Theos, governor over the coast of the Mediterranean from Tyre to the frontier of Egypt (1 *Macc.*, xi. 59); and here he took the fortified towns of Bethsur and Joppa, and founded Adida, in the plain of Sephela. (1 *Macc.*, xi. 65; xii. 33, 38.)

After the treacherous seizure of Jonathan by Trypho [JONATHAN APPHUS], Simon was chosen by the people as their chief (1 *Macc.*, xiii); and, according to Josephus (*Antiq.*, xiii. 6, 6), as high-priest also. After putting Jerusalem in a state of defence, he marched out to meet Trypho, who did not venture to give him battle, and who was soon after compelled to retreat into winter-quarters in Gilead, where he murdered Jonathan and his two sons. Simon recovered his brother's corpse, and interred it in his father's sepulchre at Modin, and built over it a magnificent mausoleum, which was standing in the time of Eusebius. About this time (B.C. 143) Trypho had murdered Antiochus, and proclaimed himself king. Simon immediately declared for his competitor, Demetrius Nicator, with whom he made a very favourable treaty, whereby Simon was recognised prince and high-priest of the Jews, all claims upon whom for tribute Demetrius relinquished, and consented to bury in oblivion their offences against him. Thus the Jews became once more free and independent, and they began to reckon from this period (170 Aer. Seleuc.; 143-142, B.C.) a new civil æra, which is used on the coins of Simon as well as by Josephus and the author of the *First Book of Maccabees* (1 *Macc.*, xiii. 41.). The last remains of their bondage to the Syrians were removed in the next year by the surrender of the Syrian garrison in the citadel of Jerusalem.

The succeeding period of peace was employed by Simon in extending and consolidating his power, and improving the condition of his people. He made a harbour at Joppa, established magazines and armouries, improved the laws and administered them with vigour, restored the religious rites, and renewed the treaties of alliance which Jonathan had made with the Romans and Spartans. (1 *Macc.*, xiv., xv.) In the year 141 B.C., the people met at Jerusalem, and registered a public act recounting the services of the house of Mattathias, and recognising Simon and his heirs as perpetual prince and high-priest of the Jews: and this act was afterwards confirmed by Demetrius. (1 *Macc.*, xiv. 35.) After the capture of Demetrius by the Parthians, his successor Antiochus Sidetes renewed the treaty with Simon, allowed him to coin money, and declared Jerusalem a free and holy city. Soon afterwards however Antiochus not only refused to ratify this treaty, but demanded of Simon the surrender of several fortified places, including the citadel on Mount Zion, or the payment of 1000 talents. Simon refused these demands, and Antiochus sent a large army into Palestine, which was soon however driven back by John Hyrcanus and Judas, the sons of Simon (B.C. 139-8). For the next three years the Jews again enjoyed a season of tranquillity, during which Simon occupied himself in inspecting and improving the state of the country. In the course of his tour he visited his son-in-law Ptolemy, at his castle of Doc, where he and his two sons Mattathias and Judas were treacherously put to death by Ptolemy, who aimed at the principality of Judæa (B.C. 135). He was succeeded by his surviving son John Hyrcanus. [HYRCANUS, JOHN; ASMONAEANS; MACCABEES.]

The coinage of Simon is the first of which we have any historical account among the Jews. [SHEKEL.]

(Josephus, *Antiq.*; Prideaux's *Connection;* Jahn's *Hebrew Commonwealth;* Winer's *Biblisches Realwörterbuch.*)

SIMON MAGUS, that is, the magician, is mentioned in the *Acts of the Apostles* as having imposed upon the people of Samaria by magical practices. When Philip the Deacon preached the gospel at Samaria, Simon was among those who received baptism at his hands. But when Peter and John came down to Samaria, and Simon perceived that the Holy Ghost was received by those upon whom they laid their hands, he offered them money if they would give him the same power. Peter vehemently rebuked him, and he showed some appearance of penitence (*Acts*, viii. 9-24); but the early Christian writers represent him as afterwards becoming one of the chief opponents of Christianity. According to them he was the founder of the Gnostic heresy, and was addicted to magical practices and to abominable vices. After travelling through several provinces, endeavouring as he went to spread his errors and to damage Christianity as much as possible, he came to Rome, where it is said that he worked miracles which gained him many followers, and obtained for him the favour of Nero. At last, as he was exhibiting in the emperor's presence the feat of flying through the air in a fiery chariot, which he was enabled to perform by the aid of dæmons, the united prayers of Peter and Paul, who were present on the occasion, prevailed against him, and the dæmons threw him to the ground. There are also other marvellous stories about his life and doctrines.

(Calmet's *Dictionary;* Winer's *Biblisches Realwörterbuch;* Lardner's *Credibility.*)

SIMON MATTHES. [SIMON MACCABAEUS.]

SIMON, RICHARD, was born at Dieppe, in Normandy, May 13, 1638. After he had finished his studies, he entered into the Congregation of the Oratory, and became lecturer on philosophy at the College of Juilly. Being summoned by his superiors to Paris, he applied himself to the study of divinity, and made great progress in oriental learning. There being a valuable collection of oriental manuscripts in the Oratory of Rue St. Honoré, Simon was directed to make a catalogue of them, which he did with great skill. In 1668 he returned to Juilly, and resumed his lectures on philosophy, and two years after published his defence of a Jew whom the parliament of Metz condemned to be burned on the charge of having murdered a Christian child: 'Factum pour le Juif de Metz,' &c. Paris, 1670. In the following year, with a view to show that the opinions of the Greek church are not materially different from those of the Church of Rome with respect to the Sacrament, he published his 'Fides Ecclesiæ Orientalis,' Paris, 1671, 8vo., and 1682, 4to. This work, which is a translation of one of the tracts of Gabriel, metropolitan of Philadelphia, with notes, Simon gave as a supplement to the first volume of the 'Perpetuity of the Faith respecting the Eucharist,' whose authors he accused of having committed many gross errors, and not having sufficiently answered the objections raised by the Protestant minister Jean Claude, in his 'Reponse au Traité de la Perpétuité de la Foi sur l'Eucharistie.' [CLAUDE.] This involved him in a controversy with the writers of Port-Royal, and laid the foundation of that opposition which he afterwards met with from the learned of his own communion. His next publication, which came out under the assumed name of Recared Simeon, was a French translation of the work of Leo of Modena: 'Cérémonies et Coutumes qui s'observent aujourd'hui parmi les Juifs,' Paris, 1674, 12mo. A second edition appeared in 1681, under the name of the Sieur de Simonville, containing also a supplement respecting the Caraites and the Samaritans, and a comparison between the ceremonies of the Jews and the discipline of the Church. In 1675 he published the 'Voyage de Mont Liban,' from the Italian of Dandini, with notes, and about the same time his 'Factum du Prince de Neubourg, abbé de Feschamps, contre les Religieux de cette Abbaye,' in which work, as was usual with him, he took an opportunity to attack the Benedictines. But the work which rendered him most famous is his 'Histoire Critique du Vieux Testament,' which immediately after its publication (Paris, 1678, 8vo.) was suppressed on the ground that it contained doctrines dangerous to religion and the Church. The work however was so much admired for its learning and criticism, that it was reprinted the year after, and translated into Latin at Amsterdam, 1681, and into English at London, 1682, 4to., by John Hampden. After the publication of his 'Histoire Critique,' Simon left the Congregation of the Oratory, and repaired to Belleville, a village near Caux, where he held a curacy; but in 1682 he resigned his office and removed to Dieppe, and thence to Paris to renew his studies and make arrangements for the publication of other works. In 1684 he published at Frankfort, 'Histoire de l'Origine et du Progrès des Revenues Ecclésiastiques,' under the name of Jerome à Costa, of which a second edition appeared at the same place in 1709, in 2 vols. 8vo. In the same year (1684) he printed in London his 'Disquisitiones Criticæ de variis per diversa Loca et Tempora Bibliorum Editionibus,' which was immediately translated into English. In 1688 he published at Frankfort, under the name of John Reuchlin, 'Dissertation Critique sur la Nouvelle Bibliothèque des Auteurs Ecclésiastiques par Du Pin,' in which he defends some opinions contained in his 'Histoire Critique,' which had been controverted by Du Pin. His next publication was 'Histoire Critique du Nouveau Testament,' Rotterdam, 1689, 4to., an English version of which appeared the same year at London. Besides the above, Simon was the author or editor of many other works. He was unquestionably a man of profound learning and great acuteness, and he contributed in no small degree to lessen the authority of his own church; but a love of controversy, in all its bitterness, and too great a propensity to depreciate and abuse those who happened not to acquiesce in his opinions, rendered him equally obnoxious to Protestants and Roman Catholics. He died at Dieppe, in April, 1712, in the seventy-fourth year of his age.

SIMO'NIDES was a native of Iulis, in the island of Ceos, and was born about B.C. 556. His father's name was Leoprepes, and his grandfather's Simonides, who was also a poet.

Simonides is said to have obtained great fame as a poet at an early age. He appears to have remained in Ceos till about B.C. 525, when he removed to Athens, where he was honourably received by Hipparchus, and became acquainted with Anacreon and Lasus (Plato, *Hipparch.*, p. 228; Aelian, *Var. Hist.*, viii. 2). After the murder of Hipparchus, he took refuge with the Aleuadae and Scopadae in Thessaly, whose praises he celebrated in some of his poems (Theocrit., xvi. 34, &c., with the Schol.; compare Plato, *Protagor.*, p. 333). How long Simonides remained in Thessaly is not known; but after the battle of Marathon (B.C. 490) we find him again at Athens. For the next ten years he appears to have lived chiefly at Athens, and to have been actively engaged in the pursuit of his art. After the banishment of Themistocles and the death of Pausanias, with both of whom he lived on intimate terms, he retired to Hieron's court at Syracuse (Aelian, *Var. Hist.*, ix. 1; iv. 15), where he died, B.C. 467, in his ninetieth year.

Most of the poems of Simonides are lost; but enough have come down to us to enable us to form some opinion of the merits of his poetry, and to justify the panegyrics which the antient writers bestow upon him. He was one of the most distinguished of the elegiac poets, and particularly excelled in the pathetic, as we see in his 'Lament of Danae' and in other remains of his poetry. He is stated to have had the superiority over Aeschylus in an elegy which he composed in honour of those who died at Marathon, when the Athenians instituted a contest of the chief poets. But some of Simonides's best poems are epigrams, which species of poetry he carried to greater perfection than any of his predecessors. The Persian war gave constant employment to this muse, as he was frequently employed by the different states of Greece to adorn with inscriptions the tombs of those who fell, and the votive offerings which were dedicated in the various temples. We still possess several of his epigrams belonging to this period. Of these one of the most celebrated is upon the Spartans who fell at Thermopylæ: 'Stranger, tell the Lacedæmonians that we are lying here in obedience to their laws;' and another upon the Athenians who fell at Marathon: 'Fighting in the van of the Greeks, the Athenians at Marathon destroyed the power of the glittering Medians.' Simonides also celebrated the sea-fights of Artemisium and Salamis in two larger poems, which are often referred to by antient writers, but of which no fragments have come down to us.

The remains of the poems of Simonides have been published by Schneidewin, under the the title of 'Simonidis Carminum Reliquiæ,' Bruns., 1835, 8vo. The Greek letters Ξ, Ψ, Ω, are said to have been invented by Simonides, who is also stated to have converted the sign of the aspirate H into a long e.

Simonides of Ceos must not be confounded with Simonides of Amorgus, which is an island not far from Paros. The latter was a contemporary of Archilochus, and flourished from B.C. 693 to 662. He wrote iambics, in which he attacked private persons, and of which a few fragments have come down to us. He also wrote a satirical poem upon women in the iambic metre, which is still extant. The fragments of his poems have been published by Welcker Bonn, 1835.

(Müller's *History of the Literature of Greece*, p. 125, &c., 140; Bode's *Geschichte der Lyrischen Dichtkunst der Hellenen*, vol. i., p. 318, &c.; vol. ii., p. 122, &c.)

SIMONY is the buying or selling for money or other corrupt consideration any ecclesiastical benefice, dignity, or preferment, or the causing a clerk to obtain or to relinquish such benefice or preferment for corrupt consideration. The word is derived from Simon, who is mentioned in the 'Acts of the Apostles' (viii., 18-24) as having offered money to Peter and John in order that he might obtain from them apostolical powers.

Whether Simony was an offence at common law is at least doubtful. Lord Coke, it is true, repeatedly says that the common law doth abhor Simony, and adduces as evidence of this repugnance the fact that a patron of a living could not by the common law recover a pecuniary compensation for being impeded in his presentation. It is certain that Simony is a great ecclesiastical offence by the canons both of the Roman Catholic and of the Anglican church. The 40th canon of the latter (A.D. 1603), 'to avoid the detestable crime of Simony,' and because the buying and selling of spiritual and ecclesiastical functions, &c. 'is execrable before God,' prescribes an oath to be ministered to every person assuming such offices, by which he denies that he has made any Simoniacal payment, contract, or promise, directly or indirectly, for procuring such ecclesiastical office, or that he will perform any such contract made on his behalf without his knowledge.

But the offence now depends on the statute 31 Elizabeth, c. 6, although the word Simony is not mentioned in the act. By that statute any person presenting to a benefice for profit or 'any such corrupt cause' forfeits to the crown that presentation and double the value of one year's profit of the benefice, and the person paying the price is rendered incapable of holding that benefice (§ 5). Any person so corruptly admitting or instituting another is subject to the like pecuniary penalty, and the benefice is 'eftsoons merely void,' and the presentation reverts to the patron as though the party so admitted were dead (§ 6). An incumbent resigning or exchanging a benefice with cure of souls for profit, and the person with whom the bargain is made, both forfeit double the price, together with two years' profit of the benefice (§ 8). Any person obtaining for such corrupt consideration the ordaining of a minister, forfeits 40*l.*, and the minister so corruptly ordained forfeits 10*l.* and is incapable of holding any ecclesiastical preferment for seven years. The modifications which that enactment has undergone by subsequent statutes and decisions will be found under the head Benefice (p. 223-6).

The indignation of ecclesiastical authorities against Simony, excepting in so far as relates to the admission of persons into the ministry, seems somewhat unreasonable, and is certainly inefficacious, for the trafficking in ecclesiastical preferment is extensively pursued. Provided that the qualification of persons for holy orders is carefully investigated before their admission to the ministry, and that the discipline of the church can be strictly and easily enforced by the bishops and other ecclesiastical authorities, the reason why a minister who has been admitted to a benefice for a pecuniary consideration should be disqualified for his office is not very obvious, especially in a country where advowsons are by law a marketable commodity, and the legislature recognises a bargain for compelling a minister to resign a benefice in favour of another person, provided the latter is within certain degrees of consanguinity to the patron.

(Rogers's *Ecclesiastical Law;* Bacon's *Abridgment,* 'Simony.')

SIMOOM. [Samieli.]

SIMPLE BODIES. [Atomic Theory.]

SIMPLE CONTRACT debts are those which are contracted without any engagement under the seal of the debtor or of his ancestor, and which are not of record by any judgment of a court. Money due for goods bought by the debtor is the most usual of simple contract debts; and the declaration against a defendant, in an action for goods sold, usually alleges that the defendant undertook (or contracted) to pay the plaintiff the sum due. Simple contract debts are the last which are payable out of a deceased person's estate, when the assets are insufficient. [Executor.]

SIMPLI'CIUS, a native of Tibur, succeeded Hilarius as bishop of Rome, A.D. 467. He had a controversy with Acacias, Patriarch of Constantinople, about precedence. Simplicius dedicated several churches at Rome to particular saints, and he also framed several regulations concerning the discipline of the clergy of Rome. He died A.D. 483.

SIMPLI'CIUS was a native of Cilicia, and lived in the reign of Justinian. He had been trained in the study of philosophy by Ammonius, and appears to have been engaged in teaching at Athens when Justinian issued the decree which imposed perpetual silence on the few yet remaining votaries of heathen science and superstition in that city. Simplicius and six of his philosophic friends, who were resolved not to abandon the religion of their forefathers, left Athens, to seek in a foreign land the freedom which was denied to them at home. They went to Persia, where Chosroes then reigned, expecting to find all their hopes realised; but when they saw the actual state of affairs in the East, they repented of the steps which they had taken, and declared that they would rather die on the borders of the empire than enjoy the favours and the wealth which the barbarian monarch might bestow upon them. They returned to their country; and Chosroes, in a treaty which he at the time concluded with the Greek emperor, nobly stipulated that the seven philosophers who had visited his court should be exempt from the penal laws which Justinian enacted against his pagan subjects. Simplicius and his friends, after their return, lived in peace and retirement at Athens, where they devoted the remainder of their lives to the study of philosophy, enjoying the reputation of being wise and virtuous men.

Simplicius wrote Commentaries on Aristotle's Categoriæ, Physica, De Coelo, and De Anima. One of his objects in these commentaries is to reconcile the Platonic and Stoic systems with the Peripatetic school, to which he himself belonged. They are the most valuable of all the extant Greek commentaries on Aristotle; for Simplicius possessed a profound knowledge of his author, as well as of other philosophical writers of antiquity; and as he frequently quotes the opinions of antient philosophers whose works are no longer extant, his commentaries are a fruitful source for those who wish to study the history of antient philosophy. His commentaries are printed in some of the early editions of Aristotle; they are also contained in 'Scholia in Aristotelem, collegit Ch. A. Brandis,' Berlin, 1836, &c.

Simplicius also wrote a Commentary on the Enchiridion of Epictetus, which for its pure and noble principles of morality has commanded the admiration of all ages. The best separate edition of this commentary is that by Schweighaüser, with a Latin translation, in 2 vols., Leipzig, 1800. It has been translated into English by Dr. G. Stanhope, London, 1704, 8vo.; into French by Dacier, Paris, 1715; and into German by Schulthess, Zürich, 1778.

SIMPLON. [Switzerland.]

SIMPSON, THOMAS, a distinguished English mathematician, was born at Market-Bosworth in Leicestershire, August 20, 1710. He appears even in his boyhood to have had a strong inclination for acquiring information by reading and conversation; but his father, who was a weaver, intending that he should follow that occupation, endeavoured to divert him from a pursuit which interfered with the labour of his hands. The impulse of genius however prevailed over the remonstrances of the parent, and the youth, having quitted his father's house, went to reside at Nuneaton, where, in the exercise of his trade, he obtained the means of subsisting, and during the intervals of leisure he indulged his taste for the acquisition of knowledge.

Young Simpson was led to the study of mathematics by having accidentally obtained possession of a copy of Cocker's 'Arithmetic,' to which was annexed a short treatise on algebra; and, similarly to what is related of Tycho Brahé, it is said that he applied himself to astronomy from admiration of the science in consequence of the occurrence (in 1724) of a great eclipse of the sun at the time, which had been predicted. It is added that an itinerant pedlar and fortune-teller instructed him at the same time in the mysteries of judicial astrology, and this art he occasionally practised during several years.

While yet a stripling he married a woman about fifty years of age, the widow of a tailor and the mother of two children, of whom the younger was his senior by two years: all the family however appear to have lived together in harmony, Simpson working at his trade by day, and increasing his income by keeping a private school in the evenings. In 1733 he went to reside at Derby, where he continued to follow the united avocations of weaver and schoolmaster, and where he found means to increase his knowledge of mathematics. With arithmetic, geometry, and algebra he was already acquainted; and now, having obtained a loan of Stone's translation of the Marquis de l'Hôpital's 'Analyse des Infinimens Petits,' he was enabled by the force of genius and unremitting application to make himself master of the direct and inverse method of fluxions. Being thus qualified, he began in or before the year 1735 to write answers to the mathematical questions in the 'Ladies' Diary,' and even to propose questions for solution in that work. Some of the questions have a certain degree of intricacy, and they afford evidence that, at this time, the scientific attainments of Simpson, considering his means, must have been very extensive.

In the year 1735 or 1736 Simpson came to London and took lodgings in Spitalfields, where at first he both worked at the loom and gave instruction, as he had done in the country; but his great abilities becoming known to the world, and being perhaps more conspicuous from the obscurity of his situation, he was enabled to give up his trade and devote himself wholly to science. Having brought his family to the metropolis, he established himself there as a teacher of the mathematics, and employed his leisure hours in extending his researches into the highest branches of the science.

On the death of Dr. Derham, Mr. Simpson was, in 1743, appointed professor of mathematics in the Royal Military Academy at Woolwich; and this post he held during nearly all the rest of his life. He is said to have been successful in acquiring the friendship and esteem of his pupils; and while exerting himself diligently in fulfilling his public duties, he found time to compose numerous works on the most abstruse points in the mathematical and physical sciences.

In 1746 he was admitted a fellow of the Royal Society, and on account of the mediocrity of his circumstances he was excused the payment of the admission fee and the annual subscriptions: several of his mathematical papers were printed in the 'Transactions,' but most of them were afterwards republished in the volumes of his works. In 1760, when the present bridge at Blackfriars was about to be built, Mr. Simpson was consulted with other mathematicians concerning the form which would be most advantageous for the arches; he appears in consequence to have taken some pains in investigating the conditions of the stability of vaults, and to have given the preference to those of a hemi-cylindrical form, but he did not live to complete the work, and the results of his researches have never been made public.

As Mr. Simpson advanced in life, he became gradually a prey to melancholy, which appears to have been increased by the influence of bad habits; his mental faculties were at length so far impaired that he became incapable of performing the duties of his professorship, and in the beginning of the year 1761 he was prevailed on to retire to his native town. The fatigues of the journey increased his disorder, and he died May 14, in that year, in the fifty-first year of his age.

Considering the circumstances attending Simpson's early life, and the laborious occupation in which he was afterwards engaged, it is not without surprise that we contemplate the number of works which he wrote, and the profound research those works display. His first publication, which came out in 1737, was entitled 'A New Treatise of Fluxions,' in which the direct and inverse methods, as they were called, are demonstrated with considerable precision and perspicuity, and agreeably to the manner of Newton; the work also contains several useful applications of the calculus to subjects in natural philosophy and astronomy. Thirteen years afterwards, that is, in 1750, he published 'The Doctrine and Applications of Fluxions,' which he dedicated to the earl of Macclesfield, and which, though it embraces the same subjects as form the body of the 'Treatise,' must, from the numerous improvements it contains, be considered as a separate work.

In 1740 Simpson published 'A Treatise on the Nature and Laws of Chance,' besides 'Essays on several subjects in pure and mixed Mathematics;' and two years afterwards 'The Doctrine of Annuities and Reversions,' with tables showing the values of single and joint lives. These works were followed, in 1743, by 'Mathematical Dissertations on Physical and Analytical Subjects,' among which will be found an investigation of the figure of a planet revolving on its axis, and of the force of attraction at the surfaces of bodies which are nearly spherical; also a theory of the tides and of astronomical refractions. These dissertations were dedicated to Martin Folkes, Esq., the president of the Royal Society.

'An Elementary Treatise on Algebra' was published in 1745; 'The Elements of Geometry,' in 1747; and in the next year 'A Tract on Plane and Spherical Trigonometry,' with the 'Theory of Logarithms.' With the elements of geometry are given notes in which are suggested improvements on some of the demonstrations of Euclid; but in making occasional observations on the notes given in the first edition of Dr. Robert Simson's 'Euclid,' for example on the note to the first proposition of the eleventh book, he has fallen into some slight inaccuracies which have been remarked on in the succeeding editions of the latter work. A second edition of Thomas Simpson's 'Geometry' was published in 1760.

In the year 1752 he published 'Select Exercises in Mathematics,' in which are given many geometrical and algebraical problems with their solutions, and a theory of gunnery; but his last and most valuable work was that which is entitled 'Miscellaneous Tracts' (1754). This consists of eight separate papers, four of which relate to pure mathematics, and the others to physical astronomy. The first paper contains investigations for determining the precession of the equinoxes and the nutations of the earth's axis; the second contains equations for correcting the place of a planet in its orbit on the hypotheses of Bullialdus and Seth Ward; and the third is on the manner of transferring the motion of a comet from a parabolical to an elliptical orbit. In the fourth paper are explained the advantages, in point of accuracy, which arise from using a mean of several astronomical observations instead of one single observation. The fifth contains the determination of certain fluents; the sixth, the resolution of algebraic equations by means of surd divisors; and the seventh, a general rule for the resolution of isoperimetrical propositions. The eighth paper contains the resolution of some important problems in astronomy; the propositions in the third and ninth sections of the first book of Newton's 'Principia' are demonstrated, and the general equations are applied to the determination of the lunar orbit.

In order that the merit of this last paper may be rightly appreciated, it is necessary to observe that about the year 1745 the modern analysis was first applied to the determination of the elements of the orbits of the earth, moon, and planets; these bodies being supposed to perturbate each other's motions by their mutual attractions, as well as to be subject to the general attraction of the sun. In the prosecution of the research, the mathematicians Clairaut, D'Alembert, and Euler particularly investigated the effect of the sun's attraction in causing a progression of the apogee of the moon's orbit, which progression, being a remarkable consequence of perturbation, was considered as a test of the correctness of the general principle and law of attraction which had been assumed by Newton. The first efforts of M. Clairaut showed an amount of progression in the period of a revolution of the moon about the earth, equal to about half only of that which had been determined from astronomical observations ('Mémoires de l'Académie,' 1747); and it is remarkable that both D'Alembert and Euler obtained at the same time a like erroneous result. This circumstance at first caused some doubts to be entertained of the truth of Newton's hypothesis, that the force of attraction varies inversely as the square of the distance: but the process employed by the three mathematicians being one of successive approximations only, it was afterwards discovered by Clairaut that, on continuing the process, the second step in the approximation produced a quantity nearly equal to that which had been obtained by the first step; and thus the computed progression was found to coincide with the results of observation. Now Simpson, employing a differential equation of motion like that which had been used by the foreign mathematicians, obtained the values of its terms by means of indeterminate coefficients; a method which entirely avoided the inaccuracy resulting from the species of approximation which they had adopted; and thus he arrived at once at the true value of the progression.

The 'Tracts' were not published till seven years after Clairaut's 'Mémoire' came out, and it appears that, in the interval, that mathematician during a visit to England had an interview with Simpson; the latter states however, in the preface to his 'Tracts,' that previously to having had any communication with M. Clairaut, he had discovered that the movement of the moon's apogee could be accounted for on the Newtonian law … There is therefore no reason to doubt th… the merit of arriving at a determination … to confirm the truth of that law by a process entirely his own: the whole investigation exhibits profound mathematical skill, and fully entitles him to the character of having been one of the ablest analysts, for all the purposes of practical science, of which the country can boast.

Mr. Simpson continued during the whole of his life his contributions to the 'Ladies' Diary,' of which work he was the editor from 1754 to 1760.

**SIMSON, ROBERT**, one of the many mathematicians who have given a lustre to the universities of Scotland, was a son of Mr. John Simson, of Kirton Hall in Ayrshire, and was born in October, 1687. About the year 1701 he was sent to the university of Glasgow, where he acquired that proficiency in the learned languages which he retained during all his life, and at the same time he made considerable progress in moral philosophy and theology, being destined by his father for the church. Young Simson soon however found a pursuit more congenial to his taste in the study of mathematics, and chiefly of the antient geometry: to this subject he applied himself at first as a relief from what he considered as a more laborious occupation, and it became at length almost the sole employment of his life.

In 1710 Mr. Simson made a visit to London, where he remained about a year, and where he became acquainted with Dr. Halley, Mr. Caswell, Dr. Jurin, and Mr. Ditton; from the conversation of the last gentleman, who was then mathematical master of Christ's Hospital, he gained, not as a pupil, but as a friend, a considerable accession to his knowledge of science.

On the resignation of Dr. Robert Sinclair, Mr. Simson was appointed, in 1711, to succeed him as professor of mathematics in the university of Glasgow. He then applied himself to the duties of his office, and regularly gave lectures on five days in each week during the session of seven months. This practice he continued for nearly fifty years; but in 1758, being then seventy-one years of age, he was obliged to employ an assistant, and three years afterwards the Rev. Dr. Williamson, who had been one of his pupils, was appointed his successor.

In 1735 Dr. Simson published in 4to. a 'Treatise on Conic

Sections,' and a second edition in 1750: in this work the investigations are conducted agreeably to the spirit of the antient geometry, and propositions are introduced expressly that, it might serve as an introduction to the treatise of Apollonius on the same subject.

By the advice, it is said, of Dr. Halley, Simson early directed his attention to a restoration of the works of the Greek geometers, and his first effort was made on the porisms of Euclid: a branch of the antient analysis which is only known from the short account in the works of Pappus. In this difficult task however he succeeded, but his 'Tract' on the subject was not published till after his death. Having acquired a sort of key to that analysis, he undertook a restoration of the 'loci plani' of Apollonius, and this he completed about the year 1738. The work was first published in 1746, and Dr. Simson acquired by it the reputation of being one of the most elegant geometers of the age. Another subject on which the peculiar talents of Dr. Simson were exercised, was the 'sectio determinata' of Apollonius, and this also he was so fortunate as to restore. The work appears to have been commenced at an early period of his life, but it was only published, along with the Porisms, after his death.

A perfect edition of the principal part of Euclid's 'Elements' was the next object of Dr. Simson's labours. Numerous errors were known to exist in the Greek copies, and the correction of these was a task worthy of a scholar who had made the antient geometry almost exclusively his study. An edition of the 'Elements' and of the 'Data' was published in 4to. about 1758, and the work has always enjoyed a high character both for precision in the definitions and accuracy in the demonstrations. It is probable that the British mathematician has even corrected errors which existed in the original text, though his high regard for Euclid has led him to assume that all those which he has discovered have arisen from the negligence or unskilfulness of the antient editors or copyists. Having been very generally used for the purposes of elementary instruction, many editions of this work have since been published.

After his retirement Dr. Simson employed himself chiefly in correcting his mathematical writings; but though he had several works nearly fit for publication, he printed none except a new edition of Euclid's 'Data.' He was seriously ill only during a few weeks previously to his death, which took place October 1, 1768, in the eighty-first year of his age.

In 1776 Earl Stanhope published, at his own expense, and for private circulation, the above-mentioned restorations of Euclid's books of Porisms, and of the two books of Apollonius 'De Sectione Determinata:' together with these works the same nobleman published a tract on the limits of ratios and another on logarithms, both of which had also been written by Dr. Simson. An edition of the works of Pappus was found among the Doctor's MSS., and was sent by his executors to the University of Oxford.

Dr. Simson, though devoted to geometry, was well acquainted with the modern analysis, and the latter was occasionally the subject of his college lectures; it is however to be regretted that so much of his time was spent in the effort to restore the precise works of the antients, when it might have been more profitably employed in forming a connected system of their analysis, and in showing its application to the solution of problems relating to physical science. He was never married, and the greater part of his long life was spent within the walls of the college; his hours of study, his exercises, and even his amusements being regulated with great precision. In his disposition he was cheerful and sociable; and his conversation, which was animated, abounded with literary anecdote and good humour, though he was subject, when in company, to occasional fits of absence. He was a man of strict integrity and pure morals, and he appears to have had just impressions of religion, though he never allowed the subject to be introduced in mixed society.

SIN. One of the few passages of Scripture in which we have something which approaches to the character of a definition relates to this word: 'Sin is the transgression of the law.' (1 *John*, iii. 4.) Within this definition would be comprehended all actual sins, when the word law is interpreted to mean the Christian law, the rule by which the minds of all who profess Christianity are bound; and not merely open palpable offences against the law, such as murder, theft, lying, and the like, but sinful omissions of duty, and those sins which are only those of contemplation and thought: since the Christian rule commands us not to neglect the performance of our duties, and to keep a watch over the thoughts as well as over the actions and words.

It was this comprehensive and most excellent law which was in the mind of the Apostle when he said that 'sin was transgression of the law,' or at least that other divine law which bound the conscience of the Jews. But the expression may be taken to express more generally any law which a person holds in his conscience to be binding upon him, whether it be a law of nature only, or a law in which the natural perception of right and wrong is modified by and mixed with what is received as the will of God concerning us by direct revelation from him.

When the word sin is however applied to any act, it is always, among correct writers or speakers, used with reference, either expressed or implied, to religious obligation, and to the responsibility in which we stand to God, and the liability in which we are to future punishment. 'To do wrong' would express the same act as 'to commit sin;' but we use the former phrase without thinking of the offence which is done against God in any act of the kind; not so when we use the other phrase.

Under this definition it is evident that there may be degrees in sin: and we mention this to remove what we deem an erroneous opinion on this subject, which goes the length of saying that there is really no difference between the slightest violation of any moral obligation and the more heinous transgressions. The error on this point arises out of one of the commonest mistakes in respect of language—confounding words in their abstract with words in their concrete state. It is true that sin in the abstract is one and indivisible, and there are no degrees in it; it expresses that which is most offensive in the sight of a pure, holy, and judging God. But when we say 'a sin,' we then refer to some particular act; and common sense tells us that in all acts in which the law is transgressed there is not the same amount of moral turpitude, the same amount of defiance to the Divine Power, the same injury to society or to our neighbour, and consequently not the same amount of offence in the sight of God. At the same time it cannot be too strongly inculcated upon all to keep a watchful guard upon themselves lest they commit even the smaller offences; for nothing is more certain in the philosophy of mind, than that small offences lead imperceptibly to the toleration of greater, so that the man who thinks little of small offences may become, before he is aware, guilty of those of the most heinous nature.

There is also what divines call Original Sin; a phrase which is differently interpreted by different persons. By some it is considered as being the act of sin committed by our first parents when they transgressed the law which had bound them not to eat of the fruit of a certain tree; and this act of sin is regarded as partaken in by all the posterity of Adam, who were, as it were, existent in him their common father, and as fixing upon all the guilt of his sin, and exposing them to punishment which would be inflicted for this particular sin, to say nothing of their own sin, but for the great redemption. There are many modifications of this notion and many intermediate shades of opinion till we arrive at the view of original sin which represents the nature of man as changed by the transgression in this particular of our common ancestor; so that a nature previously perfectly innocent and free from the least tendency to sin, became changed into one in which the disposition to sin is inherent and the repugnance to the Divine will strong and universal. There are some classes of professing Christians who do not use the phrase original sin, though they admit the proneness of man to sin, attributing it to his ignorance and imperfection, to the violence of his appetites and passions, and in general referring it to that state of probation in which it seems to them to have been the intention of their Maker to place us.

SINAI, MOUNT. [ARABIA, p. 213.]

SINA'PIS, the name of a genus of plants belonging to the natural order Cruciferæ or Brassicaceæ. All the species are known by the name of mustard, a word derived from *mustum ardens*, in allusion to their hot and biting character. The genus is known by its siliquose fruit, which is rather terete with nerved valves; small, short, acute style; subglobose seeds disposed in one row in each cell, and spreading calyx. The leaves are of various forms, lyrate or deeply toothed. The flowers yellow, arranged on terminal bractless racemes. They are chiefly natives of the temperate parts of both hemispheres of the old world. Between 40 and 50 species of this genus are enumerated. Of these two species are well known and much cultivated in this country, *Sinapis nigra* and *S. alba*, the black and white mustard.

*S. nigra*, the black mustard, is known by its smooth, even, somewhat tetragonal siliques closely pressed to the peduncle; lyrate lower leaves, and lanceolate upper leaves. It is found in cultivated fields, waste grounds, and road-sides throughout Europe. The young plants of both black and white mustard are eaten as salad, and are both cultivated for this purpose. The black however differs from the white mustard in the flowers and seed being much smaller, and in the latter being black. But the great purpose for which the black mustard is grown is for the seeds, which when ripened and powdered form the well-known condiment mustard. 'To raise the seed for flour of mustard and other officinal occasions, sow either in March or April in an open compartment, or large sowings in fields, where designed for public supply. Sow moderately thick, either in drills six or twelve inches asunder, or broad-cast, after the ground has been properly ploughed and harrowed, and rake or harrow in the seed. When the plants are two or three inches high, hoe or thin them moderately where too thick, and clear them from weeds. They will soon run up to stalks, and in July, August, or September return a crop of seed ripe for gathering; being tied up in sheaves and left three or four days on the stubble.' (Don's Miller.) Rain damages the crop very much. Black mustard exhausts the soil rapidly. It is cultivated to a great extent in the county of Durham. When once grown it is difficult to extirpate on account of the great vitality of the seeds, which, if buried at almost any depth and for any length of time, will germinate when brought to the surface. In preparing the flour of mustard in this country, the black husk of the seed is separated by delicate sifting. This process, which is not gone through on the Continent, makes the British mustard of so much lighter and more agreeable colour. The mustard on the Continent however is stronger, as the greater proportion of the volatile oil on which the strength of the mustard depends resides in the testa, or husk of the seed, which in this country is thrown away.

*S. alba*, white mustard: siliques hispid, spreading, rather narrower than the ensiform beak: leaves lyrate, smoothish; stem smooth. It is a native of Britain and most countries in the south of Europe. It is frequently cultivated, and when young is eaten as a salad. Its seeds are white, and by expression yield a bland insipid oil perfectly free from acrimony, but leaving behind a cake more pungent than the seeds themselves. In the culture of this plant for salad the seed should be sown once a week or fortnight, in dry warm situations, in February and March, and in shady borders in the heat of summer. They are best sown in shallow flat drills, from three to six inches apart. The seeds should be put in thick and regular, and covered with not more than a quarter of an inch of mould. In winter or early spring it may be grown under a hand-glass, or in hotbeds and stoves.

SINAPIS. Two species of this genus are used in this country to yield the mustard of commerce, S. alba and S. nigra, or white mustard and black mustard. Both are annuals, the latter extensively cultivated in Yorkshire and Durham. Of the former the seeds are large, smooth, not veined or reticulated, and when bruised and mixed with water, do not evolve a pungent odour. The integument or skin is also thin, and the quantity of fixed oil obtained from it is less than from that of the black mustard. White mustard is of a light colour externally (but one variety is blackish), and when reduced to powder, is of a light yellow colour.

The seeds of black mustard are about the size of the head of a common pin, ovato-globose, of a reddish-brown, beautifully veined, internally yellow, oily, and yielding a yellowish-green powder. The chemical constitution of the two is essentially different, as it is only the black mustard which evolves, when bruised and mixed with water, the pungent principle which irritates the eyes, nostrils, and skin. The white mustard possesses a non-volatile principle, which is developed by the addition of water. It is the young plants from this species which are eaten with cress as a salad.

The chemical constitution of black mustard seems to be of the most complex kind. According to Dr. Pereira, it contains myronate of potash, myrosyne, fixed oil, a pearly fat matter, gummy matter, sugar, colouring matter, sinapisin, free acid, peculiar green matter, and some salts, chiefly sulphate and phosphate of lime. The volatile oil does not pre-exist in the mustard, but is formed, when water is added, 'by the mutual action of the contained myrosyne and myronate of potash (sinapisin?).' It may be obtained by distilling one part of the marc (*i.e.* the cake of bruised mustard-seeds which remains after the fixed oil has been expressed) with from five to eight parts of water. It is soluble in alcohol and æther, and also, what is very singular, in water, requiring however five hundred parts for its solution. Water in which it is dissolved is a powerful vesicant and rubefacient. It has been recommended as a counter-irritant in the same cases as sinapisms or mustard-poultices are employed. It possesses the advantage of extreme rapidity of action; and when used in cases of torpor or coma, if on the return of sensibility the patient complains of pain from the application, this can be immediately removed by washing the part with sulphuric æther, a property no other rubefacient agent possesses, and which entitles it to a preference in many cases. It is the only volatile oil of indigenous origin which is heavier than water, its specific gravity being 1·015 at 68° of Fahr. It possesses the same power as other volatile oils in preventing the development of fungi.

The fixed oil is perfectly bland, like that of olive or rape, which last it greatly resembles. It exists to the extent of 20 per cent. in white, and about 28 per cent. in black mustard-seed. To obtain it the seeds are crushed in a mill or between rollers, and the skins should be subjected to pressure as well as the farina or flour. The cake may then be sifted and reduced to a fine powder, as it retains all the pungent properties. In France the oil is generally left in the seeds, which renders them very difficult to powder, and makes it expensive. It is also less potent than English mustard in equivalent quantity. The marc or cake is sometimes used as manure, but this is a waste. The oil is valuable for burning, especially as it does not freeze, except at a temperature below zero. It also forms, with an alkali, a firm good soap. It has been supposed to be anthelmintic as well as purgative, but its medicinal properties are insignificant.

Flour of mustard, mixed with water, forms the well-known condiment so much used with all the more indigestible articles of food, the solution of which it seems to favour by rousing the powers of the stomach. A table-spoonful of mustard in a tumbler of water forms a ready and useful emetic in many cases of poisoning, especially when narcotic poisons have been taken. Added to foot-baths, mustard has a revulsive action, which is often serviceable in the commencement of colds, and when gout has seized the stomach or brain; also when cutaneous diseases have suddenly receded.

Sinapisms are generally directed to be made with vinegar, but water of the temperature of about 100° Fahr. is preferable, and less expensive. French mustard for the table is often prepared with vinegar. Some years ago, the seeds of white mustard, taken whole, in the dose of a table-spoonful, were recommended as a cure for many complaints. This was only an old practice revived, and not free from danger, as the seeds have been known to lodge in the intestines and cause death. See Cullen's 'Materia Medica,' vol. ii., p. 170. Respecting the mustard-plant of Scripture, see 'Trans. of Linnean Society of London,' vol. xvii., p. 449.

SINCAPORE. [SINGAPORE.]

SINCLAIR, SIR JOHN, Bart., third son of G. Sinclair, Esq., heritable sheriff of Caithness, was born at Thurso castle, in the county of Caithness, in the year 1754.

He embraced the profession of the law, and was called to the English bar in 1782, having been admitted a member of the faculty of advocates in Scotland in the year 1775.

In 1780 he was chosen member for his native county, and sat in the house during several successive parliaments, sometimes for Caithness, sometimes for other places. He was created a baronet in 1786, and in 1810 was honoured with a seat at the board of privy council. He was likewise a member of several learned societies, and became extensively known by his writings, which, for more than fifty years, issued rapidly from the press. His death took place at Edinburgh, on December 21, 1835, in the 82nd year of his age.

Sir J. Sinclair did much for the improvement of his country. He established a very useful society in Scotland in 1791 for improving wool, and his exertions led to the formation of the Board of Agriculture in 1793, of which he was the first president. Among the most important of his numerous works may be mentioned his 'Statistical Account of Scotland;' 'History of the Revenue of Great Britain;' and 'Account of the Northern Districts of Scotland.' The first of these is an extraordinary work, and displays an almost incredible amount of labour and research.

SINDE. [HINDUSTAN.]

SINDIA, FAMILY OF. The origin of this celebrated family of Mahratta chiefs and princes is comparatively modern. The family were sudras, of the peaceful tribe of koombee, or cultivators. The first who distinguished himself as a soldier was

RANOJEE SINDIA, who was originally a potail, or head man of a village. The Paishwa Bajerow, who succeeded his father Biswanath Row in 1720, appointed Ranojee to the humble office of bearer of his slippers. A circumstance which seemed to show his fidelity and attachment to his master is said to have led to his promotion. Bajerow one day found him asleep on his back, with the slippers firmly clasped to his breast, and was so much pleased as to appoint him immediately to a station in his body-guard. Ranojee Sindia was active and enterprising, and he was rapidly promoted. In 1743 he had risen to the highest rank of Mahratta chiefs; for when Bajerow came into Malwa in that year, Ranojee signed a bond which was required by the emperor of Delhi, Mahomed Shah, as a surety for the good conduct of his master the Paishwa. Before Ranojee died he had obtained the hereditary government of one-half of the extensive province of Malwa. By his wife, who belonged to his own tribe, he had three sons, Jeypah, Duttagee, and Juttabah; and by a Rajpoot woman he had two sons, Tukajee and Madhajee, of whom

MADHAJEE SINDIA became the head of the family. The date of his birth is uncertain; it was probably about 1743; he was present at the battle of Paniput in 1761, when the Mahrattas were defeated by Ahmed Shah Abdallah and his Afghans, in union with the Rajpoot and Mohammedan princes of northern Hindustan. In this disastrous battle one-half of the Mahratta army, which amounted to 200,000 men, are said to have been slain. Madhajee Sindia was pursued by an Afghan horseman for many miles, who at length overtook him, and left him for dead in a ditch, after having wounded him with his battle-axe in the knee in such a manner as to render him lame for life. The Sindia family, as well as the other Mahratta chiefs, were for a time deprived of all their possessions in Malwa and Hindustan proper; but this was not of long continuance. The Paishwa Bajerow died in 1761, and was succeeded by his son Madhoo Row, under whom, on the death of Mulhar Row Holkar in 1764, Madhajee Sindia became the most powerful of the Mahratta chiefs. Besides being the principal leader of the household-horse of the Paishwa, he had a large army of his own; and the return of Ahmed Shah to Cabul, and the contests among the Mohammedan princes under the weak emperor Shah Alim II., in a few years afforded opportunity to him and his brother Tukajee Sindia to recover their former hereditary government and possessions in Malwa and northern Hindustan.

In 1770, on the invitation of Nujeeb ud Dowlah, who was the minister of Shah Alim, Madhajee Sindia, Bassajee Row, and Tukajee Holkar entered Hindustan proper with their armies, for the purpose of expelling the Sikhs, who had invaded the emperor's territories. This was soon accomplished; and on the death of Nujeeb ud Dowlah in 1771, Madhajee Sindia obtained possession of Delhi, whither he invited Shah Alim to return from Allahabad, where he had been living under the protection of the British since 1755. In December the same year the emperor was crowned with great pomp in his capital. He was not however the less in subjection. Madhajee compelled him to sign a commission by which he appointed the Paishwa vicegerent of the empire; and the Paishwa, by a like commission, appointed Madhajee his deputy.

In 1772, and again in 1773, with his two colleagues Bassajee and Holkar, Sindia invaded and ravaged Rohilcund, and was preparing to cross the Ganges, when the murder of the young Paishwa Narrain Row, the usurpation of the office by his uncle Ragoba, and the appearance of the British and the nabob of Oude, who had been invited to assist the Rohillas, caused him to return to Poona. A confederation of Mahratta chiefs was got up against Ragoba, who, after a reign of a few months, was compelled to fly. Sevajee Madhoo, the posthumous son of Narrain Row, was appointed Paishwa, and Ballajee Pundit, better known as Nana Furnavese, was elected dewan, or minister. The British, on the condition of his ceding to them certain territories, came to the assistance of Ragoba, which occasioned a war between them and the Mahrattas. This war, twice interrupted by treaties which were not completed, continued till 1782, when the treaty of Salbhye was concluded, by which Madhajee Sindia was confirmed in all his possessions, the places taken from him by the British were restored, and he was recognised by them as an independent prince.

Madhajee Sindia had now time and opportunity to prosecute his plans of aggrandisement. In 1785 he again appeared at Delhi, and by the murder of two of the imperial ministers once more got the emperor into his power; he also conquered Agra and Alyghur, and obtained possession of nearly the whole of the Doab. About this time he engaged in his service a Frenchman, De Boigne, who became of the most essential service to him; for by his assistance he formed an army consisting of troops regularly disciplined, he fought pitched battles, besieged fortresses previously deemed impregnable, gradually subjected raja after raja to contribution, and added district after district to his possessions, till he became master of nearly all the territory southwest from the banks of the Ganges to the Nerbudda. The battle of Meerta, gained by De Boigne in 1790 over the collected forces of Joudpoor, had made Sindia master of that principality, as well as of the weaker state of Odeypoor; to these conquests was added soon after that of Jypoor, which was followed in 1792 by the defeat of the troops of Junkajee Holkar, when four corps of regular infantry belonging to Holkar's army, which were commanded by a French officer, were almost utterly destroyed. Sindia himself had returned to Poona in 1791, where he died in 1794.

Madhajee Sindia's life was one of incessant activity; he was engaged in a series of contests in which he displayed great talent and untiring energy, and by which his power and possessions were gradually extended, consolidated, and confirmed. His habits throughout the whole of his career were those of a plain soldier; he was never seduced by luxury, and he despised the trappings of state. Though occasionally guilty of violence and oppression, his life was for the most part unstained by cruelty; his disposition was mild, and he was desirous of improving the countries which he conquered. Towards the British and those states which were unconnected with the Mahratta government he conducted himself as an independent prince, but in matters relating to the Paishwa he paid the most scrupulous attention to all the forms of humility, of which he made a curious display when Sevajee Madhoo Row, at the termination of his minority in 1791, entered upon the duties of his office, and Sindia came to Poona to pay his respects to him. Sir John Malcolm thus relates it: 'The actual sovereign of Hindustan from the Sutleje to Agra, the conqueror of the princes of Rajpootana, the commander of an army composed of sixteen battalions of regular infantry, 500 pieces of cannon, and 100,000 horse, the possessor of two thirds of Malwa, and some of the finest provinces in the Deckan, when he went to pay his respects to a youth who then held the office of Paishwa, dismounted from his elephant at the gates of Poona; placed himself in the great hall of audience below all the mankarries, or hereditary nobles of the state, and when the Paishwa came into the room, and desired him to be seated with others, he objected on the ground of being unworthy of the honour, and, untying a bundle that he carried under his arm, produced a pair of slippers, which he placed before Madhoo Row, saying, 'This is my occupation: it was that of my father.' Madhajee, at the moment he said this, took the old slippers the Paishwa had in use, which he wrapped up carefully, and continued to hold them under his arm; after which, though with apparent reluctance, he allowed himself to be prevailed upon to sit down. It has been supposed that by this affected humility he aimed at obtaining the situation of dewan to the Paishwa; if such however was his object, he was frustrated in it, for Nana Furnavese still retained it.

Madhajee Sindia had no sons. His brother Tukajee had three, of whom the youngest, Anund Row, became the favourite of his uncle, who adopted Dowlut Row Sindia, the son of Anund Row, as his heir.

DOWLUT ROW SINDIA, at the death of his grand-uncle, was only thirteen years of age. He was opposed by the widows of Madhajee, who set up another prince in opposition to him, and he was not established in his power till after several battles had been fought. He married, soon after his accession, the daughter of Sirjee Row Gatkia, an artful and wicked man, who became his minister, to whom is doubtless to be ascribed much of the rapacity and cruelty which marked the early part of Dowlut Row's reign. The seizure and imprisonment of Nana Furnavese, the murder of several Brahmins, the plundering of Poona and the neighbouring places under pretence of paying the expenses of his marriage; and the aiding of Casee Row Holkar in the murder of his brother Mulhar Row, are among his early atrocities; in addition to which it should be mentioned, that when Sirjee Row Gatkia defeated Jeswunt Row Holkar in 1801, he plundered the city of Indore, set fire to the best houses, and murdered many of the inhabitants; in 1802 however Holkar defeated Sindia, and re-established himself in Malwa. But the interference of the British at length put a stop to this career of spoliation and bloodshed. The Paishwa Bajerow, having been defeated by Jeswunt Row Holkar in 1802, fled to Bassein, and placed himself under the protection of the British, by a treaty, the chief conditions of which were, that he should cede to them the island of Salsette, and they should restore him to the office of Paishwa. After many fruitless negociations with Sindia and the Raja of Berar, the British resident left the court of Sindia, August 3, 1803, and war was commenced on the 8th by an attack on the fortress of Ahmednugghur by Major-General Wellesley, which he soon took, and followed up on the 25th of September, 1803, by the battle of Assaye, when he gained a complete victory over the confederated forces of Sindia and the Raja of Berar, which were under the command of the French general Péron, and greatly more numerous than his own. In Hindustan Proper, General Lake, on the 29th of August, 1803, defeated Sindia's forces in the Doab, took the strong fort of Alyghur, and afterwards the cities of Delhi and Agra. In the short period of five months was included a series of the most brilliant and decisive victories; the battles of Delhi and Laswaree, of Assaye and Arghaum, the reduction of the strong forts of Ahmednugghur, Alyghur, Agra, Gwalior, Asserghur, and Cuttack, besides a number of inferior conquests. The two Mahratta chiefs were compelled to sue for peace separately. Sindia's brigades, which had been trained under De Boigne and Péron, and which amounted to at least 40,000 well-disciplined infantry, were destroyed; 500 guns, cast in the foundries which Madhajee had established, were taken; and by the treaty of December, 1803, he was compelled to cede to the British the Upper Doab, Delhi, Agra, Saharunpoor, Meerut, Alyghur, Etawah, Cuttack, Balasore, the fort and territory of Baroach, &c., amounting altogether to more than 50,000 square miles. By a treaty of defensive alliance, February 27, 1804, he engaged to receive a British auxiliary force in those dominions which he was suffered to retain, which were still large, and which were considerably increased, after the subjugation of Holkar, by the territory of Gohud and the strong fort of Gwalior, which were given up to him by the treaty of Muttra, November 23, 1805, one of the conditions of which treaty was, that his father-in-law Sirjee Row Gatkia should be for ever excluded from his councils.

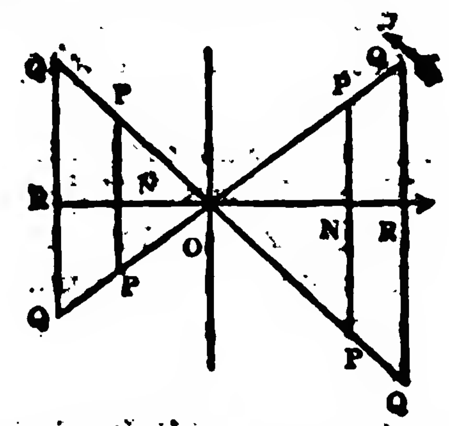
Dowlut Row Sindia, though he retained for a considerable time no friendly feeling towards his British alllies, by whom he had been so severely humbled, never again ventured into a direct contest with them; and after he was freed from the influence of his father-in-law, he became by degrees better disposed towards them; so that in the war of 1818, by which the Mahratta power was entirely destroyed, he prudently kept aloof, though the Paishwa urgently called upon him for his assistance. The consequence was that he retained his territories, and continued on friendly terms with the British till his death, which took place March 21, 1827. He left an army of about 14,000 infantry, 10,000 cavalry, and 250 pieces of ordnance, with territories worth about 1,250,000*l.* per annum.

Janko Row Sindia, the present Raja of Gwalior, was elected by the widow of Dowlut Row, Baiza Bai. She was expelled from his territories in 1833 by Janko Row, who is now (1841) about 19 years of age.

(Malcolm's *Political History of India*; Malcolm's *Central India*; Mill's *British India*; *Biographie Universelle*; *Art de vérifier les Dates*.)

SINE and COSINE. We separate from the article Trigonometry the mere description and properties of these fundamental terms, which, though originally derived from simple trigonometry, are now among the most useful foundations of mathematical expression. For what we have to say on their history, we refer to the article just cited.

According to the antient system of trigonometry, the sine and cosine are only names given to the abscissa and ordinate of a point, not with reference to the position of that point in space, but to the radius vector of that point and its angle. Thus, measuring angles from the line O N, and in the direction of the arrow, the angle N O P has an infinite number of sines and cosines. With reference to the *radius* O P,



P N is the sine and O N the cosine of $\angle$ N O P; but with reference to the radius O Q, Q R is the sine and O R the cosine. The fundamental relation

$$(\text{sine } \theta)^2 + (\text{cosine } \theta)^2 = (\text{radius})^2$$

is obvious enough.

The student always began trigonometry with this multiplicity of definitions, and with the idea of some particular radius being necessary to the complete definition of the sine and cosine. But as he proceeded, he was always taught to suppose the radius a unit; that is, always to adopt that line as a radius which was agreed upon to be represented by 1. Hence he gradually learned to forget his first definition; and, passing from geometry to arithmetic, to use the following: P O being unity, the sine of N O P is P N, which is therefore in arithmetic the fraction which P N is of P O; and the cosine is the fraction which O N is of P O. If Q O had been used as a unit, the result would have been the same; for by similar triangles, R Q is the same fraction of Q O which N P is of P O.

In the most modern trigonometry, and for cogent reasons, the student is never for a moment allowed to imagine that the sine and cosine are in any manner representatives of lines. In a practical point of view, the final definition of the old trigonometry coincides exactly with that of the new; but the latter has this advantage, that all subsequent geometrical formulæ are seen to be homogeneous in a much more distinct manner. The definition is this: The sine of N O P is not N P, nor any number to represent N P; it is the fraction which N P is of P O, considered as an abstract number. Thus if O N, N P, P O, be in the proportion of 3, 4, and 5, P N is $\frac{4}{5}$ of O P: this $\frac{4}{5}$ is the sine of N O P, not $\frac{4}{5}$ of any line, nor any line considered as $\frac{4}{5}$ of a unit; but simply $\frac{4}{5}$, four-fifths of an abstract unit. Similarly the cosine is the fraction which O N is of O P. In just the same manner the abstract number $\pi$, or 3·14159.... is not styled (as it used to be) the circumference of a circle whose diameter is a unit, but the proportion of the circumference to the diameter, the number of times which *any* circumference contains its diameter. We cannot too strongly recommend the universal adoption of this change of style, a slight matter with reference to mere calculation of results, but one of considerable importance to a correct understanding of the meaning of formulæ.

The line O P being considered as positive [Sign], the signs of P N and N O determine those of the sine and cosine; and the manner in which the values of these functions are determined when the angle is nothing, or one, two, or three right angles, is easy enough. The following short table embraces all the results of sign:—

| | O | I | II | III | IV |
|---|---|---|---|---|---|
| Sine | 0 +| 1 + | 0 − | 1 − | 0 |
| Cosine | 1 + | 0 − | 1 − | 0 + | 1. |

Read this as follows:—When the angle $= 0$, the sine $= 0$; from thence to a right angle the sine is positive: at the right angle the sine is $+1$; from thence to two right angles the sine is positive, &c.

The fundamental theorems of the sine and cosine, from which all their properties may be derived, are,

$$\sin(a+b) = \sin a \cos b + \cos a \sin b$$
$$\sin(a-b) = \sin a \cos b - \cos a \sin b$$
$$\cos(a+b) = \cos a \cos b - \sin a \sin b$$
$$\cos(a-b) = \cos a \cos b + \sin a \sin b.$$

introduction of the square root of the negative quantity. It is so general, that exponents of the form $a+b\sqrt{-1}$ shall be included: without this, the new algebra just referred to is not free from the results of INTERPRETATION.

However we may proceed, the series above given for the sine and cosine of $x$ become

$$\sin x = x - \frac{x^3}{2.3} + \frac{x^5}{2.3.4.5} - \frac{x^7}{2.3.4.5.6.7} + \ldots$$

$$\cos x = 1 - \frac{x^2}{2} + \frac{x^4}{2.3.4} - \frac{x^6}{2.3.4.5.6} + \ldots$$

and these series are always convergent. Their present form depends entirely on the unit chosen; if however by $x$ we mean $x^\circ$, $x'$, or $x''$, we must write

$$\sin x = ax - \frac{a^3\,x^3}{2.3} + \frac{a^5\,x^5}{2.3.4.5} - \ldots.$$

$$\cos x = 1 - \frac{a^2\,x^2}{2} + \frac{a^4\,x^4}{2.3.4} - \ldots.$$

where [ANGLE, p. 23] $a$ is ·01745,32925...., ·00029,08882,...., ·00000,48481,.... according as $x$ means a number of degrees, of minutes, or of seconds.

The preceding is enough on the fundamental meanings of these terms, and on their connection with algebra. Some applications will be seen in TRIGONOMETRY.

SINE and COSINE, CURVES OF. By the curve of sines is meant that which has the equation $y = \sin x$, and by the curve of cosines, that which has the equation $y = \cos x$: it being understood that $x$ stands for as many angular units as there are linear units in the abscissa. The undulatory forms of these curves are easily established· and if the ordinate of a curve consist of several of them, as in $y = a \sin x + b \cos x + c \sin 2x$, the several parts of the compound ordinate may be put together in the same manner as that in which the simple undulations are compounded in ACOUSTICS, p. 92. Except as expressing the most simple form of undulating curves, these equations are of no particular use in geometry.

SINE-CURE. Sine-cures are ecclesiastical benefices without cure of souls, and are of three sorts:—1. Where the benefice is a donative [BENEFICE, p. 220], and is committed to the incumbent by the patron expressly without cure of souls, the cure either not existing or being entrusted to a vicar; this is the strictest sine-cure. 2. Certain cathedral offices, viz. the canonries and prebends, and, according to some authorities, the deanery. 3. Where a parish is destitute, by some accident, of parishioners; this last kind has been called depopulations, rather than sine-cures.

Rectors of a parish in which vicars were likewise established with cure of souls have often by degrees exempted themselves from their ecclesiastical functions, and so have obtained sine-cures; but this is rather by abuse than legitimately.

Sine-cures are exempt from the statute of pluralities. (Burn's *Ecclesiastical Law*.)

SINEW. [TENDON.]

SINGAPORE is a British settlement in the East Indies, situated at the most southern extremity of the Malay Peninsula. It consists of the island of Singapore, and about fifty islets dispersed in the sea south and east of the principal island, or in what is called the Straits of Singapore. The territories of this settlement embrace a circumference of about a hundred miles, including the seas and straits within ten miles of the coast of the island of Singapore, and they lie between 1° 8′ and 1° 32′ N. lat., and between 103° 30′ and 104° 10′ E. long.

The island of Singapore occupies about half the space between the two capes with which the Malay Peninsula terminates on the south, Capes Buru and Ramúnia (commonly called Romania). It has an elliptical form, and is about 25 miles in its greatest length from east to west, and 15 in its greatest width. It contains an estimated area of about 275 square miles, and is about one-third larger than the Isle of Wight. It is divided from the continent of Asia by a long and narrow strait called Salat Tabrao, or the old strait of Singapore. This strait is nearly forty miles long, and varies in width between two miles and a quarter of a mile. At its western extremity, near the island of Marambong, it has only a depth of 2½ fathoms, but farther east it is nowhere less than five fathoms deep. This strait was formerly navigated by vessels bound for the China Seas; but the advantages which the Straits of Singapore offer for a speedy and safe navigation are so great, that the Salat Tabrao has not been used since the Straits of Singapore have become known. The last-mentioned strait extends along the southern coast of the island of Singapore, and the most navigable part lies within the British possessions. It is the high road between the eastern and western portions of maritime Asia.

The surface of the island is gently undulating, here and there rising into low rounded hills of inconsiderable elevation. The higher ground rises in general not more than a hundred feet above the sea; the highest hill, called Bukit Tima, which is north-west of the town, but nearer the northern than the southern shores of the island, does not attain 200 feet. The shores of the island are mostly low, and surrounded by mangrove-trees. In a few isolated places low rocks approach the sea, chiefly along the Salat Tabrao. In several places however the coast is indented by salt creeks, which sometimes penetrate into the land three and even five or six miles. When the island was first occupied by the British it was entirely, and is still for the greater part, covered with a forest composed of different kinds of trees, five or six of which are well adapted for every object of house-building. The soil of the interior is composed of sand and of clay iron-stone, mixed up with a large portion of vegetable matter, which gives it a very black appearance. There is a general tendency to the formation of swamps. Rivulets are numerous, but they are of inconsiderable size. Their waters are almost always of a black colour, disagreeable taste, and peculiar odour, properties which they appear to derive from the peculiar nature of the superficial soil over which they pass, which in many parts resembles peat-moss. The water however drawn from wells which are sunk lower than the sandy base is less sensibly marked by these disagreeable qualities.

The climate of Singapore is hot, but equable, the seasons varying very little. The atmosphere throughout the year is serene. The smooth expanse of the sea is scarcely ruffled by a wind. The destructive typhons of the China Sea, and the scarcely less furious tempests which occur on the coasts of Hindustan, are not known. The tempests of the China Sea however sometimes occasion a considerable swell in the sea, and a similar but less remarkable effect is produced by a tempest in the Bay of Bengal. It is only in this way, and as it were by propagation, that the sea is affected by remote tempests, and their effects are particularly remarkable in the irregularity of the tides, which at times run in one direction for several days successively, and with great rapidity. In the numerous narrow channels which divide the smaller islands, their rapidity is sometimes so great that it resembles water issuing through a sluice. The regular and periodical influence of the monsoons is slightly felt, the winds partaking more of the nature of land and sea breezes. To these circumstances must be attributed the great uniformity of the temperature, the absence of a proper continual and periodical rainy season, and the more frequent fall of showers. Few days elapse without the occurrence of rain. According to an average of four years, the number of rainy days was 185, and that of dry only 180. The greatest quantity of rain falls in December and January, and the smallest in April and May. These frequent rains keep the island in a state of perpetual verdure.

The thermometer ranges during the year between 72° and 88°. The mean annual temperature is 80·7° of Fahrenheit. In the four months succeeding February it rises to 82·50°, and in the four months succeeding October it sinks to 79°. The daily range of the thermometer never exceeds ten degrees. Crawfurd states that the climate of Singapore is remarkably healthy, which he attributes to the free ventilation that prevails, and to the almost entire absence of chilling land-winds, but Newbold thinks that it is not so healthy as Malacca, and he ascribes this to the less regular alternations of the land and sea breezes.

Singapore is not rich in agricultural productions. No part of it was cultivated when the British took possession of the place, and at first the soil was considered ill adapted for agricultural purposes. But it now appears that considerable tracts near the town have been cleared by the Chinese, and that this industrious people have succeeded in cultivating different kinds of fruits and vegetables, rice, coffee, sugar, cotton, and especially pepper and the betel-vine (*Piper siriboa*). Only the summits of the higher grounds are barren, but on their slopes and in the depressions between them the soil frequently has a considerable degree of fertility. Tropical fruits succeed very well, such as the mangusteen, pine-apple, cocoa-nut, orange, and mango. The mango is found wild in the forests. The tropical vegetables, as the egg-plant, different kinds of pulse, the yam, the batata, different varieties of cucumber, and some others, grow very well, but the climate is too hot for most European vegetables. The produce of the paddy-fields, as well as of the orchards, is far from being sufficient for home consumption, and accordingly large quantities of rice are imported from Sumatra and Java, and fruits from Malacca.

The animals of Europe have been introduced, but most of them are few in number, as pasture-grounds are scarce. The Chinese however keep a great number of hogs. None of the large quadrupeds of the continent of Asia, such as elephants, rhinoceroses, tigers, and leopards, are met with on the island, but there are several kinds of monkeys, bats, and squirrels; also the *Ictides*, the porcupine, the sloth (*Bradypus didactylus*), the pangolin, the wild hog, and two species of deer, the *Moschus pygmaeus*, which is smaller than an English hare, and the Indian roe (*Cervus munjac*). Sometimes the dugong (*Halicora dugong*) is taken in the straits. It is ten or twelve feet long, and the flesh is considered for flavour and delicacy not inferior to beef: the skin is as strong as that of the hippopotamus. Birds are numerous, especially different kinds of passeres, climbers, and waders, particularly the first, which are remarkable for their novelty and beauty. Tortoises are common. The coral reefs and shoals in the vicinity of Singapore furnish that delicate fern-like sea-weed called aggar-aggar (*Fucus Saccharinus*) in abundance, and it forms an article of considerable export to China, where it is used in thin glues and varnishes. It is made into a very fine jelly by Europeans and the native Portuguese. The average annual produce is 6000 peculs, or 7980 cwt., and it is sold at three dollars the pecul.

In 1819, when the British took possession of the islands, the population amounted to about 150 individuals, mostly fishermen and pirates, who lived in a few miserable huts; about thirty of these were Chinese, the remainder Malays. The first census was taken in 1824, and then the population amounted to 10,683 individuals. Since that period it has constantly been increasing, and at the census of 1836 it was found to amount to 29,984 individuals. More than half of the population were settled in the town of Singapore, which contained 16,148 individuals, of whom there were 12,748 males and 3400 females. West of the town only a few settlements occur along the southern shores of the island, and on some of the small islands near the coast. These settlements constitute the district of Singapore town, and contained in 1836 only 4184 individuals, viz. 2338 Chinese, of whom forty-one only were females, and 1755 Malays, of whom 759 were females; and the remainder, with a trifling exception, Klings and Bugis. The country east of the town, which is named the District of Kampong Glam, contains a greater number of settlements, and they extend to the shores of the Salat Tabrao, and the islands of Tekong and Pulo Ubin, which lie within the strait. In this district there were 9652 individuals, viz. 4288 Malays, of whom 2050 were females; 3178 Chinese, of whom 72 only were females; 1515 Bugis, of whom 672 were females; and the remainder 671 were made up of Javanese, Balinese, and a few Bengalees and Klings. The islands of Tekong and Ubin contained 1901 inhabitants.

The population is composed of nearly all the nations of Southern Asia and the Indian Archipelago, among whom a small number of individuals of European origin have settled, as appears from the following table, which also shows the increase of the population in two years, and the disproportion between males and females:—

*Population of the Island of Singapore in* 1834 *and* 1836.

| Nations constituting the Population. | 1834. Males. | 1834. Females. | 1836. Males. | 1836. Females. |
|---|---|---|---|---|
| Europeans, nearly all Britons | 100 | 38 | 105 | 36 |
| Indo-Britons | 55 | 58 | 65 | 52 |
| Native Christians, mostly Portuguese | 186 | 140 | 224 | 201 |
| Armenians | 32 | 12 | 26 | 8 |
| Jews | 6 | | 4 | |
| Arabs | 55 | 11 | 33 | 8 |
| Malays | 5,173 | 4,279 | 5,122 | 4,510 |
| Chinese | 9,944 | 823 | 12,870 | 879 |
| Natives of the Coast of Coromandel, Chuliahs, and Klings (Telingas) | 1,659 | 69 | 2,246 | 102 |
| Natives of Hindustan | 439 | 155 | 427 | 155 |
| Javanese | 400 | 269 | 580 | 323 |
| Bugis and Balinese | 1,346 | 1,018 | 1,032 | 930 |
| Caffres | 37 | 25 | 17 | 24 |
| Siamese | .. | .. | 2 | 1 |
| Parsees | .. | .. | 2 | .. |
| | 19,432 | 6,897 | 22,755 | 7,229 |



These censuses do not include the military, their followers, nor the convicts, as Singapore is a place of banishment from Calcutta and other parts of Hindustan. The number of these classes of inhabitants may be estimated at about 1200. The Europeans and Chinese constitute the wealthier classes. The Europeans are for the most part merchants, shopkeepers, and agents for mercantile houses in Europe. Most of the artisans, labourers, agriculturists, and shopkeepers are Chinese. The Malays are chiefly occupied in fishing, collecting sea-weed, and cutting timber, and many of them are employed as boatmen and sailors. The Bugis are almost invariably engaged in commerce, and the natives of India as petty shopkeepers, boatmen, and servants. The Chuliahs and Klings are daily labourers, artisans, and petty traders. The Caffres are the descendants of slaves, who have been brought by the Arabs from the Arabian and Abyssinian coasts. The most useful are the Chinese settlers. A common Chinese labourer gets from four to six Spanish dollars a month, a Kling from three to four and a half, and a Malay from two and a half to four and a half. A Chinese carpenter will earn about fifteen dollars a month, a Kling eight, and a Malay only five. The immigration of the Chinese is much favoured by circumstances. Among the dense population of China there are many paupers, who are a burden to the state, and the government connives at the poorer classes quitting the country, though it is contrary to their antient laws. The poor Chinese leaves his country without a penny, and agrees with the captain of the junk to pay from eight to twelve dollars for the passage. On landing he enters into one of the secret societies, which are always formed by the Chinese, and the society pays the passage-money and engages his services. In three months he has generally paid his debt, and then he begins to make his fortune. The Chinese emigrants at Singapore and Penang are mostly from Canton, Macao, or Fokien. Many of those of Fokien become merchants, and show a strong propensity to speculate largely. The Canton emigrants are the best miners and artisans.

It is very probable that the population of the settlement now (1841) amounts to more than 36,000 individuals, which gives more than 130 individuals to a square mile, which is a considerable population even in a country that has been settled for centuries, and is certainly a very surprising population in a country which twenty years ago was a desert.

The town of Singapore stands on the southern shores of the island, in 1° 17′ 22″ N. lat. and 103° 51′ 45″ E. long., on a level and low plain of inconsiderable width, fronting the harbour. It extends about two miles along the shore, but only a thousand yards inland, where it is enclosed by hills from 100 to 150 feet high. The commercial portion of the town occupies the most western extremity, and is separated from the other parts by a salt creek, called the Singapore river, which is navigable for small craft. A good wooden bridge connects it with the eastern part, which contains the dwellings of the Europeans, the public offices, and the military cantonments. Contiguous to this portion of the town is the government-house, which is built on a hill. The most eastern part is occupied by the sultan of Johore, the Malays, and Bugis. The whole of the warehouses, and all the dwelling-houses in the principal streets in their vicinity, are built of brick and lime, and roofed with red tiles. The more distant dwelling-houses are built of wood, but roofed with tiles. It is only on the distant outskirts of the town that there are huts with thatched roofs. The Malays and Bugis live in huts. The population (16,148 individuals) consisted, in 1836, of 8233 Chinese, 3617 Malays, 2157 Chuliahs and Klings, and the remainder was made up by Javanese, Bengalees, Bugis, native Christians, and Europeans. Ships lie in the roads of Singapore at the distance of from one to two miles from the town, according to their draught. With the assistance of lighters, cargoes are discharged and taken in with scarcely any interruption throughout the year.

The lighters convey the goods to the river of Singapore, where they discharge them at a convenient quay, and at the door of the principal warehouses. There is no want of common artisans. The Chinese follow the occupations of shoemakers, bakers, butchers, blacksmiths, gunsmiths, goldsmiths, and carpenters; they also manufacture pearl sago on an extensive scale, for the European market, the material being obtained from the island of Sumatra. They also employ a great number of forges, in which native arms and domestic and agricultural implements are made. These latter articles are mostly sent to the settlements of the Chinese on the different islands of the Indian Archipelago.

The principal public buildings at Singapore are the government-house, a court-house, a gaol, custom-house, Mission chapel, and the Singapore Institution. Sir Stamford Raffles formed a very extensive plan for this institution, which however has not been carried into effect. At present t consists of three schools, English, Malay, and Tamul, and the number of scholars amounts to upwards of seventy. A Chinese school on a large scale was contemplated in 1837, and has probably been opened. Some Chinese youths are to be admitted as students, to reside at the institution, and to receive instruction both in English and Chinese for a term of four or five years. There are several native schools in the town.

If the commerce of Singapore were limited to the produce of the place, it would hardly give employment to two or three vessels. Besides the pearl sago and the iron implements, it exports only a small quantity of pepper and gambier, and perhaps at present coffee of its own growth, together with a large quantity of aggar-aggar. But Singapore has become the London of Southern Asia and the Indian Archipelago. All the nations that inhabit the countries bordering on the Indian Ocean resort to it with the produce of their agriculture and manufacturing industry, and take in exchange such goods as are not grown or produced in their own countries. All of them find there a ready market, which at the same time is well stocked with European goods. This effect has partly been produced by the wise policy of declaring the harbour of Singapore a free port, in which no export or import duties, nor any anchorage, harbour, nor lighthouse fees are levied. The effect of this policy was evident even at the beginning of the settlement. In the first year the exports and imports by native boats alone exceeded four millions of dollars, and during the first year and a half no less than 2889 vessels entered and cleared from the port, of which 383 were owned and commanded by Europeans, and 2506 by natives: their united tonnage amounted to 161,000 tons. In 1822 the tonnage amounted to 130,689 tons, and the total value of exports and imports to upwards of eight millions of dollars.

*Number and tonnage of square-rigged vessels which entered into and cleared at the port of Singapore in* 1835 *and* 1836.

| Names of Places from and to. | INWARD. | | | | OUTWARD. | | | |
|---|---|---|---|---|---|---|---|---|
| | 1835. | | 1836. | | 1835. | | 1836. | |
| | No. | Tonnage | No. | Tonnage | No. | Tonnage | No. | Tonnage |
| Great Britain | 16 | 5316 | 19 | 5596 | 32 | 9432 | 25 | 7210 |
| Continental Europe | 3 | 961 | 3 | 836 | 6 | 1525 | 7 | 1794 |
| America | 3 | 894 | 2 | 709 | 1 | 450 | 7 | 2147 |
| Mauritius | 1 | 698 | 1 | 150 | 2 | 506 | 2 | 506 |
| Bourbon | 1 | 120 | 1 | 286 | 1 | 120 | 1 | 214 |
| China | 62 | 29,351 | 88 | 40,582 | 127 | 61,302 | 134 | 66,023 |
| Manilla | 22 | 5668 | 27 | 6379 | 14 | 2754 | 13 | 1834 |
| Calcutta | 79 | 30,965 | 87 | 38,018 | 64 | 18,108 | 53 | 17,131 |
| Madras and Coast | 13 | 4079 | 18 | 10,237 | 8 | 2518 | 10 | 5771 |
| Bombay and Coast | 45 | 26,770 | 31 | 15,081 | 28 | 16,319 | 34 | 18,704 |
| Arabia | 1 | 448 | 1 | 254 | 3 | 904 | 5 | 1378 |
| Moulmein | 1 | 203 | 3 | 900 | 3 | 510 | 7 | 2214 |
| Ceylon | 5 | 1021 | 4 | 665 | 2 | 550 | 2 | 147 |
| Malacca | 54 | 6535 | 53 | 5812 | 33 | 3945 | 52 | 5390 |
| Penang | 47 | 7703 | 57 | 10,157 | 62 | 7618 | 54 | 8566 |
| Java | 89 | 19,013 | 78 | 16,677 | 75 | 17,025 | 62 | 11,082 |
| Sumatra | 15 | 2652 | 14 | 3417 | 17 | 3439 | 12 | 2759 |
| Rhio | 10 | 2409 | 3 | 304 | 16 | 3219 | 12 | 2009 |
| Siam | 6 | 1984 | 9 | 3050 | 6 | 1683 | 8 | 2862 |
| Cochin China | 5 | 1662 | 4 | 997 | 1 | 250 | 6 | 1686 |
| New South Wales | 9 | 2737 | 6 | 1657 | 2 | 357 | 2 | 394 |
| Cape of Good Hope | | | | | | | 1 | 218 |
| Borneo | 17 | 3013 | 18 | 2494 | 15 | 2815 | 17 | 2688 |
| Tringanu and the other neighbouring ports | 6 | 988 | 7 | 646 | 8 | 825 | 6 | 648 |
| Bally and Eastern Islands | 7 | 1423 | 10 | 1764 | 1 | 405 | 11 | 2047 |
| | 517 | 156,513 | 539 | 166,053 | 517 | 156,974 | 533 | 165,417 |

According to this statement the number of vessels which entered the port in 1836 exceeded the number in 1835 by 22, and by 9540 tons; and the number of vessels which cleared out in the first-mentioned year exceeded that of the preceding year by 16, and by 9443 tons. This statement however does not include the native craft, which are largely used in the intercourse with Sumatra, the Malay Peninsula, Rhio, Borneo, and the neighbouring islands, and which in 1836 amounted to 1484, of 37,521 tons. If these are added, the shipping that entered the port in 1836 amounted to 203,574 tons.

The commerce of the newly established colony increased at first with incredible rapidity. In the year 1824, only five years after its foundation, the imports amounted to 6,914,536 Spanish dollars, and the exports to 6,604,601. In the following year however it suffered some slight diminution, and it may be said that it has been nearly stationary since that period; for in 1835 the imports amounted only to 6,611,778 dollars, and the exports to 6,238,131. In the former account however the exports to and the imports from Malacca and Penang probably were included, whilst they were not taken into account in 1836. In this year goods to the value of 160,970 dollars were imported from Malacca, and others amounting to 168,867 dollars exported to that settlement. The commercial intercourse with Penang was much more important; the goods imported from that settlement were to the value of 426,176 dollars; and those that were exported rose to 544,640 dollars. If these sums are added, the exports in 1835 amounted to 7,325,285 dollars, and the imports to 6,825,277; and the whole commerce exceeded that of 1824 by 631,425 dollars. From 1835 an increase both in imports and exports took place; for in the year ending with the 30th of April, 1837, the imports amounted to 8,243,629 dollars, and the exports to 7,806,965 dollars, exclusive of the trade with Malacca and Penang, so that the difference between that year and the preceding was 1,900,032 Spanish dollars.

The commerce of Singapore may be divided into the Eastern trade, that of the Straits, and the Western trade. The Eastern trade, or that which is carried on with the countries east and south-east of Singapore, comprehends the commerce with China, the Spanish settlement of Manilla, the independent tribes of the Indian Archipelago, the Dutch settlements on the island of Java and at Rhio, and the countries of the Peninsula beyond the Ganges which lie east of the Malay Peninsula. The most important branches of this commerce are those with China, Java, and Siam.

The commerce with China is entirely carried on in Chinese vessels. The Chinese junks come from the ports of Canton, Changlim, and Ampo, in the province of Quantong, from Amoy in the province of Fokien, and from the island of Hainan. They leave their respective ports during the north-east monsoon, about January, and return with the south-west monsoon, which blows from April to October. They perform the voyage from Canton in from 10 to 20 days, and from Fokien in 12 or 15 days. The most valuable, but not the largest of the Chinese junks are from Amoy; the largest come from the province of Quantong, and the smallest and least valuable from Hainan. They bring annually from 2000 to 2500 emigrants to Singapore. The imports from China amounted, in the year ending the 30th of April, 1836, to 712,265 dollars; the most important articles were Spanish dollars, 138,927 in number; raw silk, 113,942 dollars; chinaware, 93,902; tea, 57,509; tobacco, 47,239; cassia, 93,092; nankeens, 25,715; and gold-thread, 11,016 dollars. Minor articles were camphor, copperware, earthenware, ironware, paints, piece-goods, salt, sugar-candy, and woollens. The imports entered under the head of sundries amounted to 152,440 dollars. The exports to China amounted in the same year to 1,079,752 dollars, and consisted chiefly of opium and such articles as had been brought to Singapore from the Indian archipelago Next to opium, which amounted to 252,327 dollars, the most important articles were edible birds'-nests, to the amount of 162,852; tin, 117,386; and trepang, 74,723 dollars. Rice was sent there to the amount of 59,408; pepper, 56,023; betel-nut, 44,962; and ratans, 36,019 dollars. Other articles of importance were woollens (25,064 d.), European piece-goods (20,796 d.), cotton-twist (18,100 d.), raw cotton (16,155 d.), aggar-aggar (16,100 d.), camphor barus (16,155 d.), spices (11,314 d.), tortoise-shell (12,684 d.), sandal-wood (11,143 d.), and lakka-wood (10,800 d.). Minor articles were antimony, birds' feathers, canvas, dragon's-blood, gambier, gold-dust, glassware, European gold thread, hides, garro-wood, spirits, and sundries. Spanish dollars were sent to China to the number of 21,864.

The commerce between Singapore and Manilla is carried on partly by Spanish and partly by American and English vessels. In the year ending on the 30th of April, 1836, the imports from that settlement into Singapore amounted to 166,086 dollars, of which cigars constituted more than one-half the amount, viz. 89,468 dollars. Sugar was brought to the amount of 23,190 dollars, and the other minor articles were trepang, cotton, hides, indigo, mother-of-pearl shells, oils, wines, sapan-wood (8802 d.), spirits, and sundries (8842 d.). Cowries were imported to the amount of 2252 dollars, and also 3000 dollars.

The trade with Celebes is almost exclusively in the hands of the Bugis of Waju, a country on the western side of that island, the inhabitants of which have colonized many islands of the Indian Archipelago, and carry on what may be called the foreign trade of the countries in which they have settled. They disperse the goods obtained at Singapore over most of the islands east of Celebes, as far as the coast of New Guinea, and also over that chain of islands called the Lesser Sunda Islands. [SUNDA ISLANDS.] Their country vessels, called *prahus*, arrive at Singapore during the prevalence of the eastern monsoon. The goods brought by the Bugis from Celebes in 1835 amounted to 214,703 dollars. The most important articles were tortoise-shell (61,878 d.), gold-dust (23,230 d.), mother-of-pearl shells (21,277 d.), coffee (14,098 d.), trepang (12,755 d.), birds'-nests (10,190 d.), and rice (10,501 d.). Minor articles were birds' feathers and birds of paradise, bees'-wax, hides, oils, paddy, ratans, aggar-aggar, spices, and tobacco. The importation of sundries amounted to 23,287 dollars, and 21,650 dollars in specie were also brought to Singapore. The value of the goods exported to Celebes was 339,966 dollars, and the principal articles were derived from Europe and Hindustan, viz. opium (71,162 d.), India piece-goods (66,236 d.), European piece-goods (47,881 d.), cotton-twist (44,244 d.), and copper coin brought from England (12,076 d.). The exportation of raw silk (17,498 d.) and of gambier (13,334 d.) was also considerable. Minor articles were arms, benjamin, or benzoin, chinaware, earthenware, gold thread, ivory, iron and steel (7315 d.) ironware and cutlery (5510 d.), nankeens, stick-lac, tobacco (7569 d.), and woollens (7547 d.). Besides, there went 8792 dollars in specie and 4000 Java rupees.

The commerce between Singapore and the northern coast of Borneo is almost exclusively carried on by native vessels, many of which are of great size; some of them are managed by Bugis. The articles imported from that island in 1835 amounted to 268,074 dollars. The most important article was gold-dust, to the value of 128,748 dollars. Other articles of importance were edible birds'-nests (30,355 d.), ratans (28,776 d.), antimony-ore (24,872 d.), pepper (17,847 d.), and camphor barus (10,478 d.). Minor articles were sago (9102 d.), tortoise-shell (8624 d.), bees'-wax (8360 d.), trepang (5067 d.), ebony, hides, rice, sugar, tobacco, garro-wood (5957 d.), and lakka-wood (4472 d.). The sundries amounted to 7137 dollars, and the dollars in specie to 5290. The goods exported to Borneo were to the value of 231,342 dollars. The largest articles were India piece-goods (110,934 d.), opium (73,490 d.), nankeens (17,311 d.), Malay piece-goods (17,024 d.), and European piece-goods (9150 d.). There were also arms (5507 d.), iron and steel (6775 d.), ironware and cutlery (4449 d.), raw silk (5155 d.), china-ware (3138 d.), gambier (3792 d.), cotton-twist (2627 d.), gunpowder (2001 d.), and China sundries (2309 d.). Minor articles were trepang, benjamin, earthenware, ivory, rice, salt, saltpetre, stick-lac, tea, tobacco, woollens, Java and Eastern sundries. To these were added 9389 dollars in specie, Java rupees to the amount of 4840 dollars, and copper coin to the amount of 100 dollars.

An active commerce is carried on between Singapore and the rival settlement of the Dutch at Rhio. [RHIO.] The imports into Singapore from that place amounted, in 1835, to 111,395 dollars, of which the pepper alone amounted to 82,483 dollars, and the rice to 12,349. Minor articles were bees'-wax, cotton, gambier, hides, sugar, tin (2700 d.), and Java sundries; there were also 7933 dollars in specie imported. The exports to Rhio amounted to 167,461 dollars, and consisted especially of dollars in specie (84,882), European piece-goods (25,938 d.), India piece-goods (16,940 d.), rice (12,911 d.), and opium (5252 d.). Minor articles were anchors and grapnels, arms, chinaware, ebony, iron and steel, lead, oils, paints, ratans, raw silk, sago, salt, spelter, tea, lakka-wood, and sundries, with Java rupees amounting to 400 dollars.

The direct commerce between Singapore and Java is limited to the three ports of Batavia, Samarang, and Surabaya, but European and India goods may be shipped from these places to any other Dutch settlement on the island of Java, or on the other islands of the Archipelago, the Moluccas excepted. The exports of Java to Singapore, in 1835, amounted to 876,321 dollars. The most considerable articles were—tin (155,527 d.), European piece-goods (142,317 d.), birds'-nests (101,949 d.), and rice (86,479 d.). Next to these were tobacco (44,139 d.), spices (41,845 d.), ratans (34,589 d.), spirits, especially hollands (26,938 d.), Java sundries (26,145 d.), pepper (18,176 d.), sandal-wood (18,490 d.), sugar (17,043 d.), gold-dust (14,523 d.), cotton (10,751 d.), and tortoise-shell (10,059 d.). The importations were—woollens (9394 dollars), European sundries (8088 d.), arrack (7856 d.), hides (7519 d.), glass-ware (6275 d.), mother-of-pearl shells (5308 d.), and cotton-twist (4223 d.). Minor articles were camphor, camphor barus, coffee, copper-ware, copper sheathing, ebony, ivory, indigo, oils, paints, provisions, spelter, stick-lac, sugar-candy, tea, wine, garro-wood, and Eastern sundries. There were also brought to Singapore 48,374 dollars in specie, Java rupees to the amount of 4709 dollars, doubloons (980 dollars), and cowries (150 dollars). The exports from Singapore to the ports of Java were of the value of 568,470 dollars. The most valuable articles were India piece-goods (135,900 d.), opium (118,495 d.), and China sundries (70,790 d.). Next to these were raw silk (40,135 d.), cigars (27,112 d.), china-ware (22,336 d.), gunnies (15,252 d.), tea (14,310 d.), wheat (11,749 d.), and nankeens (10,994 d.); European sundries (9231 d.), China piece-goods (7617 d.), India sundries (7308 d.), copper (6433 d.), pepper (6014 d.), iron and steel (5537 d.), Straits sundries (4935 d.), tobacco (4829 d.), saltpetre (4449 d.), tin (4000 d.), and cassia (3340 d.) Minor articles were arms, benjamin, bees'-wax, canvas, cordage, dragons'-blood, earthenware, glue, glass-ware, gunpowder, ivory, lead, oils, provisions, European piece-goods, Malay piece-goods, sago, stick-lac (3758 d.), woollens, and American sundries (2052 d.). There are still to be added 7024 dollars in specie, and Java rupees to the amount of 2000 dollars.

The island of Bally, whose surface does not much exceed 2000 square miles, sent to Singapore goods to the amount of 59,724 dollars, of which the rice alone fetched 37,274 dollars; the tobacco 8288 d., the tortoise-shell 4021 d., and the edible birds'-nests 2755 d. Minor articles were trepang, bees'-wax, coffee, hides, sandal-wood, and Eastern sundries (1230 d.); also 4270 dollars in specie. The goods exported from Singapore to Bally amounted to 65,073 dollars, and consisted especially of opium (24,264 d.), copper coin (13,339 d.), India piece-goods (10,119 d.), and European piece-goods (4583 d.), with several minor articles, as arms, chinaware, earthenware, gold thread, ivory, ironware, China piece-goods, raw silk, woollens, and China sundries, with 200 dollars in specie.

The commerce between Singapore and the several islands which lie in the sea between the settlement and Java, including Banca, is also considerable. The goods brought from them amounted to 133,536 dollars. The larger articles were tin (47,461 d.), trepang (10,662 d.), India sundries (7942 d.), Eastern sundries (5622 d.), pepper (5689 d.), aggar-aggar (4869 d.), and tortoise-shell (4882 d.). Minor articles were bees'-wax, birds'-nests, chinaware, coffee, ebony, ghee, gambier, gold-dust, gram, oils, paddy (3612 d.), ratans, rice, sago, tobacco, wheat, garro-wood, and sapan-wood. There were also 12,296 dollars in specie sent to Singapore. The exports from our settlements amounted to 101,180 dollars, and consisted principally of opium (18,528 d.), India piece-goods (12,450 d.), rice (11,902 d.), raw silk (6858 d.), European piece-goods (5829 d.), and Malay piece-goods (5047 d.). Minor articles were anchors, arms, cotton-twist, earthenware, gambier, gold thread, gunpowder, iron and steel, ironware, nankeens, oils, sago, stick-lac, sugar, tea, tobacco (2500 d.), wheat, garro-wood, spirits, and sundries. Besides, 17,110 dollars in specie and 300 dollars in copper coin were exported.

The commerce between Singapore and Siam is mostly carried on by the Chinese who are settled in that country.

and in junks built at Bangkok and other places. The imports from Siam amounted, in the year terminating with the 30th of April, 1836, to 282,019 dollars. The principal articles were sugar (114,453 d.), rice (43,330 d.), stick-lac (18,264 d.), iron-ware (12,379 d.), sapan-wood (11,674 d.), oils (8485 d.), salt (7959 d.) and Eastern sundries (6483 d.). Minor articles were china-ware (2147 d.), hides, ivory, paddy, India piece-goods, raw silk, sugar-candy (2250 d.), tea, spirits, and China sundries. The imported silver consisted of 12,120 dollars, and ticals to the amount of 35,913 dollars. The goods imported into Siam were of the value of 180,604 dollars. The principal articles were European piece-goods (58,155 d.), India piece-goods (26,845 d.), cotton-twist (19,913 d.), opium (18,925 d.), ratans (9533 d.), ebony (9200 d.), bees'-wax (8475 d.), woollens (5085 d.), gambier (4708 d.), and iron and steel (4560 d.). Minor articles were anchors, arms, betel-nut, earthenware, lead, lakka-wood, and European, India, China, and Eastern sundries. Only 400 dollars, and cowries to the amount of 100 dollars, were sent to Siam.

The commerce with Cochin China is much less considerable. It is likewise carried on by the Chinese settled at Kangkao and Saigun in Camboja, and at Quinhon, Faifo, and Hué in Cochin China. In 1835 the imports from these places amounted to 62,319 dollars, and consisted chiefly of sugar (27,055 d.), rice (10,356 d.), copper (9300 d.), and salt (4388 d.), with some ebony, indigo (2970 d.), iron, oils, raw silk, tea, and Eastern sundries. The exports amounted to 91,073 dollars, and the principal articles were woollens (28,534 d.) and opium (26,019 d.). The other articles, as arms, canvas, copper sheathing, gambier (4708 d.), iron, iron-ware (2485 d.), lead, piece-goods, ratans, saltpetre, spelter, tea, tobacco, sapan-wood, European sundries (3267 d.), and China and Eastern sundries, amounted in general to small sums; but 9500 dollars in specie were exported.

The commerce of the Straits is carried on with the Malay Peninsula and with the island of Sumatra. The harbours on the eastern side of the peninsula, which trade with Singapore, are Pahang, Tringanu, and Calantan, and this trade is rather active. The trade with the western coast of the peninsula is not important, and is almost entirely limited to the harbour of Salangore. In 1835 the imports from these places to Singapore were 319,134 dollars. The most valuable articles were gold-dust (145,040 d.) and tin (107,670 d.). Pepper amounted to 11,273 dollars, and sugar to 4210 dollars. The other articles were trepang, bees'-wax, birds'-nests, coffee, ebony, ghee, hides, ivory, iron-ware, ratans (2216 d.), raw silk, rice, stick-lac, tortoiseshell, garro-wood, lakka-wood, and several other articles; 31,313 dollars were also imported. The exports in 1835 amounted to 316,370 dollars. The principal article was opium, to the amount of 169,348 dollars, and next to it followed cotton-twist (40,867 d.), tobacco (30,034 d.), Malay piece-goods (21,538 d.), European piece-goods (14,994 d.), and India piece-goods (9474 d.). Minor articles were arms, bees'-wax, cotton, earthenware, gambier, iron and steel (3431 d.), iron-ware and cutlery, raw silk, salt, and several sundries. There were also 14,408 dollars sent from Singapore to these ports.

The commerce between Singapore and the island of Sumatra is almost entirely limited to the ports along the eastern coast of the island; there is hardly any commercial intercourse with the Dutch settlements of Bencoolen, Padang, and Trappanuli, which are on the western coast. The commerce of the eastern coast is divided between Singapore and Penang. The ports south of the free port of Batu Bara send their goods to Singapore, whilst those which are farther north visit Penang. The harbours connected with the first-named settlement are Campar, Siack, Indragiri, Iambie, Assahan, and Batu Bara. The goods imported from these places amounted to the sum of 130,921 dollars. The principal articles were coffee (44,842 d.), betel-nut (24,946 d.), cotton (12,134 d.), sago (10,972 d.), ratans (8261 d.) gold-dust (5936 d.), and benjamin (4652 d.). Minor articles were trepang, bees'-wax (3712 d.), dragon's-blood, gambier, hides, ivory, iron, iron-ware, mother-of-pearl shells, paddy, pepper, rice (3682 d.), spices, tortoise-shell, lakka-wood, and several sundries. There were also sent to Singapore 1250 dollars, and Java rupees to the amount of 300 dollars. The goods exported to these places amounted to the value of 165,601 dollars. The principal articles were India piece-goods (37,774 d.), European piece-goods (16,443 d.), raw-silk (12,680 d.) opium (11,767 d.), Malay piece goods (10,837 d.), China sundries (8995 d.), iron (6390 d.), and salt (5915 d.). Minor articles were arms (2475 d.), brass-ware, china-ware (3196 d.), copper sheathing, cotton-twist, earthenware, gold thread, gunpowder, iron-ware, nankeens, oils, stick-lac, tea, tobacco, wheat, woollens, and several sundries. There were also sent to Sumatra 26,906 dollars, and Java rupees to the amount of 1800 dollars.

The western trade of Singapore comprehends that with Calcutta, Madras, Bombay, the island of Ceylon, and Arabia, with the Cape of Good Hope, Mauritius, and Australia, and with Europe and America. In the commerce which is carried on between Singapore and Calcutta larger capitals are employed than in that with China or Great Britain. The imports from Calcutta amounted, in 1835, to 1,191,390 dollars. The principal article was opium, of which 1640 chests, of the value of 957,855 dollars, were imported. Next to it were India piece-goods, which amounted to 135,679 dollars; gunnies (24,745 d.), cotton (21,060 d.), rice (14,042 d.), wheat (13,978 d.), India sundries (8024 d.), and saltpetre (7451 d.). The other articles, as brass-ware, canvas, copper-ware, cordage, copper sheathing, ebony, ghee, hides, mother-of-pearl shells, tobacco, and European sundries, amounted only to small sums. The exports from Singapore to Calcutta were to the value of 876,851 dollars. The most valuable article was gold-dust, which amounted to 473,565 dollars. Tin was sent to the amount of 69,045 dollars, pepper 44,839 d., cigars 29,550 d., European piece-goods 20,669 d., sapan-wood 18,829 d., spirits 17,992 d., ratans 13,465 d., gambier 10,230 d., Java sundries 8402 d., spices 6333 d., Eastern sundries 5721 d., canvass 5931 d., cotton-twist 5619 d., European sundries 4712 d., and tea 4510 d. Minor articles were anchors and grapnels (2014 d.), arms, benjamin, bees'-wax, betel-nut (3589 d.), cassia (3951 d.), copper, cordage, glass-ware, iron and steel, sago (3142 d.), sugar-candy, tobacco, wine, sandal-wood, woollens, and India, China, and American sundries (3916 d.). From Singapore there were sent to Calcutta 70,189 dollars, sicca rupees to the amount of 5092 dollars, Java rupees 1943 dollars, sycee silver 650 dollars, ticals 25,004 dollars, sovereigns 475 dollars, gold mohurs 93 dollars, and cowries 2989 dollars.

The commerce with Madras is much less important. The imports from that place to Singapore amounted only to 151,133 dollars. The largest article was India piece-goods (132,679 d.), and all the others, except ebony (6822 d.), amounted to small sums, and were trepang, earthenware, ghee (2993 d.), mother-of-pearl shells, European piece-goods (2880 d.), rice, wine, spirits, and a few sundries. The exports to Madras amounted to 138,365 dollars, and consisted principally in money, viz. 99,758 dollars in specie, ticals to the amount of 17,000 dollars, sicca rupees 311 dollars, and Java rupees 125 dollars. Cigars, amounting to 5187 dollars, were the most important article. Other articles were benjamin, chinaware, cordage, earthenware, gold-dust, glassware, iron and steel, ironware (2984 d.), European piece-goods, ratans, sago, spices, sugar-candy, woollens (2168 d.), spirits, and some sundries.

The commerce with Bombay is more important. The imports from that place amounted to 156,904 dollars. Opium was to the amount of 117,195 dollars, and India piece-goods 19,578 dollars. The other articles were of little value, and consisted of brassware, cotton (2308 d.), grain, saltpetre, tortoiseshell, woollens, and a few sundries; there were also imported 13,000 dollars. The exports to Bombay amounted to 196,757 dollars. The largest articles were gold-dust (38,683 d.), tin (31,050 d.), sugar (30,489 d.), spices (17,051 d.), piece-goods (11,202 d.), ratans (7598 d.), and cigars (5441 d.). Minor articles were benjamin, betel-nut, cassia (2962 d.), gambier, ivory, oils, pepper, raw silks, sago, garro-wood (3360 d.), sapan-wood, spirits, and several sundries. Bombay received also from Singapore 30,437 dollars, ticals to the amount of 5896 dollars, Bombay rupees 371 dollars, gold coins 92 dollars, and doubloons 62 dollars.

The exports from Singapore to Ceylon amounted only to 3849 dollars, and consisted of chinaware (1097 d.), ratans, cigars, sugar (1358 d.), and a few sundries. But Ceylon sent to Singapore goods to the amount of 30,876 dollars, of which ebony alone was of the value of 19,872 dollars. The other articles, except cordage (4669 d.), were small, and consisted of trepang, birds' feathers, canvas, ghee, hides, India piece-goods, wheat, spirits, and some sundries.

The imports from Arabia to Singapore amounted only to 6395 dollars, and consisted of India sundries (4240 d.), and small quantities of gold thread, tortoiseshell, oils, and salt.

But Singapore exported to Arabia, probably on account of the pilgrims who go from the Malay Peninsula and the Indian Archipelago to Mecca, the value of 70,153 dollars, of which 41,000 dollars were in specie. The largest articles of goods were benjamin (8708 d.), tin (6779 d.), sugar (5885 d.), and garro-wood (4710 d.) Minor articles were gold-dust (607 d.), pepper, India piece-goods, rice, sago, spices, sugar-candy, sapan-wood, and a few sundries.

The imports into Singapore from the Cape, Mauritius, and Australia amounted only to 4860 dollars, of which 2900 were in specie, to which arms and ebony in small quantities were added. But Singapore exported to these places goods to the amount of 88,674 dollars. The most important articles were tin (12,570 d.), cigars (11,272 d.), wheat (11,017 d.), Eastern sundries (8739 d.), sugar (6425 d.), and coffee (5886 d.) The other articles were of less importance, and consisted of antimony, bees'-wax, canvas, cassia, cordage (2608 d.), gram, gambier, gold-dust, gunnies, opium (2400 d.), pepper, paddy, provisions (2302 d.), ratans, rice (2633 d.), sago, sugar-candy, tea (2360 d.), tobacco, wines, spirits, and European sundries (3216 d.).

The United States of America carry on an active commerce with Singapore, but as most of their goods are not adapted for the market of Southern Asia, they generally pay for the goods that they buy with ready money. They imported 87,800 Spanish dollars, and also manufactured goods (14,546 d.), provisions (9853 d.), and American sundries (9122 d.) Minor articles were canvas, cordage, gunpowder, hides, cigars, and tobacco (1556 d.) The whole importation amounted to 125,897 dollars, whilst the articles exported were of the value of 177,526 dollars. The most important articles among the exports were tin (43,751 d.), sugar (38,184 d.), coffee (34,279 d.), pepper (19,793 d.), tortoise-shell (6784 d.), rice (6258 d.), and gunnies (5760 d.). Minor articles were antimony, betel-nut, canvas, cassia (3956 d.), cordage, dragon's-blood, gambier, hides, oils, opium (2660 d.), India piece-goods, ratans (2117 d.), sago, cigars, spices (2400 d.), tea, and several sundries.

As to the harbours of continental Europe, that of Hamburg had the greatest share in the trade. But the imports from these places amounted only to 65,657 dollars, and the largest articles were spirits (12,876 d.), piece-goods (12,700 d.), wine (10,578 d.), and European sundries (16,584 d.). Minor articles were arms, canvas (3000 d.), cordage (2300 d.), cotton-twist (2340 d.), glassware, gold thread, iron (2161 d.), ironware, lead, oils, paints, provisions, salt, and woollens. The goods exported from Singapore to these parts amounted to 115,303 dollars. The largest articles were coffee (42,649 d.), tin (23,319 d.), sugar (15,942 d.), pepper (13,772 d.), European sundries (5329 d.), and cassia (3355 d.). Minor articles of export were bees'-wax, cordage, gold-dust, hides, rice, ratans, sago (2084 d.), cigars (2386 d.), tortoise-shell, sapan-wood, arrack, and some sundries.

The commerce of Singapore with Great Britain is nearly equal to that with Calcutta, and more active than that with China. Great Britain imported into the port of Singapore in the year ending with the 30th of April, 1836, goods to the amount of 1,150,808 dollars. The most important article consisted of several kinds of piece-goods, to the amount of 675,776 dollars. Other articles of importance were cotton-twist (58,994 d.), European sundries (56,772 d.), iron (49,409 d.), woollens (48,976 d.), arms (45,778 d.), earthenware (31,560 d.), glassware (23,480 d.), gunpowder (20,793 d.), copper sheathing and nails (16,728 d.), ironware and cutlery (15,486 d.), anchors and grapnels (14,383 d.), and wines (13,445 d.). The importations were — beer (8281 d.), canvas (5188 d.), cordage (6684 d.), opium (2000 d.), paints (3077 d.), provisions (4220 d.), spelter (3296 d.), and spirits (4724 d.). Minor articles were brassware, gold thread, lead, and tea. Great Britain sent also to Singapore 17,000 Spanish dollars, and copper coin to the amount of 25,072 dollars. The goods shipped at Singapore for Great Britain amounted to the value of 890,017 dollars. The most important articles were tortoise-shell (125,101 d.), tin (101,204 d.), pepper (91,289 d.), raw silk (70,675 d.), sugar (62,406 d.), Eastern sundries (59,586 d.), coffee (53,644 d.), tea (44,376 d.), sago (35,891 d.), spices (34,939 d.), mother-of-pearl shells (27,570 d.), China sundries (25,544 d.), bees'-wax (22,656 d.), cassia (22,298 d.), antimony (18,704 d.), gambier (16,339 d.) hides (13,950 d.), benjamin (8708 d.), Java sundries (7982 d.), ratans (6988 d.), Straits sundries (5943 d.), and ivory (5053 d.). Minor articles were birds' feathers and birds of paradise, camphor, cordage (2524 d.), coloured cotton-twist (2541 d.), dragons'-blood, ebony, gold-dust (4355 d.), nankeens (3440 d.), oils, China piece-goods, rice, cigars, wines, sapan-wood (4262 d.), and India sundries (3106 d.). There were also sent to Great Britain 95 sovereigns, and cowries to the value of 1086 dollars.

Such is the state of the commerce of Singapore at present, but it will probably increase largely in a few years. If the Chinese government continue the vexatious restrictions on our commerce at Canton, it may be expedient to discontinue the direct commercial intercourse with the Celestial empire. Instead of Canton, the settlement of Singapore would be the market to which tea and other articles of Chinese industry would be brought, and our goods adapted for their consumption would be sold. The consumption of all these articles, with the exception of opium, would probably be much increased by such a change, for the Chinese themselves would be able to sell their goods at a less price at Singapore than we have hitherto paid for them at Canton. Our vessels and merchants have to pay very heavy dues, whilst Chinese vessels pay very little in comparison, and are almost entirely free from dues whenever a part of their return cargo consists of rice. This article is at present always to be had at Singapore, and might be grown to an indefinite extent in the eastern districts of Sumatra and in our Tenasserin provinces, if there was a demand for it. Thus it is probable that the Chinese junks would be able to sell tea and other articles at least 10 per cent. less than we pay for them at Canton; besides, the tea is brought to Canton by a transport over land of many hundred miles, whilst the countries in which it grows are near the sea; and it could be brought directly from Amoy, Ningpo, and Sanghae, to Singapore, at a much less expense. The only difference would be, that our vessels, instead of proceeding to Canton, would stop at Singapore; but that can hardly be considered a loss, when we reflect that the increased consumption of Chinese goods, in consequence of the decrease in price, would certainly be attended by an increase of our shipping.

*History.*—On the site of the present British settlement formerly stood the capital of a Malay kingdom. According to the history of that nation, Sang Nila Utama, from Menangkabau in Sumatra, founded the city of Singhapúra (the lion's town) about 1160, and Raffles was able in 1819 to trace the outer lines of the old city. It then was the capital of the kingdom of Malacca. This town was taken in 1252 by a king of Java, and the residence of the king was transferred to the town of Malacca, which was then founded. After that event the town seems gradually to have decayed, and the country to have been abandoned; for when the British, after having restored the town of Malacca to the Dutch in 1816, wished to form a settlement on the shores of the Strait of Malacca or its neighbourhood, that they might not be entirely excluded from the commerce of the Indian Archipelago by the Dutch, they found on their arrival at Singapore that the population of the whole island did not exceed 150 individuals, as already stated. It was then a part of the kingdom of Johore, which had been so reduced by internal discord, that some of the superior officers had become independent. One of them, the Tumungong, or chief justice, had got possession of the island of Singapore and the adjacent country, and from him the British obtained, in 1819, permission to build a factory on the south shore of the island. Soon afterwards a person who had some claim to the throne of Johore came to the British settlement and received a small pension. From this person, who was afterwards king of Johore, and the Tumungong, the British obtained, in 1824, the sovereignty and fee-simple of the island, as well as of all the seas, straits, and islands, for the sum of 60,000 Spanish dollars, and an annuity of 24,000 Spanish dollars for their natural lives. In 1826 Singapore was placed under the provincial government of the Straits Settlement, which is fixed on the island of Penang.

(Crawfurd's *Journal of an Embassy to the Courts of Siam and Cochin China*; Finlayson's *Mission to Siam and Hué*; Moor's *Notices of the Indian Archipelago*, &c.; Newbold's *Political and Statistical Account of the British Settlements in the Straits of Malacca*.)

SINIGAGLIA. [Pesaro et Urbino.]

SINKING FUND. [National Debt.]

SINO'PE, or SINUB. [Paphlagonia.]

SINTOC, or SINDOC, sometimes written Syndoc, is the bark of a species of Cinnamomum, which has been called C. Sintoc by Blume, who says it is a tree 80 feet in height, indigenous in the primeval forests of Java. It is in flattish pieces, of a warm spicy taste, but is seldom seen in this country. It resembles the Calilawan bark, called clove-bark by some, which is called *kulie-lawan* by the natives of Java, and is the produce of a nearly-allied species, the *Cinnamomum Calilawan* of Blume, which grows in similar situations with the former, and of which the bark is used as a spice, and its essential oil is employed as a medicine and as a perfume by the Javanese.

SIOUX INDIANS, one of the most numerous and powerful of the native tribes within the territories of the United States of North America. They inhabit a large tract between 42° and 49° N. lat. and 90° 30′ and 99° 30′ W. long., comprehending nearly the whole of the country between the Mississippi on the east and the Missouri on the west, north of 42° 30′ N. lat., or the present territory of Iowa. They also occupy a large tract of the territory of Wisconsin on the east of the Mississippi, extending along the river from Fort Crawford on the south to the St. Croix river, and the whole country west of the last-mentioned river as far north as Lake Spirit, and westward to the eastern banks of the Mississippi. In these parts their country borders on that of the Algonquins, who occupy the tract west of Lake Superior, but along the banks of the Red River of Lake Winnipeg the Sioux claim the whole tract to the boundary-line of the United States (49° N. lat.). On the banks of the Missouri they are found near Fort Mandan on the north (47° 30′), and at the mouth of the Soldiers' River (42°) on the south, and it is stated that they hunt in the country west of the Missouri between 43° and 47° N. lat. The southern boundary of their country may be marked by a line drawn from the mouth of Soldiers' River to Fort Crawford.

The Sioux Indians call themselves Dacotas, but in their external relations they assume the name of Ochente Shakoan (the nation of the seven fires or councils), a name which refers to a division into seven great tribes, of which they were formerly composed. The French Canadians divide them into Gens du Lac and Gens du Large. The former once lived about Spirit Lake, and are now principally found along the banks of the Mississippi. They live in villages, and have begun to apply themselves to the cultivation of the ground. The Gens du Large, under which name the greater number of the tribes are comprehended, rove about in the prairies between the Mississippi and Missouri, and live almost exclusively by the chase. On these prairies the buffalo is found in uncommon numbers, and probably there is no part of North America in which this animal is so plentiful. Hence the means of subsistence are very abundant, and the nation of the Dacotas is more numerous than any other in such high latitudes. It is stated that the Dacotas themselves compose a population of 28,000 individuals, and that there are above 7000 warriors. The Assiniboines, who live north of the Dacotas, within the territories of the Hudson's Bay Company, formerly constituted an integral portion of the Dacotas, but separated from them in consequence of a quarrel, whence they are named, by the Dacotas, Hoka (the revolted). The Chippewas name them Assiniboines or Stone Boines, and the Dacota they call Boines. This branch of the Dacota Indians is stated to be no less numerous than the Dacotas themselves.

The language of these two tribes differs from that of their neighbours, yet some distinctions of the nature of dialects appear to prevail in some words as spoken by the roving Indians and by the Dacotas. They believe in the existence of a Supreme Being, and a great number of subordinate beings, whose powers and attributes vary much. The Supreme Being is called Wahkan Tanka, or Great Spirit, and they consider him as the Creator of all things, and as the ruler and disposer of the universe; they hold him to be the source of all good and the cause of no evil. The next spirit in respect to power is the Wahkan Shecha, or Evil Spirit, whose influence is exclusively exerted in doing evil. The third divinity is the thunder, whose residence they fix in the west, and some believe that it dwells on the summit of the Rocky Mountains, because in this country all thunder-storms come from the west. The thunder is considered the spirit of war. They offer sacrifices to these three powers, and these sacrifices are accompanied with prayers, but not with dances.

To rise early, to be inured to fatigue, to hunt skilfully, to undergo hunger without repining, are the only points to which the Dacotas think it important to attend in the education of their children.

The Dacotas who live along the Mississippi and St. Peter's river raise maize, and they also cultivate beans, pumpkins, and other vegetables. But these agriculturists constitute only a small portion of the tribe: by far the larger part occupy themselves with hunting wild animals, especially the buffalo. The other animals which abound in their country are beavers, otters, martens, minxes, musk-rats, lynxes, wolverines, elks, moose deer, bears, and wolves. As the wild animals are so abundant in their country, the Dacotas are not obliged to live in small societies, but they generally live in camps consisting of eighty or a hundred lodges, each lodge containing several families. Sometimes there are above three hundred warriors in one encampment.

(Lewis and Clarke's *Travels up the Missouri, &c.*; and Keating's *Narrative of an Expedition to the Source of the St. Peter's River, &c., under the command of Major Long.*)

SIPHNO, called also *Siphanto* and *Sifanno* (by Carpacchi, *Isole del Mondo*), an island in the Archipelago, forming one of the group called the Cyclades. The original name was Merope; it was called Siphnus from a personage of that name. It was colonised by Ionians from Athens. (Herodot., viii. 48.) In the reign of Polycrates, the tyrant of Samos, about 520 B.C., the inhabitants were very flourishing in consequence of their gold and silver mines, and, according to Herodotus (iii. 57), they were the most wealthy of the islanders. They had a deposit at Delphi of the tenth of the produce of the mines. Some exiles, who were expelled from Samos by Polycrates [SAMOS], invaded Siphnus about this time, and levied a contribution of 100 talents. The Siphnians were among the few inhabitants of the Archipelago who resisted the Persian claim of earth and water, and they contributed one small ship of war at the battle of Salamis. (Herod., viii. 48.) Their mines were not afterwards so valuable (Demosthenes, περὶ συντάξεως). Pausanias (x., 11) says that after a time they ceased to send treasure to Delphi, and that in consequence the sea broke in on their mines and destroyed them. Siphnus is very little noticed by antient authors. From Stephanus Byzantinus, Hesychius, and Suidas we learn that the natives were of dissolute manners, insomuch that to do like a Siphnian (Σιφνιάζειν) was a term of reproach. In the work of Constantine Porphyrogennetus 'De Thematibus,' Siphnus is in the theme of Hellas, and in the Synecdemus of Hierocles it forms part of the Provincia Insularum.

In the reign of Henry I., Latin emperor of Constantinople, Marco Sanado, the first duke of Naxos, conquered the island and made it part of his dominions. It passed from him into the hands of the Gozzadini family, who held it till it was wrested from them by Barbarossa, after the capture of Rhodes in the time of Soliman II. It was, in common with the neighbouring islands, partially protected from the oppressions of the Turks by the Venetians; and Tournefort (*Voyage du Levant*) mentions that about 50 years before his visit to the place, so little was the power of the Porte there, that the inhabitants, assisted by a Provençal corsair, expelled the Turks who had been sent there to work the lead-mines.

Siphnus is between 36° 50′ and 37′ 10′ N. lat., and in 25° 10′ E. long.: it is situated to the south-east of Serpho, north-east of Milo, and south-west of Paro, lying immediately opposite Antiparo. It is of an oblong form, narrower at the north than at the southern extremity. Pliny reckons it at about 28 Roman miles in circumference, and Carpacchi (Isole del Mondo) at 40. Tournefort mentions five ports, which were much frequented about 50 years before his visit there: Faro, Vathy, Kitriani, Kironisso, and Kastron, of which Kastron is on the east, Faro and Kitriani on the south, and Vathy on the west side. Another on the east side, Agia Sosti, is marked in the map attached to Fiedler's 'Reise durch Griechenland,' 1841. Tournefort gives the names of five villages, Artimone, Stavril, Catavati, Xambela, and Petali; and of four convents of caloyers, Brici or La Fontaine, Stomongoul, St. Chrysostome, and St. Hélie.

Fiedler mentions only two towns: Kastron, on a strong and rocky hill overlooking the sea, which is the residence of the governor; and Stawri, the Stavril of Tournefort, in the centre of the island. Siphnus is in the pashalik of Naksha. The bishop is also bishop of Milo. The population in the time of Tournefort was about 5000; they were taxed in the year 1700 at 4000 crowns of French money. The lands are chiefly laid out in vineyards; the wine is not so good as that of the neighbouring islands. The chief trade is in silk, figs, honey, wax, sesame, and cotton stuffs, which are celebrated for their quality: the inhabitants import the raw material. There are very few sheep, horses, or horned cattle. The climate is good, and the inhabitants long-lived.

Siphnus was celebrated among the antients for a sort of stone mentioned by Pliny (*Nat. Hist.*, xxxvi. 22), of which drinking-cups were made, which was easily carved, and hardened afterwards by boiling oil. This was a species of talc, according to Fiedler, who gives further particulars relating to the geology of the island. Tournefort was shown the situation of one gold-mine, but could not discover the entrance. Fiedler gives an account of one near Agia Sosti.

The antiquities of the island are few. On the south side, at Porto Plati Gallo, are the remains of an old Greek town. Tournefort speaks of a temple sacred to Pan near the castle, which is also noticed by Carpacchi, and of several marble sarcophagi with good sculpture. There are also Greek inscriptions, which are given by him and Fiedler. The Greek coins of Siphnus are very numerous: they are of gold, silver, and copper. The types on them are the head of Apollo (there was a town called Apollonia in Siphnus, according to Stephanus Byz., 'Απολλωνία), the Chimæra, head of Bacchus, and a dove with wings spread. The coins struck under the emperors have Pallas on the reverse. Kastron is a castle built apparently when the Venetians first occupied the island. Various buildings bear the arms of the Gozzadini family, three of whom were still living there in the time of Tournefort.

SIPHON (σίφων), a tube or pipe. This machine, which has been described in the article HYDRAULICS, was probably invented in the second century B.C., by Hero of Alexandria, who, in the 'Spiritalia,' or Pneumatics, mentions its employment for the purpose of conveying water from one valley to another over the intervening ground.

In order that a fluid may issue from that branch of a siphon which is on the exterior surface of the vessel containing it, it is necessary, as has been stated in the article above mentioned, that the extremity of the branch should be below the surface of the fluid in the vessel; but it may be observed that there is an exception to the rule when the interior diameter of that branch is very small; for example, when it is less than 1-10th of an inch, the interior diameter of the branch in the vessel being considerably greater. For if such a fluid as water or wine be introduced into a bent tube having one branch only very small, and the open ends be uppermost, the top of the fluid in the more slender branch will, by the effect of capillary attraction, stand higher than the top of that in the other branch. It would follow therefore, that if the bent tube were inverted, and the orifice of its larger branch were placed under the surface of the fluid in a vessel, the fluid would begin to issue from the other branch, though the orifice of the latter were a little above the level of that surface.

The effect of a siphon may be produced by capillary attraction alone; for if a piece of cotton cloth have one of its extremities in a vessel of water, and part of it be made to hang over the edge of the vessel, the water will be attracted along the threads of the cloth, and will descend from thence in drops, provided the extremity of the part thus hanging over be below the surface of the water in the vessel.

The phenomena presented by springs of water are explained by supposing that the rain which is absorbed in the earth occasionally finds its way by small channels to some interior cavity, and from thence by other channels, which may be considered as natural siphons, to an orifice on a lower level at the surface of the ground. At this orifice it issues in a stream of water, which continues to flow till the surface of the water in the cavity has descended below the tops of the vertical bends in the channels: the water then ceases to flow till the rains again raise the water in the cavity above those bends. But it sometimes happens that a spring, without ceasing to flow, discharges periodically greater and smaller quantities of water in given times; and this is accounted for by supposing the existence of two cavities either unconnected or communicating with one another by small channels. The channels leading from one of these cavities to the point of efflux are supposed to be below the level of the water in both cavities, so that the water flows through them continually; but if the channels from the other have vertical bends, so that they act as siphons, and at the same time these channels carry off the water in them faster than it can flow from the first cavity to the second, it will be only when the water in the latter cavity is above the level of all such bends that a discharge will take place from thence. As the water in that cavity may only attain the necessary height in consequence of periodical falls of rain, it will follow that corresponding increases in the total quantity of water discharged can only then take place.

For the amusement of young persons, several philosophical toys have been constructed, in which the effects are produced by means of concealed siphons. The siphon is sometimes placed within a figure in the middle or on the edge of a cup, and sometimes between its exterior and interior sides. Such are Tantalus's Cup and the siphon fountain.

SIPHONA'RIA. [SEMIPHYLLIDIANS, vol. xxi., p. 218.]

SIPHONIA. [SPONGIADÆ.]

SIPHO'NIA, a genus of plants of the natural family of Euphorbiaceæ, consisting of two species, but one may be only a variety of the other. This is celebrated as being the tree which yields the large quantities of caoutchouc, called *Cahuchu* by the native Americans, annually imported from Para in South America. The genus has been named Siphonia, from the Greek word *siphon* (σίφων) a tube, from the purposes to which caoutchouc is applied; but it was originally called *Hevea* by Aublet, and the name was changed by Richard from its similarity to *Evea*. The species, or South American caoutchouc, was named *S. Cahuchu* from its Indian name Cahuchu. The same plant was first called *Jatropha elastica* by the younger Linnæus; so that it is known and referred to by three names, and in some works these are considered to indicate distinct plants. Aublet has figured the plant, and Jussieu the details of its inflorescence.

*Siphonia elastica* is a tree fifty to sixty feet in height, common in the forests of Guiana and Brazil, and which has been introduced into the West Indies. Condamine frequently mentions it in his voyage down the Amazon. Caoutchouc [CAOUTCHOUC] is the milky juice of the plant which exudes on incisions being made, and solidifies on exposure to the air. Aublet states that a deep incision is first made into the wood near the bottom of the tree, another is then made longitudinally from the upper parts of the tree down to the first lateral and oblique incision, others are also made along the stem, which terminate in the longitudinal one, and the milky juice which exudes from all is collected in a vessel placed at the original incision. He also states that the nuts are edible, and Mr. Morney says that a caterpillar, which spins a tough coarse kind of silk, feeds on the leaves.

SIPHONI'FERA, M. D'Orbigny's name for an order of testaceous Mollusks, consisting of the families *Spirulidæ*, *Nautilidæ*, *Ammonitidæ*, and *Peristellidæ*, according to the arrangement of M. Rang. The latter family comprises the genera *Ichthyosarcolites* and *Belemnites*.

SIPHONOBRANCHIA'TA, M. De Blainville's name for the first order of his first subclass of Mollusks, *Paracephalophora dioica*. He describes the *Siphonobranchiata* as possessing organs of respiration constantly formed of one or two pectiniform *branchiæ*, situated obliquely on the anterior part of the back, and continued in a cavity, the superior wall of which is provided with a tubiform canal more or less elongated and attached to the columella; and arranges under the order the following families:—SIPHONOSTOMATA; ENTOMOSTOMATA; and *Angyostomata*.

The *Angyostomata* are described as differing very little from the other families as far as the *animal* is concerned, and as possessing a very large subventral foot, which can be folded together longitudinally for the purpose of being withdrawn into the shell.

The aperture of the *shell* of the family is described as being more or less notched anteriorly, generally very narrow, but always much longer than it is wide, and the columella as being straight or nearly straight.

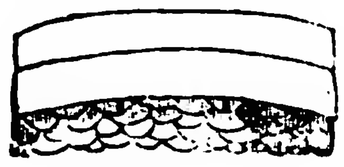
The *operculum* is rudimentary in a certain number of genera, and entirely null in others.

The *genera* arranged under the *Angyostomata* are *Strombus*, *Conus*, *Terebellum*, *Oliva*, *Ancillaria*, *Mitra*, *Voluta*, *Marginella*, *Peribolus*, *Cypræa*, and *Ovula*.

SIPHO'NOPS, Wagler's name for a genus of Cæciloïdians.

The first suborder of the Batrachians, the *Péromèles* of MM. Duméril and Bibron, consists but of one family, the *Ophiosomes* (snake-bodied Batrachians) or *Cæcilioïdians*. Their round elongated form, without either tail or feet, approximates so closely to that of the serpents, that the greater number of authors have arranged them in the order Ophidians, acknowledging at the same time the anomalies which they present, and observing that they ought to form a very distinct group. [SERPENTS, vol. xxi., p. 281.]

The characters which lead to the classification of these reptiles into one family, and to their separation from all others, are, 1st, a body extremely extended in length, and of a cylindrical shape; 2nd, the absence of limbs or lateral appendages proper for locomotion; 3rd, a skin naked in appearance and viscous, but concealing between the circular folds which it forms many rows or rings of flat, delicate, imbricated scales, with free and rounded borders, resem-



Scales of Cæcilia albiventris.

bling those of the greater part of the fishes; 4th, the rounded orifice of their cloaca situated below, very near the posterior extremity of the body, which is sometimes truncated, as it were, and rounded; sometimes obtusely pointed, as in the genus *Typhlops;* 5th, their head, as in all the Batrachians, is articulated to the spine by means of two distinct and separate condyles; 6th, their lower jaw moves upon the cranium without any separate articular bone, and the two branches which form it are short and very solidly soldered together towards the symphysis of the chin.

In the Serpents the occipital bone presents, below the vertebral hole, a single articular eminence, or condyle; and the structure and disposition of the jaws will be remembered by those who have referred to the article SERPENTS. The brevity of the jaws, and their construction in the Cæciliоïdians, reduce the aperture of their mouth to a very small diameter.

The bodies of the vertebræ of the Cæcilioïdians are doubly excavated into cones, instead of being concave before and convex behind. Their tongue is large, papillose, fixed by its borders upon the gums in the concavity of the jaw, and not protractile, nor forked, nor susceptible of entering into a sheath. The disposition and structure of their teeth are noticed in the article SERPENTS and more fully detailed in this.

Professor Owen observes that in the extinct family of the Labyrinthodonts [SALAMANDROIDES], the Batrachian type of organization was modified so as to lead directly from that order to the highest form of reptiles, viz. the loricate or crocodilian Saurians; that some of the existing edentulous genera of the *Bufonidæ* [FROGS] connect the Batrachian with the Chelonian order, and that the family founded upon the Linnean genus *Cæcilia* forms the transition to the ophidian reptiles. 'The characters,' says the Professor, 'which retain the *Cæciliæ* in the Batrachian order are generally known, and may be briefly enumerated as the double occipital condyle, the biconcave vertebræ, the smooth mucous integument with minute and concealed scales, and the branchial apertures retained by the young some time after their birth. In the fixed tympanic pedicle, and the anchylosed symphysis of the lower jaw, the *Cæciliæ* are also far removed from the typical ophidian structures; but the teeth, in their length, slenderness, sharp points, wide intervals, and diminished number, begin to exhibit the characters of the dental system of the serpent tribe.' (*Odontography.*)

The characters above set forth show the connection which these reptiles have with the Batrachians; but there is one striking feature, metamorphosis, which is not yet quite satisfactorily made out. Muller indeed states that he had observed young *Cæciliæ* whose neck was furnished with small branchial fringes, as will be hereafter more particularly noticed.

The departure in a degree of the *Cæcilioïdians* from the Batrachians is marked by the presence of small scales; by ribs which are forked at their vertebral extremity, and much more distinct than in the genus *Pleurodeles;* by the absence of a sternum; and especially by the form and structure of the mouth, the aperture of which is small, the lower jaw being shorter than the upper, and the teeth long, sharp, and generally curved backwards.

The *Cæcilioïdians* resemble many species of the osseous fishes of the division of the *Murænidæ* in the form and structure of the skeleton, the articulation of the jaws, the mode of implantation of the teeth, &c.; but the mode of junction of the head with the spine by means of two condyles, the presence of lungs and nostrils which open distinctly within the cavity of the mouth, and the entire absence of branchiæ, remove these animals from that class.

ORGANIZATION.

*Skeleton.*—The cranium presents above a single vaulted piece, in which no trace of orbits is perceptible. The lower jaw is not articulated with the skull by an intermediate bone, as in the birds, lizards, and serpents, but nearly as it is in the mammals, without however there being the slightest trace of a zygomatic bone. The branches of the lower jaw are joined anteriorly by a true suture, as in the lizards.

Professor Owen states that the teeth are implanted in a single row upon the maxillary, intermaxillary, and palatine bones, the upper jaw being thus provided with two semi-elliptical and sub-concentric series; that there are also two rows of equal-sized teeth on the premandibular bones of the lower jaw in certain species: the *Cæcilia,* he remarks, is the last example in the ascending survey which he has taken of the dental system of this disposition of teeth, which was so common in the class of fishes.

'There are,' writes the Professor, 'twenty teeth in the anterior or outer premandibular row in the lumbricoïd and white-bellied *Cæciliæ,* and ten or twelve of much smaller size in the second row. There are twenty teeth in the outer row of the upper jaw, of which six are supported by the intermaxillaries, and sixteen in the inner or palatine row. All these teeth are long, slender, acute, and slightly recurved. In the rostrated *Cæcilia* the first two teeth of the maxillary and premandibular series are longer and stronger than the rest: they are succeeded by small and recurved teeth; the median margins of the palatal bones are bristled with small teeth; the second row in the lower jaw is represented by two small recurved teeth on the internal border of the premandibular bones. In the modification of the dental system presented by this species may be perceived a retention of the Batrachian type. The annulated Cæcilia (*Siphonops annulatus*) has the maxillary and palatine teeth strong, pointed, and slightly recurved. In the glutinous and two-banded *Cæciliæ* (*Epicrium*), the teeth are slender, acute, and more inclined backwards, thus approaching nearer to the ophidian type; in the latter species (*Epicrium—Rhinatrema—bivittatum*) the palatal series, instead of ranging concentrically with the outer row, is chevron-shaped with the angle turned forwards and rounded off. The teeth of the *Cæcilia* are sub-transparent; their intimate structure corresponds with that of the frog's tooth; but their mode of implantation resembles that of the teeth of the Labyrinthodonts, the base being anchylosed to the parietes of a shallow alveolus.' (*Odontography.*)

In the junction of the vertebræ there is an entire difference from that of the lizards and serpents, and a perfect approximation to that of the perennibranchiate batrachians and fishes. All the bodies of the vertebræ are hollowed, both before and behind, by tunnel-shaped cavities, in which ligamentous fibres are implanted; they are not really articulated, but placed one upon the other. Their superior spinous processes are like those of the *Amphisbænæ* and those in the neck of birds, in other words, depressed so as to present only a slight *carina.* Each body of a vertebra is furnished below with an apophysis curved backwards, and forked forwards for the reception of the eminence of the preceding vertebra. On the sides is seen a small projection, on which one of the bifurcations of the rib is applied, for the other and longer fork rests upon an inferior eminence. The ribs are short, straight, directed backwards, and triangular, forked as in the birds, and united to the vertebræ very nearly in the same manner.

*Respiratory System.*—In *Cæcilia lumbricoïdea* the rudiment of a lung only has been observed; and Meyer, who made this observation, and recognised also scales under the folds of the skin, conceives that these animals are species between the two orders of reptiles which he indicates under the name of *Ophisaurians* on account of the existence of the ribs and the presence of the single lung. Müller announced the existence of branchial holes in a young *Cæcilia* (*hypocyanea*) preserved in the Museum of Natural History at Leyden. He noticed an aperture of the size of a line on each side of the neck, at some lines' distance from the extremity of the buccal slit. This aperture was much wider than it was deep, situated in the yellow stripe which exists on the sides. The edge of the hole was rough (âpre), and in the interior were observed black fringes, which appeared to be fixed to the horns of the *os hyoïdes*, or branchial arcs; but they did not project beyond the external orifices. The holes themselves are in free communication with the buccal cavity. It must be remembered that this observation was made without dissection. The specimen is four inches and a half in length, whilst an adult individual, which showed no trace of holes, was more than a foot long.

*Generation.*—Mayer thinks that he observed two intromittent organs in the *Cæciliæ*. See further the remarks at the end of this article.

SYSTEMATIC ARRANGEMENT.

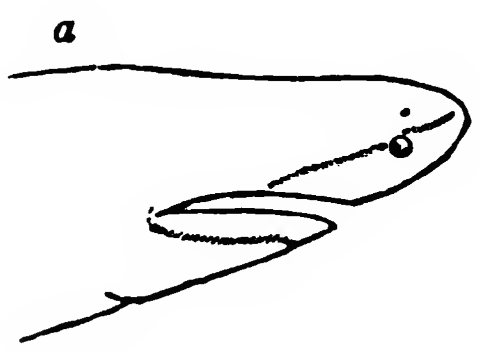
The position assigned to the Cæcilioïdians will be found in the articles REPTILES and SERPENTS. We will only here add that Müller proposes for them the name of *Gymnophids*, his first order of naked amphibians. The second order consists of the *Derotremes*, the third of the *Proteïdians*, the fourth of the *Salamandrines*, and the fifth of the *Batrachians*. Tschudi arranges the *Cæcilioïdians* between the Pipas and Salamanders, adopting the three genera of Wagler, who placed them between the *Amphisbænæ* and the *Batrachians*.

*Geographical Distribution of the Suborder.*—America, Asia, and Africa.

Genera.—*Cæcilia, Siphonops, Epicrium, Rhinatrema.*

*Cæcilia.*

*Generic Character.*—*Head* cylindrical; muzzle projecting. Maxillary and palatine teeth short, strong, conical, and slightly curved. *Tongue* velvety or cellulose, most frequently offering two hemispherical convexities corresponding to the internal orifices of the nostrils. Eyes distinct or not distinct through the skin. A fosset or false nostril below each nostril. (D. and B.)



Head of Cæcilia lumbricoides.

*a*, seen in profile: *b*, mouth open, to show the tongue, the teeth, and the internal orifices of the nostrils. (Dum. and Bib.)

*Geographical Distribution of the Genus.*—Of the four species, one is Asiatic, one African, and two American.

Example, *Cæcilia lumbricoidea.*

*Description.*—The longest and most slender of the whole family, its length being more than ninety times the diameter of its body measured towards the middle. MM. Duméril and Bibron state that individuals fifty-three centimetres long have the thickness of a stout goose-quill; cylindrical; its body however being rather smaller in its last part than its first, excepting at the extremity, where it is always a little convex. The muzzle is wide and rounded; the maxillary and palatine teeth are rather long, sharp, a little sessile backwards, and separated from each other. The tongue adheres to all parts in the concavity formed by the submaxillary branches; its surface exhibits small vermiculiform folds and furrows, and there are two hemispherical convexities, corresponding to the internal orifices of the nostrils, which are great and oval. The external nostrils are two very small lobes situated on each side of the end of the muzzle, under which are seen two very small apertures, upon a portion of the border of each of which there seems to be a small tentacle. MM. Duméril and Bibron were unable to perceive the eyes through the skin, which is perfectly smooth over the whole head; that which envelopes the body is scarcely marked with circular folds, except at the posterior extremity, that is to say, at about the twenty-secondth of the length of the body, where there are from twelve to fifteen. When these folds are raised, large but delicate scales are discovered, bearing much resemblance to those of the carp, forming one or two verticillations, in the composition of which they show themselves to be very distinctly imbricated. The vent is situated under the terminal extremity of the body, which is rounded. The colour is of a brownish or olive tint.

*Locality.*—Surinam.



Siphonops. (Wagler.)

*Generic Character.*—*Head* and *body* cylindrical; muzzle short; maxillary and palatine teeth strong, pointed, and a little recurved; tongue large, entire, adhering on all sides, with a surface hollowed into small vermiculiform sinkings. Eyes distinct through the skin. A fosset or false nostril in front of and a little below each eye.

MM. Duméril and Bibron remark that the species of this genus generally have the muzzle shorter than the *Cæciliæ*, which gives their mouth the air of opening less under the head. The fossets or false nostrils are placed not under the muzzle, but under the eyes, a little more or less forward. The skin which covers the eye is sufficiently transparent to enable the observer to see that organ through. The border of their nostrils and false nostrils are without the least rudiment of a tentacle. Their teeth resemble those of the *Cæciliæ*; but their tongue, whose surface is furrowed with small vermiculiform sinkings, has no hemispherical protuberances.

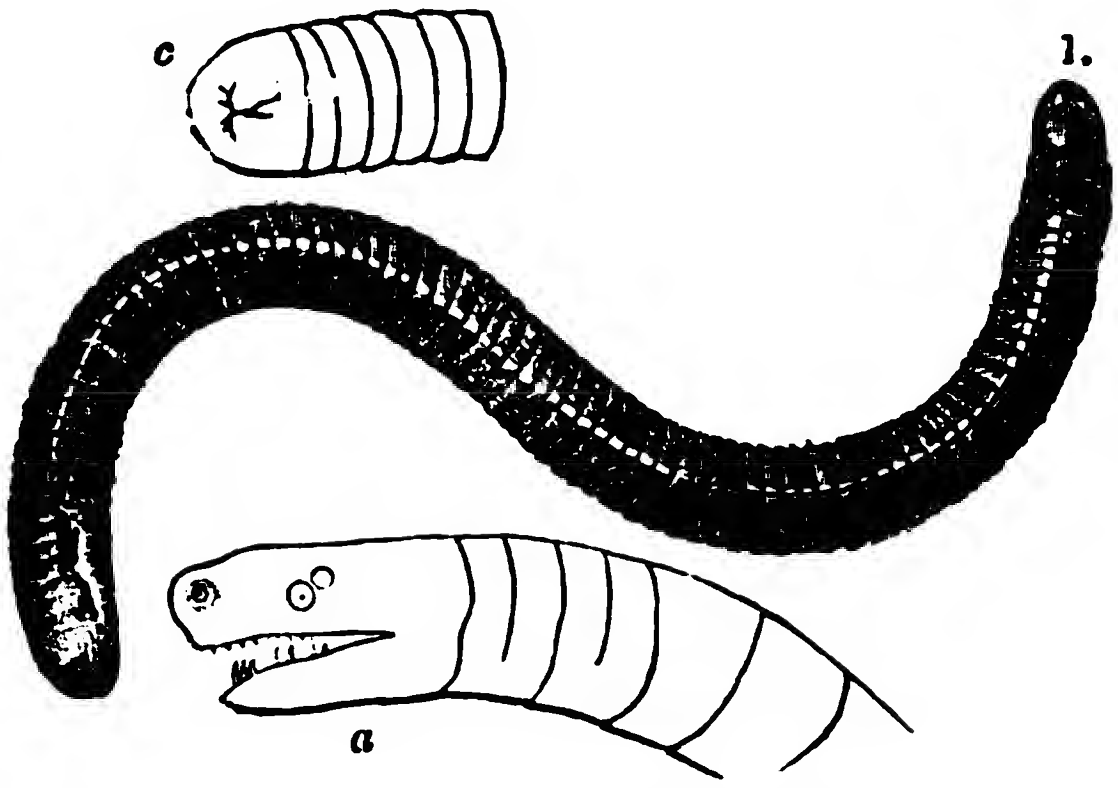
*Geographical Distribution of the Genus.*—Two species only are known, both American.

Example, *Siphonops annulatus* (*Cæcilia annulata*, Auct.).

*Description.*—Muzzle very short, very thick, very much rounded, hardly less than the back of the head. Nostrils opening on the sides of the muzzle, entirely at the end, and a little upward. False nostrils placed below each eye, and very slightly forward. Diameter of the body a sixteenth or seventeenth of its total length: it is rather strong, and perfectly cylindrical, of the same size throughout its extent. There are from eighty-six to ninety annular folds, slightly and equally separated from each other; these cease a little in front of the vent, so that the skin of the terminal extremity of the body, which is rounded, offers no wrinkles.

MM. Duméril and Bibron state that in no individual could they discover scales in the thickness of the skin, where they probably exist, as in the other *Cæciliæ*, but doubtless much smaller and more difficult of exposure, on account of the extremely close tissue, which renders it as it were coriaceous. Colour olive or bluish-ash, but, in all, the circular folds have a white tint.

*Locality.*—Cayenne and Surinam.



1, Siphonops annulatus very much reduced. *a*, head and neck seen in profile; *b*, mouth open, to show the tongue, the teeth, and the internal orifices of the nostrils; *c*, terminal extremity of its body seen below. (Dum. and Bibr.)

Epicrium. (Wagler. *Ichthyophis*, Fitzing.)

*Generic Character.*—*Head* depressed, elongated; *muzzle* obtuse; maxillary and palatine teeth of loose texture (effilées), sharp, and couched backwards. *Tongue* entire, with a velvety surface; eyes distinct through the skin, a fosset (with a tentaculated border?) below the eye, near the border of the upper lip. *Body* subfusiform, with numerous circular folds close-set one against the other. (Dum. and Bibr.)

Example, *Epicrium glutinosum; Cæcilia glutinosa*, Linn.: the only species known.

*Description.*—The diameter of the body taken near the middle is the twenty-second or twenty-third part of the total length. There are about three hundred and twenty-five folds, rather uniformly approximated. Those which occupy the two first thirds of the length of the trunk do not completely surround it, that is to say, they do not descend so as to meet under the belly. These same folds of the two first thirds of the length of the trunk are remarkable for breaking on a point of their circumference, so as to form, each of them, a very open chevron, the summit of which, directed forwards, is found placed on the medio-longitudinal line of the back. The other folds of the body, those, namely, which surround the last third of it, form complete rings. The scales which these folds hide are small, numerous, delicate, transparent, subcircular, and offering on their superior surface a small figure in relief, representing a net with quadrilateral meshes. A yellowish band extends to the right and left all along the body, from the muzzle to the anal extremity: above and below the tint is slate-colour.

*Locality.*—Java and Ceylon.

Rhinatrema. (Dum. and Bibr.)

*Generic Character.*—*Head* depressed, elongated; muzzle obtuse; maxillary and palatine teeth of loose structure (effilées), sharp, and couched backwards. *Tongue* entire, of a velvety surface. *Eyes* distinct through the skin. No fossets, neither under the muzzle nor below the eyes. *Body* subfusiform, with numerous circular folds.

Example, *Rhinatrema bivittatum; Cæcilia bivittata*, Auct.: the only species.

*Description.*—Head a little elongated and slightly depressed, bearing some resemblance in form to that of certain Ophidians, particularly of the *Coronellæ*. The teeth very loosely constructed (effilées), and very much couched backwards; the second row above, instead of forming a curved line like the first, makes an angle rounded at its summit. The diameter of the middle of the trunk is one twenty-sixth of the total length of the body, round which there are three hundred and forty perfectly annuliform folds. There exists a small conical tail. The folds of the skin may be easily raised by a point; and a great number of circular transparent scales, with a surface relieved by projecting lines, forming a sort of net. There is a large yellow band on each side of the body; the submaxillary branches, whose border is brown, are of the colour of the lateral bands, as well as the margin of the cloaca, and a small longitudinal stripe upon the tail.

*Locality.*—Cayenne?

Rhinatrema bivittatum. *a*, its scales.

MM. Duméril and Bibron terminate their account of the *Cæciliæ* with the following information.

M. Leperieur, during his stay at Cayenne, having procured a living *Cæcilia*, which he placed in a vessel filled with water, he saw it bring forth, in the space of some days, from five to seven young, perfectly similar to their mother. Upon this MM. Duméril and Bibron observe that the *Cæciliæ*, in spite of their bearing a greater resemblance to the Batrachians than to the other reptiles, must be ovoviviparous. The fecundation of their germs must be effected in the interior of their body; and their metamorphoses must take place in the body of their mother, as in the case of the Black Salamander of the Alps. [Cecilians.]

SIPHONOSTO'MATA, M. de Blainville's name for his first family of Siphonobranchiata.

The forms comprised under this family are principally to be found under the extensive genus *Murex* of Linnæus. All the known animals belonging to it are carnivorous and marine, and all are furnished with a horny operculum. The *Siphonostomata* are thus subdivided by M. de Blainville:—

* No persistent *bourrelet* on the right lip.

Pleurotoma. (Lam.)

Generic Character.—*Animal?*

*Shell* fusiform, slightly rugose, with a turriculated spire; aperture oval, small, terminated by a straight canal more or less long. The right lip trenchant and more or less incised.

*Operculum* horny.

A. Species in which the incision is a little behind the middle of the lip, and the tube of considerable length.

Example, *Pleurotoma Babylonia.*

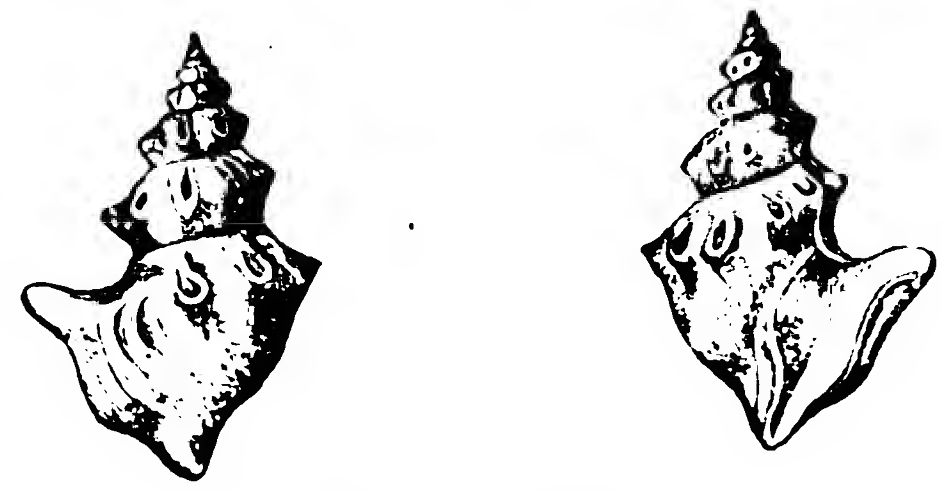
*Description.*—The shell fusiform-turreted, transversely carinated and belted, white, with black-spotted belts, the spots quadrate; whorls convex; tube or canal rather long.

*Locality.*—The East Indian Seas and the Moluccas.

Pleurotoma Babylonia.

B. Species in which the incision is entirely against the spire, and whose tube is short. (Genus *Clavatula*, Lam.)

Example, *Pleurotoma auriculifera.*



Pleurotoma auriculifera.

This genus has been taken on different bottoms at depths varying from eight to sixteen fathoms.

Lamarck characterises 23 living species of *Pleurotoma*, and 30 fossil, the latter mostly from Grignon. Defrance makes the number of fossil species 95.

Mr. G. B. Sowerby has described in addition 36 living species collected by Mr. Cuming, M. Deshayes one, and Dr. Turton one. (*Synopsis Testaceorum; Zool. Proc.*, &c.) M. Deshayes in his tables makes the number of living species 71, and the number of fossil (tertiary) 150. Of these he records *Pl. Cordieri*, *Caumarmondi*, *Vulpecula*, *craticulata*, and a new species as both living and fossil (tertiary). In Europe the principal localities for the fossils are the calcaire grossier, the London clay, the contemporary beds near Bordeaux, and the Subapennine beds. Dr. Mantell notes an imperfect *Pleurotoma* in the blue clay of Bracklesham. Mr. Lea has described and figured eleven fossil species from the new tertiary at Claiborne, Alabama. Professor Sedgwick and Mr. Murchison notice three species, *prisca* (?), *fusiformis*, and *spinosa*, from the Gosau deposit and its equivalents in the Alps; and Mr. Murchison records two species, *Pleurotoma articulata* and *Pl. corallii*, in the Silurian rocks. (*Silurian System.*)

Rostellaria. (Lam.)

This genus, in our opinion, belongs to the Strombidæ, under which article it will be described.

### Fusus. (Lam.)

*Generic Character.—Animal* not differing much from that of *Murex*.

*Shell* fusiform, often ventricose in the middle, rugose, thick, and with a very elevated spire; canal very straight and elongated; aperture oval; right lip trenchant, the left smooth.

*Operculum* horny

Animal of Fusus. *a*, operculum.

A. Turriculate or subturriculate, but not umbilicated species.

Example, *Fusus Colus* (*Murex Colus*, Linn.).

*Description.*—Shell fusiform, narrow, transversely furrowed, white, the apex and base rufous; whorls convex, nodulously carinated in the middle; canal long and slender; the lip sulcated within, and denticulate on the margin.

*Locality.*—The East Indian Ocean.

Fusus Colus.

B. Species subturriculated and umbilicated. (Genus *Latirus*, De Montf.)

Example, *Fusus filosus*.

*Description.*—Shell fusiform-turreted, thick, knotty, but smooth to the touch, whitish yellow girt with numerous orange-red lines; whorls knotty above, the knots hemispherical; the aperture white; the lip striated within.

*Locality.*—The seas of New Holland.

C. Subturriculate species, with the canal notched at the extremity.

Example, *Fusus articulatus*.

*Description.*—Shell fusiform-turreted, very delicately striated transversely, shining, saffron-coloured or violaceous-cœrulescent, girt with articulated bay lines; lip sulcated within; columella with one plait above; canal short and emarginate.

D. Species with the whorls of the spire rounded and convex.

Example, *Fusus Islandicus*.

*Description.*—Shell fusiform-turreted, ventricose below, not knobbed, transversely striated, white, the whorls convex; the lip thin, smooth within; the canal rather short and subrecurved.

*Locality.*—The seas of Iceland.

E. Muricoïd species.

Example, *Fusus muriceus*.

F. Buccinoïd species.

Example, *Fusus buccineus*.

*Fusi* have been found on bottoms of mud, sandy mud, and sand, at depths ranging from the surface to eleven fathoms.

Lamarck records 37 living species of *Fusus*, and 36 fossil, nearly all from France, and principally from Grignon. Defrance makes the number of the latter 70, four of which are analogues from Grignon, and one from the Plaisantin.

M. Deshayes in his tables gives sixty-seven as the number of living species of *Fusus*, and 111 as that of the fossil species (tertiary): of these he records *Fusi craticulatus, rostratus, strigosus, lignarius, sinistrorsus, Tarentinus, antiquus, brevicauda, carinatus, despectus*, and *Peruvianus*, both living and fossil (tertiary). Dr. Mantell notes one species (*longævus*) from the blue clay at Bracklesham. Professor Sedgwick and Mr. Murchison enumerate six species from the Gosau deposit and its equivalents in the Alps. Dr. Fitton notes *Fusi clathratus, quadratus, rigidus, rusticus*, and an indistinct species in the strata below the chalk. (*Observations on the Strata between the Chalk and Oolite*, &c., in *Geol. Trans.*, 2nd series, vol. iv.) Mr. Lea records sixteen new species from the tertiary beds at Claiborne, Alabama, and one from Maryland. (*Contributions to Geology*.)

### Pyrula. (Lam.)

*Generic Character.*

*Shell* pyriform, in consequence of the lowness of the spire; the canal conical and very long or moderate, sometimes slightly notched; aperture oval, rather large; columella smooth and bent; right lip trenchant.

*Operculum* horny.

A. Subfusiform species; the spire being slightly elevated.

Example, *Pyrula carnaria*. (*Pyrula Vespertilio*, Lam.; *Fusus carnarius*, Mart.; *Murex Vespertilio*, Gm.)

*Description.*—Shell subpyriform, thick, ponderous, muricated anteriorly, of a rufous-bay colour; the last whorl crowned above with compressed tubercles; spire rather prominent; the sutures simple; canal sulcated and subumbilicated.

*Locality.*—East Indian Ocean.

Pyrula carnaria.

B. Species with a long and rather narrow tube; spire very short.

Example, *Pyrula Spirillus*.

*Description.*—Shell ventricose anteriorly, the canal very long, delicately striated transversely, white, spotted with saffron-colour; body-whorl abbreviated, carinated in the middle, flattened above, tuberculated below the middle; spire very much depressed, its apex mamilliferous.

*Locality.*—East Indian Ocean. Coasts of Tranquebar.

C. Species with a long and rather narrow tube, but sinistrorsal or left-handed, and with the indication of a plait on the columella or pillar. (Genus *Fulgur*, De Montf.)

Example, *Pyrula perversa*.

*Description.*—Shell sinistrorsal, pyriform, very ventricose, smooth, yellowish-white, ornamented with broad rufo-fuscous longitudinal lines; the last whorl crowned above with tubercles; the upper whorls tuberculiferous at the base; the canal or tube rather long and striated.

*Locality.*—The Antilles. Bay of Campeachy.

D. Species more ventricose and delicate.

Example, *Pyrula Ficus*.

*Description.*—Shell fig-shaped, delicately decussated, cœrulescent-grey; sprinkled with variegated bay or violet spots; transverse striæ the largest and most crowded; the spire short, convex, mucronated at the centre; mouth cœrulescent-violaceous generally.

*Locality.*—The East Indian Ocean. The Moluccas.

Pyrula Ficus.

E. Ventricose species, with a short tube; aperture very large and wide, sensibly notched.

Example, *Pyrula Melongena*.

*Description.*—Shell pyriform, turgidly ventricose, cœrulescent, glaucous, or rufous, banded with white; the whorls channelled at the sutures; the last sometimes unarmed, but more frequently muricated, with various sharp tubercles; spire short, acute; aperture smooth and white.

*Locality.*—West Indian Seas; Antilles.

F. Species still shorter; aperture very wide; the right lip subalated.

Example, *Pyrula abbreviata*.

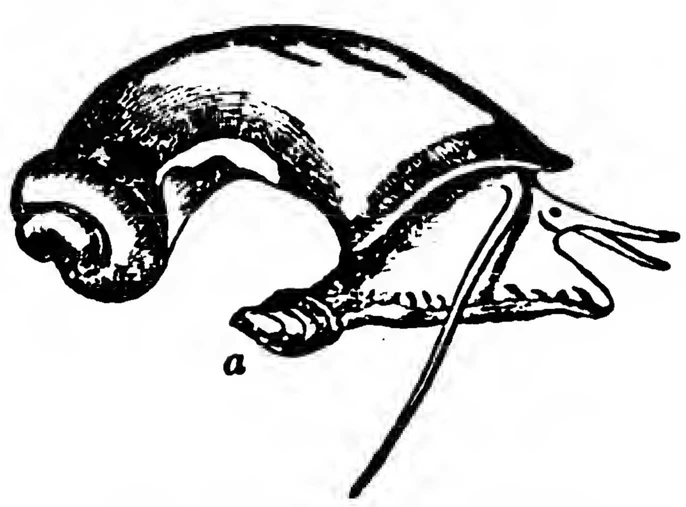
*Description.*—Shell subpyriform, very ventricose, rather rough, transversely sulcated, cinerescent-white; the spire rather prominent; the canal short, widely umbilicated; muriculated on the back with subechinate elevated furrows; outer lip striated within, and its margin denticulated.

*Pyrulæ* have been found on mud, sandy mud, and sand, at depths ranging from the surface to nine fathoms.

The number of living species recorded by Lamarck is twenty-eight. M. Deshayes has described one more (*P. fulva*), and a variety of *P. Vespertilio*, Lam. Lamarck records six fossil species, four from Grignon and Courtagnon, one from Parnes, and one from Houdan. Defrance notices twelve, three of which, from the Plaisantin, he considers as analogous, and other three from the neighbourhood of Bordeaux, analogues also. M. Deshayes, in his tables, makes the number of living *Pyrulæ* thirty-one, and the number of fossil (tertiary) twenty-one; of these last he indicates *Pyrulæ reticulata, Ficus, Melongena,* and *Spirillus*, as being found both living and fossil (tertiary). Dr. Mantell records two species, *bulbiformis ?* and *lævigata*, from the blue clay of Bracklesham in Sussex, and one from the arenaceous limestone of Bognor. Dr. Fitton records three, *Brightii, depressa,* and *Smithii ?*, from the strata below the chalk (gault of Kent). Mr. Lea records three, *Pyrulæ cancellata, elegantissima,* and *Smithii*, from the tertiary beds at Claiborne, Alabama.

### Fasciolaria. (Lam.)

*Generic Character.*




Animal of Fasciolaria. *a*, operculum.

*Shell* fusiform, not very thick, rather convex in the middle, with a moderate spire; aperture oval; canal rather long, sometimes slightly bent; right lip trenchant, often wrinkled internally; columellar lip with some very oblique plaits.

*Operculum* horny.

A. Fusiform, but not tuberculous species.

Example, *Fasciolaria Tulipa*.

*Description.*—Shell fusiform, ventricose in the middle, unarmed, smooth, sometimes orange-rufous, sometimes marbled with white and bay, girt with transverse brown lines unequally congregated; whorls very convex; sutures fimbriated at the margin; tube sulcated; outer lip white and striated within.

*Locality.*—West Indian Seas; the Antilles.

Fasciolaria Tulipa, with the operculum in situ.

B. Fusiform and tuberculous species.

Example, *Fasciolaria Trapezium*.

*Description.*—Shell fusiform, ventricose, tuberculiferous, rather smooth, white or rufescent, girt with rufous lines; the tubercles conical, subcompressed, and in a single series in the middle of the whorls; columella reddish-yellow; outer lip elegantly striated within, the striæ red.

*Locality.*—The East Indian Ocean.

C. Tuberculated and turriculated species.

Example, *Fasciolaria filamentosa*.

*Description.*—Shell elongated, fusiform, turreted, transversely sulcated, white, painted with longitudinal orange-red stripes; middle of the whorls subangulated, and the whorls themselves crowned with short and compressed tubercles; the canal rather long; the outer lip striated within.

*Locality.*—The East Indian Seas.

*Fasciolariæ* have been found on muddy bottoms, at depths ranging from the surface to seven fathoms.

Lamarck records eight living species. Mr. Broderip has described one (*granosa*) brought by Mr. Cuming from Panama. M. de Blainville states that seven fossil species are known. M. Deshayes, in his tables, makes the number of living *Fasciolariæ* seven only, and the number of fossil (tertiary) species five. Professor Sedgwick and Mr. Murchison record one species (*Fasciolaria elongata*) in the Gosau deposit and its equivalents in the Eastern Alps. Mr. Lea notices two, *Fasciolariæ plicata* and *elevata*, in the Claiborne tertiary, Alabama.

### Turbinella. (Lam.)

*Generic Character.*—*Animal* imperfectly known.

*Shell* ordinarily turbinated, but also sometimes turriculated, rugous, thick; spire rather variable in form; aperture elongated, terminated by a straight canal, often sufficiently

Turbinella Rapa.

short; the left lip nearly straight and formed by a callosity hiding the columella, which has two or three unequal, nearly transverse plaits; right lip entire and trenchant.

A. Fusiform and nearly smooth species.

Example, *Turbinella Rapa.*

*Description.*—Shell subfusiform, ventricose in the middle, thick, very ponderous, unarmed, white; the whorls above covering the base of the preceding one; canal rather short; columella subquadriplicated.

*Locality.*—The East Indian Ocean.

B. Turbinaceous and spiny species.

Example, *Turbinella Scolymus.*

*Descripion.*—Shell subfusiform, ventricose in the middle, tuberculated, pale yellow; spire conical, tuberculato-nodose; the last whorl crowned above with great tubercles; canal transversely sulcated; the columella orange-coloured and three-plaited.

*Locality.*—The East Indian Ocean.

C. Turriculated, subfusiform species.

Example, *Turbinella Infundibulum.*

*Description.*—Shell fusiform-turreted, narrow, many-ribbed, transversely sulcated, the ribs longitudinal and thick, the furrows smooth and red, and the interstices yellow; canal perforated, the aperture white.

*Turbinellæ* have been found on bottoms of sandy mud, at depths varying from the surface to eighteen fathoms.

Lamarck records 23 living species, all from the seas of warm climates. Mr. Broderip describes three more brought by Mr. Cuming from the Galapagos Islands, Elizabeth Island, and the Caracas. M. de Blainville observes that when he wrote (1825) no fossils had been found. M. Rang (1829) states that there are fossil species. M. Deshayes, in his tables, makes the number of living species 32 and the number of fossil (tertiary) 3.

* * A persistent *bourrelet* on the right lip.

Columbella. (Lam.)

*Generic Character.*—*Animal* incompletely known.

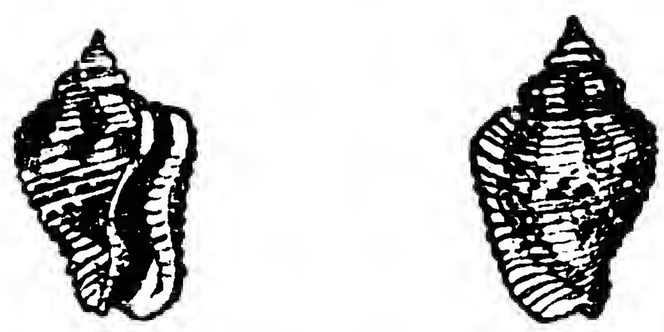
*Shell* thick, turbinated, with a short obtuse spire; aperture narrow, elongated, terminated by a very short canal slightly notched, narrowed by a convexity at the internal side of the right lip and the plaits of the columella.

*Operculum* horny, very small.

Example, *Columbella mercatoria.*

*Description.*—Shell ovate-turbinated, transversely sulcated, white, painted with small, rufo-fuscous, transverse, subfasciculated lines, sometimes banded; outer lip denticulated within.

*Locality.*—The Atlantic Ocean.



Columbella mercatoria.

*Columbellæ* have been found on bottoms of sandy mud and mud at depths ranging from the surface to sixteen fathoms.

Lamarck describes eighteen species, all from the seas of warm climates. M. de Blainville acknowledges that this genus would perhaps be better placed among the operculated *Angyostomata*, or narrow-mouthed testaceous gastropods. M. Rang however arranges it between *Triton* and *Turbinella.* Mr. G. B. Sowerby has described thirty-nine additional species brought home by Mr. Cuming. Defrance notices one fossil species. M. Deshayes, in his tables, makes the number of living species thirty-three and of fossil (tertiary) four. M. de Blainville remarks that the *Columbella avara* of Say has not the character of the thickened right lip.

Triton. (Lam.)

*Generic Character.*—*Animal* a good deal resembling that of *Murex.*

*Shell* oval, with the spire and canal straight and moderate; ordinarily rugose, furnished with few varices, which are scattered and arranged longitudinally; aperture suboval, elongated, terminated by a short open canal; the columellar lip less excavated than the right, and covered by a callosity.

*Operculum* horny and inclined to oval.

Animal of Triton.

*a*, operculum.

A. Comparatively smooth species, with cordons slightly or not at all marked, with the exception of that of the right lip.

Example, *Triton variegatus,* the marine trumpet or Triton's shell.

*Description.*—Shell elongated-conical, trumpet-shaped, ventricose below, girt with very obtuse smooth ribs, white, elegantly variegated with red and bay; the sutures crisped at the margin; the aperture red; the columella wrinkled with white and with a single plait above; the edge of the outer lip spotted with black, the spots bidentated with white.

*Locality.*—The seas of the West Indies and the Asiatic seas, especially those of the torrid zone.

Triton Variegatus.

B. Species more tuberculous, or spiny, whose aperture is more open, and terminated by a more or less ascending canal. (Genus *Lotorium* of De Montfort.)

Example, *Triton Lotorium.*

*Description.*—Shell fusiform-turreted, distorted below, very much tuberculated, transversely rugous, and striated, rufous; the whorls above angulate-tuberculated; canal tortuous, the extremity recurved, the aperture trigono-elongated and white; the outer lip toothed within.

*Locality.*—East Indian Ocean.

C. Species with a shorter spire, always very tuberculous, most frequently umbilicated, a sinus at the posterior junction of the two lips. (Genus *Aquillus*, De Montfort.)

Example, *Triton cutaceus*.

*Description.*—Shell ovate, ventricose-depressed, cingulated, tuberculato-nodose, yellow-rufescent; the belts rather prominent, separated by a furrow; the whorls above angulato-tuberculate, rather flattened above; canal short, umbilicated; the outer lip notched within.

*Locality.*—The Atlantic Ocean.

D. Species like those of section C, but whose aperture is closely narrowed by a callosity and irregular teeth. (Genus *Persona*, De Montf.)

Example, *Triton Anus*, the Grimace of collectors.

*Description.*—Shell ovate, ventricose-gibbous, distorted, flattened beneath; nodulous above, subcancellated, white, spotted with rufous; the aperture narrowed, sinuous, irregular, ringent; the lip very much toothed; the canal short and recurved.

*Locality.*—The East Indian Seas.

Tritons have been found on various bottoms at depths ranging from the surface to thirty fathoms.

The number of living species recorded by Lamarck amounts to fifty-one. Mr. G. B. Sowerby has described eight additional species, and Mr. Broderip the same number brought home by Mr. Cuming. Lamarck describes three fossil species, all from Grignon. M. de Blainville states that one of the species has its analogue. Defrance makes the number of fossil species ten, one from the Plaisantin, an analogue according to Brocchi. M. Deshayes in his tables, published before the descriptions of Mr. Sowerby and Mr. Broderip, makes the number of living species of *Triton* 43 and of fossil (tertiary) 25. Of these last, he records *Tritones nodiferus, Lampas, Scrobiculator, succinctus, clathratus*, and *unifilosus* as both living and fossil (tertiary).

### Struthiolaria. (Lam.)

*Generic Character.*

*Shell* oval, the spire elevated, the aperture oval and wide; canal very short, very much notched; right lip sinuous, not toothed, furnished with a bourrelet; columellar border callous, extended; a sinus at the posterior union of the two lips.

*Operculum* horny.

Example, *Struthiolaria nodulosa*.

*Description.*—Shell ovate-conical, thick, transversely striated, white, painted with undulated, longitudinal, saffron-coloured flame-like lines; whorls angulated above, flattened on the upper side, nodulous at the angle; the sutures simple, the outer lip luteo-rufescent within.

*Locality.*—The seas of New Zealand.

Lamarck records two living species. M. Deshayes, in his tables, also makes the number of living species two; and he records one fossil (tertiary), with a query, from Paris.

### Ranella. (Lam.)

*Generic Character.*

*Shell* oval or oblong, depressed, having only two varices situated laterally; aperture oval; canal short, and a sinus at the union of the two lips, backwards.

A. Non-umbilicated species. (Genus *Bufo*, De Montf.)

Example, *Ranella granulata*.

*Description.*—Shell ovate-acute, girt with close-set granulated striæ, pale saffron colour, zoned with fulvous; columella sulcated; outer lip thick and toothed.

*Locality.*—The East Indian Ocean.

B. Umbilicated species.

Example, *Ranella foliata*.

Ranella foliata.

*Description.*—Shell ovate-conical, ventricose, not compressed, of a flesh or pale rose-colour; with frequent transverse, subgranulated, low ridges, the interstices between which are longitudinally striated; the whorls armed with one row of sharp tubercles, the middle of which are the longest, the other ridges of the body whorl obsoletely tuberculated here and there; the columellar lip expansive and foliated, and the margin of the outer lip expanded and thin; the aperture ovate, very strongly and thickly furrowed, of a rich orange-colour, and terminating above in a deep foliated sinus, which extends beyond the varix. (Brod.)

*Locality.*—The Mauritius.

*Ranellæ* have been taken on different bottoms at depths varying from the surface to eleven fathoms.

Lamarck describes fifteen living species. M. Deshayes has described another; and Mr. Broderip nine new species, eight of which were brought home by Mr. Cuming. M. de Blainville states that there is but one fossil species, but allows that Defrance admits five, three of which, from Italy, are identical. M. Deshayes, in his tables, gives the number of living species as nineteen, and of fossil (tertiary) as eight: of these last he records *Ranellæ gigantea, granulata, pygmæa*, and *tuberosa*, as living and fossil (tertiary).

### Murex. (Linn.)

*Generic Character.*—*Animal* furnished with two long and approximated tentacles; mouth without jaws, but armed with hooked denticles in lieu of a tongue; foot rounded, generally rather short; mantle large, often ornamented with fringes on the right side only; branchiæ formed of two unequal pectinations; anus on the right side in the branchial cavity; orifice of the oviduct on the right side at the entrance of the same cavity; orifice of the deferent canal at the end of the exciting organ, on the right side of the neck.

*Shell.*—Oval, oblong, more or less elevated on the spiral side, or prolonged forwards; external surface always interrupted by rows of varices in the form of spires or ramifications, or simply tubercles, generally arranged in regular and constant order; aperture oval, terminated anteriorly by a straight canal, which is more or less elongated and closed; right lip often plaited or wrinkled; columellar lip often callous.

*Operculum* horny.

Animal of Murex.

*a*, operculum.

A. Species with a very long and spiny tube. (*Thorny Woodcocks* of collectors.)

Example., *Murex Tribulus*, Linn. (*Murex tenuispina*, Lam.)

*Description.*—Shell ventricose anteriorly, the tube very long, elegantly spired throughout its length, the spires set in triple order, each row at regular intervals, greyish or purplish grey; the spires very long, thin, rather closely set, and somewhat hooked; body of the shell transversely sulcated and striated; the spire prominent.

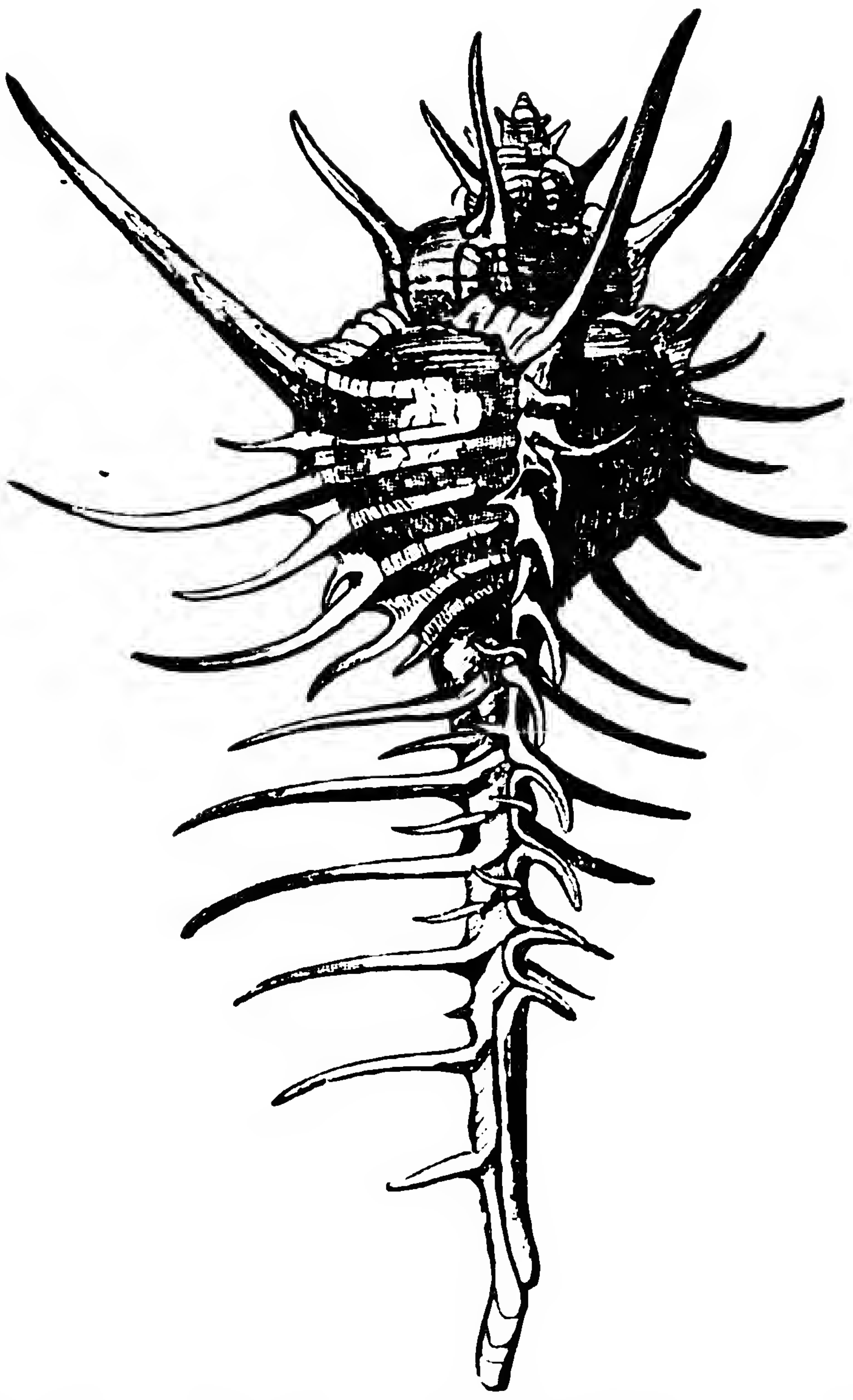
*Locality.*—The Indian Ocean; Moluccas.

This is the *Venus's Comb* of collectors, and when perfect is a most delicate and striking shell.

B. Species with a very long tube and without spines. (Genus *Brontes*, De Montf.)

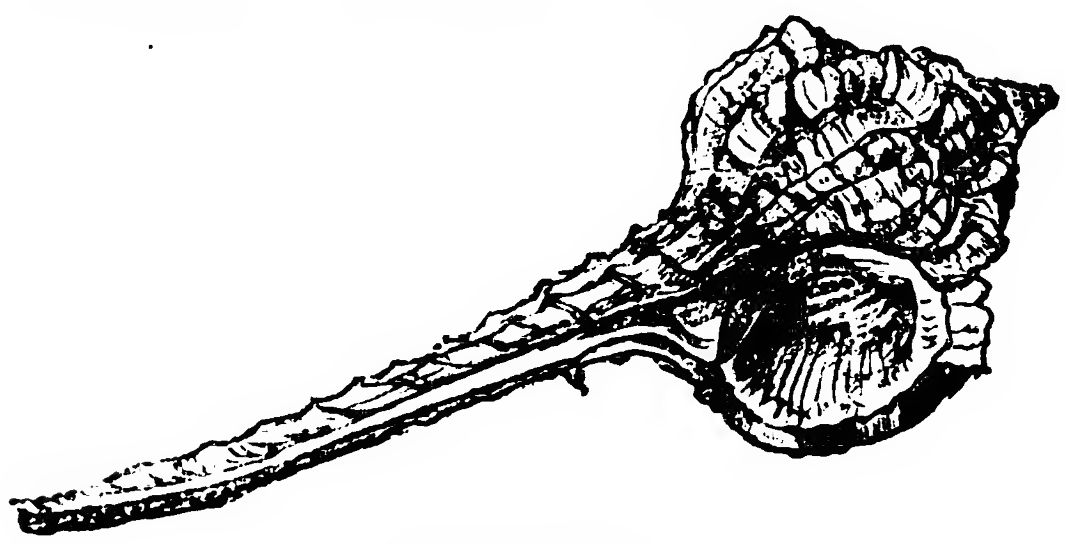
Example, *Murex Haustellum* (*Snipe's or Woodcock's head* of collectors).

*Description.*—Shell anteriorly ventricose, naked, scarcely armed, fulvous inclining to red, lineated with bay; body of the shell rounded and furnished with three or more ribs between the varices; the tube very long and slender; the spire short; mouth roundish, red.



Murex Tribulus (Common Thorny Woodcock; Murex rarispina, Lam.):

*Locality*, the East Indian Ocean; Moluccas.



Murex Haustellum.

C. Species with three elevated, flattened, and compa-ratively thin varices.

Example.—*Murex acanthopterus.*

*Description.*— Shell oblong, fusiform, trialated, transversely sulcated and striated, white; the alæ membranaceous; whorls angulated; aperture ovate-rounded.

*Locality.*—East Indian Seas.

Murex regius.

D. Species with three ramified varices. (Genus *Chicoreus*, De Montf.)

Example, *Murex adustus.*

*Description.*—Shell abbreviate-fusiform, suboval, ventricose, thick, with three rows of frond-like ramifications, transversely sulcated, black; the fronds short, curved and dentate-muricated; the tubercle of the interstices very large; aperture small, roundish, white.

*Locality.*—East Indian Ocean.

E. Species which have a greater number of varices; the tube nearly closed.

Example, *Murex regius.*

No description can convey an adequate idea of the splendid colouring of this species when it is in fine condition; the form is given below.

*Locality.*—The western coast of Central and South America.

F. Subturriculated species.

Example, *Murex lyratus.*

*Description.*—Shell fusiform-turreted, thin, multifariously varicose, horny-fulvous; the varices thin and lamelliform; the interstices smooth; the whorls convex; the tube short.

G. Subturriculated species; the tube closed; a tube pierced towards the posterior extremity of the right side, and persistent upon the whorls of the spire. (Genus *Typhis*, De Montf.)

Example, *Murex pungens*, fossil.

H. Species more globular; the spire and canal shorter, very open; the aperture rather wide,

Example, *Murex vitulinus.*

*Description.*—Shell ovate-oblong, ventricose, somewhat rough, with seven rows of varices, which are obtuse, asperulate, and ruddy; the interstices white; tube narrow, somewhat acute; the aperture white; the lip toothed internally

I. Species which have an oblique fold very much anterior to the collumella, and an umbilicus. (Genus *Phos*, De Montf.)

*Murices* have been found on different bottoms at depths ranging from five to twenty-five fathoms; and species of *Typhis* on sandy mud at depths varying from six to eleven fathoms.

Lamarck records 66 recent and 15 fossil species, mostly from Grignon. To the recent species are to be added 26 *Murices* described by Mr. Broderip from specimens brought home by Mr. Cuming, and 5 of *Typhis* (recent), also described by Mr. Broderip.

M. de Blainville remarks that among the fossil species of France there is no true analogue; but he adds that Defrance, who admits 50 fossil species, counts 30 analogues from the Plaisantin, after Brocchi.

M. Deshayes, in his tables, makes the number of recent species of Murex (apparently including *Typhis*) 75, a number much below the mark, and gives 89 as the number of fossil species (tertiary). Of these last he records the following as having been found both living and fossil (tertiary): —*cornutus*, *Brandaris*, *trunculus*, *erinaceus*, *tripterus*, *cristatus*, *fistulosus*, *tubifer*, a new species, *elongatus*, *angularis*, *saxatilis* (var.), another new species, *Lasseignei*, and a third new species.

Dr. Mantell records one species (*argutus*) from the blue clay of Bracklesham (Sussex); and another (*Smithii*) from the arenaceous limestone of Bognor. Professor Phillips names one (*Haccanensis*) from the coralline oolite of Yorkshire. Dr. Fitton records one (*Calcar*) from the gault of Kent and Blackdown; and Mr. Lea one from the Claiborne tertiary, Alabama.

The Entomostomata and *Siphonostomata* may be considered as the two great tribes of carnivorous gastropods or trachelipods appointed to keep down the undue increase of the Conchifera and herbivorous gastropods, whose shells the majority of those carnivorous testaceans penetrate by means of an organ which makes a hole as truly round as if it had been cut by an auger, and then feed on the juices of the included animal.

Dr. Buckland notices this habit with a view to the condition of the testaceous inhabitants of the earlier seas of our planet with his wonted felicity. 'Most collectors,' says the Professor, 'have seen upon the sea-shore numbers of dead shells, in which small circular holes have been bored by the predaceous tribes, for the purpose of feeding upon the bodies of the animals contained within them: similar holes occur in many fossil shells of the tertiary strata, wherein the shells of carnivorous trachelipods also abound; but perforations of this kind are extremely rare in the fossil shells of any older formation. In the green-sand and oolite they have been noticed only in those few cases where they are accompanied by the shells of equally rare carnivorous mollusks; and in the lias and strata below it,* there are neither perforations, nor any shells having the notched mouth peculiar to perforating carnivorous species. It should seem from these facts that, in the economy of submarine life, the great family of carnivorous trachelipods performed the same necessary office during the tertiary period which is allotted to them in the present ocean. We have further evidence to show that in times anterior to and during the deposition of the chalk, the same important functions were consigned to other carnivorous mollusks, viz. the testaceous cephalopods: these are of comparatively rare occurrence in the tertiary strata and in our modern seas; but throughout the secondary and transition formations, where carnivorous trachelipods are either wholly wanting or extremely scarce, we find abundant remains of carnivorous cephalopods, consisting of the chambered shells of *nautili* and ammonites, and many kindred extinct genera of polythalamous shells of extraordinary beauty. The molluscous inhabitants of all these chambered shells probably possessed the voracious habits of the modern cuttle-fish; and by feeding like them upon young *testacea* and *crustacea*, restricted the excessive increase of animal life at the bottom of the more antient seas. Their sudden and nearly total disappearance at the commencement of the tertiary era would have caused a blank in the "police of nature," allowing the herbivorous tribes to increase to an excess that would ultimately have been destructive of marine vegetation, as well as of themselves, had they not been replaced by a different order of carnivorous creatures, destined to perform in another manner the office which the inhabitants of the ammonites and various extinct genera of chambered shells then ceased to discharge. From that time onwards we have evidence of the abundance of carnivorous trachelipods, and we see good reason to adopt the conclusion of Mr. Dillwyn, that in the formation above the chalk the vast and sudden decrease of one predaceous tribe has been provided for by the creation of many new genera and species possessed of similar appetencies, and yet formed for obtaining their prey by habits entirely different from those of the cephalopods. The design of the Creator seems at all times to have been to fill the waters of the seas and cover the surface of the earth with the greatest possible amount of organised beings enjoying life; and the same expedient of adapting the vegetable kingdom to become the basis of the life of animals, and of multiplying largely the amount of animal existence by the addition of *carnivora* to the *herbivora*, appears to have prevailed from the first commencement of organic life to the present hour.' (*Bridgewater Treatise.*)

SI'RACUSE. [SYRACUSÆ.]

SIRE'DON, Wagler's name for the AXOLOTL. Since that article was written, further information has been obtained relative to the structure of this genus of perennibranchiate Batrachians. The form and character of the teeth, as given by Professor Owen, will be found in the article SALAMANDRIDÆ, vol. xx., p. 328, and we avail ourselves of this opportunity to introduce a reduced copy of the figure of the animal, lately published by MM. Duméril and Bibron, to whose excellent work on Reptiles we refer for the latest particulars known.

Siredon seen in profile; *a*, mouth seen in front, open to show the teeth.

We shall confine ourselves in this article to an account of its organization, as observed by Cuvier, so that the reader may have some notion of its relationship to the other perennibranchiate Batrachians.

Cuvier then remarks that the Axolotl approaches nearly to the Salamander, and especially to its larva. The cranium of the Axolotl is indeed more depressed; its sphenoïd bone wider and flatter; the bones of the nose proportionally smaller; the ascending apophyses of the intermaxillary bones longer and narrower; but, especially, in lieu of those large and fixed bones which Cuvier calls vomers or palatines, there are two oblong plates detached from the cranium beset with teeth in quincuncial order, and continuing themselves with the pterygoïds, which reach them because they are longer than in the Salamander, and which also carry teeth in front on their external edge. Behind, these pterygoïds are widened, without always articulating themselves to the sphenoïd, as in the Salamander of the Alleghanies. [SALAMANDRIDÆ, vol. xx., p. 332.] The space between the orbital and the petrous bone is also more considerable than in the Salamanders. The lower jaw has a regular dental portion forming the symphysis and the greatest part of the external surface, and armed all along its superior edge with small, fine, and pointed teeth; an articular portion, which doubles the posterior part of the internal surface of the preceding, forms the posterior angle and carries the articular tubercle; lastly, there is a true opercular bone, long and delicate, covering at the internal surface the interval of the two preceding, but furnished throughout with very small pointed teeth arranged in quincuncial order. And this is the structure which we find in the SIREN, with this difference, that the dental portion in the latter has no true teeth, which are only seen on the opercular bone.

In all the Axolotls that Cuvier examined, the branchial apparatus was cartilaginous. It consisted of two suspensory branches, or anterior horns, affixed to the cranium under the fenestra rotunda, carrying an unequal piece, to which two lateral branches were attached on each side: the first carried the first arch of the branchiæ; the second, the three others. The first of these arches had dentilations on its posterior border; the two intermediate ones, on both their borders. Under the unequal piece was one which went backward, and whose extremity was bifurcated.

When Cuvier wrote this description (in the *Ossemens Fossiles*), he thought that this animal was the larva of some unknown Salamander; but in his last edition of the *Règne Animal* he corrected this conjecture, and placed it where all zoologists now place it, among the Batrachians.

SIREN (Zoology), a genus of Perennibranchiate Batrachians.

*Generic Character.*—Form elongated, nearly like that of the eels; branchial tufts three on each side; no posterior feet, nor any vestige of a pelvis; head depressed; gape of the mouth not wide; muzzle obtuse; eye very small; the ear concealed; lower jaw armed with a horny sheath and several rows of small teeth; the upper jaw toothless; but numerous small, pointed, retroverted teeth occur on the palatal region. [SALAMANDRIDÆ, vol. xx., p. 328.]

Dr. Garden appears to be the first who called attention to this form, which is declared by Cuvier to be one of the most remarkable of the class of Reptiles, and indeed of the whole animal kingdom, from the anomalies of its organization, and its apparent relationship with different families, and even classes. Dr. Garden (1765-1766) sent a description of this reptile to Linnæus and Ellis, and the former, relying upon Dr. Garden's assurance that the Siren did not change its form, established an additional order for it in his class *Amphibia*, with the name of *Meantes*.

Pallas, Hermann, Schneider, and Lacépède however saw, as Cuvier remarks, nothing more in the *Siren* than the larva of some large unknown Salamander; whilst Camper, followed by Gmelin, went so far as to give it a place among the fishes. The latter arranges it at the end of the Eels, under the name of *Murœna Siren*. These differences of opinion sufficiently show the doubts which arose on the examination of this extraordinary form.

Cuvier, in 1807, satisfactorily established, in a memoir read to the Institute of France, and inserted in the 1st vol. of the 'Zoological Observations of Humboldt,' that whatever changes it might undergo, the Siren was a reptile *sui generis*, which never could have hind feet, and whose whole bony framework differed essentially from that of the Salamanders; that there was no probability that it ever changed its form or lost its *branchiæ*; and that the *Siren* is consequently a true amphibian, which respires at will throughout

* Carnivorous gastropods occur in the Silurian rocks; and the long tube of the *Siphonostomata* is equally characteristic of carnivorous habits with the notch of the *Entomostomata*.

its life, either in the water by means of branchiæ, or in the air by means of lungs. This conclusion rested upon that solid basis which has given such value—a value daily becoming more appreciated—to the views of this great zoologist,—his personal observations made on the osteology and splanchnology of the animal.

Dr. Garden had, in his correspondence with Linnæus and Ellis, come to the same conclusion from other evidence. Dr. Garden had observed the animal from the length of four inches to that of three feet and a half; he had satisfied himself that in the whole province there was not, with the exception of the alligator, any Saurian or Salamander which exceeded six or seven inches in length, and he had convinced himself that it was oviparous, and that it propagated without losing its branchiæ.

In 1766 Hunter, as we shall presently see, declared the Siren to be a complete form, on the most satisfactory evidence: the specimens dissected by him were brought from South Carolina in 1758.

That the *Siren* is a perfect animal belonging to the perennibranchiate batrachians is now admitted by all zoologists. Cuvier indeed remarks (*Règne Animal*), that the branchiæ of *Siren intermedia* and *Siren striata* have been regarded as not participating in their respiration, and that in consequence Mr. J. E. Gray has formed them into the genus *Pseudobranchus*. Cuvier however adds, that it is, nevertheless, not difficult to see on their lower surface folds and a vascular apparatus, the use of which does not appear doubtful to him; and that M. Leconte has satisfactorily demonstrated that both these species, as well as *Siren lacertina*, are perfect animals.

Cuvier remarks that the *Siren* should be judged of not after *Amphiuma*, but from itself. He accordingly procured some sirens, and saw an osteology so finished and so firm, that it was impossible to believe that they were not adult. The branchiæ of these individuals were perfectly entire, and their lungs completely developed, and rich in well-filled vessels. No doubt therefore existed in his mind that the animals used both.

He observes, that it had been objected that it would be impossible for these animals to respire air without ribs or diaphragm; and without the power possessed by the tortoises and frogs to cause it to enter by the nostrils, in order that, so to speak, it might be swallowed, because the nostrils of the Sirens do not lead into the mouth, and the branchial apertures must let it escape. But his own observations made upon well-preserved individuals showed Cuvier that the nostrils in the siren *do* communicate with the mouth by a hole pierced, as in the *Proteus*, between the lip and the palatal bone which carries the teeth. The membranous opercula of their branchiæ are muscular internally, and capable of hermetically sealing the apertures; then it is very easy for the siren, by dilating its throat, to introduce the air into the mouth, and to force it afterwards, by contracting the throat, into its larynx. Even without this structure of the nostrils, the animal could produce the same effect by opening its lips a little: a theory which Cuvier applies to the *Proteus* as well as the *Siren*.

The simultaneous existence, observes the same author, of a larynx and a trachea with a branchial apparatus not only permanent, but perfectly ossified in many of its parts, is also worthy of especial attention, and proves, as is evident in the frogs and salamanders, that the branchial apparatus is no other than a more complicated os hyoides, and not a combination of pieces proceeding from the sternum and larynx. He adds, that it is to the salamanders that the sirens approach most nearly by the structure of the head, although neither the general form nor the proportions of the parts have so near similarity.

Having thus given a general view of the conformation of this extraordinary animal, we proceed to a sketch of the details of its

### Organization.

*Skeleton.*—The *skull* of the siren is narrowed in front by reason of the excessive reduction of the maxillary bones, which consist only of a very small osseous point. Behind there is a strong occipital crest on the parietal and petrous bones. The pieces which form the lower jaw, instead of being transverse like the branches of a cross, are directed obliquely forwards. The parietal bones occupy the greatest portion of the upper part of the cranium. They have each in front a point, expanding so as to lodge between them the posterior part of the principal frontal bones, which have each a groove for the lodgment of the posterior point of two slender bones, which proceed beside each other to the end of the muzzle. At their sides are attached two other bones, which are slender and pointed backwards, and which descend and widen far in order to raise the anterior edge of the jaw. Cuvier takes the first for the nasal bones, and the others for intermaxillary bones. These last are toothless, but their edge is trenchant, and furnished, when the animal is alive or well preserved, as well as the edges of the lower jaw, with a sheath which is nearly horny, is easily detached from the gum, and has its analogue in the tadpoles of the frogs. [Salamandridæ, vol. xx., p. 328.] Between them, at the end of the osseous muzzle, is an aperture, but not that of the nostrils. In the recent animal it is closed, and the nostril is pierced on each side on the outside of the intermaxillary bone. In the crocodile the intermaxillary adheres to the external side of the nasal bone, and all the reptiles, except the crocodile, have the nostril on the outside of the ascending apophysis of the intermaxillary bone; but the peculiarity in the Siren is, that the intermaxillary ascending to the frontal bone entirely separates the nasal bone from the frame of the external nostril. The maxillary bone excludes the nasal in the same way in the chameleon. A very small bone, suspended in the flesh below the external nostril, and without any tooth, is the sole perceptible vestige of the maxillary bone. The cavity of the nostril is covered below with a simple ligamentous membrane. The internal nostril is situated on each side, near the commissure of the lips, between the lip and the palatine teeth. All the lower part of the cranium and the face is composed of a large and wide sphenoïd, which extends from the occipital hole to the intermaxillaries. The sides of the cranium, in the orbital region and the front of the temporal bone, are closed by a single bone, in which are pierced, forward, the olfactory aperture; farther back, the optic hole, and another for the first branch of the fifth pair, and probably for the small nerves of the eye. The inferior surface of this lateral bone forms part of the palate at the sides of the sphenoïd bone. It is plain that it performs the functions of the orbital part of the sphenoïd bone, or what has been called the anterior sphenoïd, and that it fulfils in part those of the ethmoïd. Between it and the petrous bone is a great membranous space, in which is pierced the hole for the rest of the fifth pair of nerves. The petrous bone and the lateral occipital bone are perfectly distinct. It is in the petrous bone only that the fenestra ovalis is pierced, or rather cut out, but the lower part of its frame is, nevertheless, completed by the lateral occipital and the sphenoïd. Its aperture, which is large, is directed a little downwards. In the fresh state it is closed by a cartilaginous plate similar to that in the Salamander. There is only a single tympanic bone fitted obliquely by its posterior stem on the superior surface of the petrous bone, and enlarging below nearly like a trumpet, in order to furnish a large facet to the lower jaw. Cuvier found neither mastoïdian, pterygoïdian, jugal, superior occipital, nor basilary bone, and he remarks that the occurrence of the two last is impossible, when the position of the suture, which separates the lateral occipital bones, is considered. To the palate, under the anterior and lateral part of the sphenoïd and orbital bones, are fitted two delicate plates beset with hooked teeth. They may be taken for the vestiges of vomers and of palatines, or, if it be preferred, of palatines and pterygoïdians; but Cuvier did not find sufficiently marked characters to warrant giving them those names. The first, which is the largest, has six or seven oblique rows of pointed teeth, making a kind of wool-card. Those of the middle have each twelve teeth; the anterior and posterior ones have less. The second plate has four rows of similar teeth, each row consisting of from five to six.

The lower jaw of the Siren is composed of four bones on each side; one of which forms the symphysis and the trenchant border of the jaw, which it invests externally up to near its posterior extremity. One cannot, Cuvier observes, avoid taking it for the analogue of the dental portion, but it is not the portion which carries the teeth, and it has only its trenchant edge invested in the fresh animal with a horny covering, analogous to that which forms the edge opposed to the upper jaw. The posterior extremity of this trenchant edge, more elevated than the rest of the border of the bone, serves for the coronoïd apophysis. The second bone forms the greatest portion of the internal surface and the posterior angle, and carries, above, the third, which is the articular tubercle. The fourth is a delicate and narrow lamina which performs the office of the opercular bone, and covers, on the internal surface, a vacancy left between the two first. The whole of this bone is beset with small pointed teeth disposed quincuncially like those of the palatal plates.

The *os hyoïdes* of the Siren is an os hyoïdes of the larva of a Salamander or of the Axolotl, but very much ossified in many of its parts. The suspensory branch or anterior horn is a bone stouter and longer than the humerus, dilated at its two ends, narrowed in its middle, and suspended to the cranium by a ligament. The first unequal piece is also a very hard bone dilated anteriorly, compressed posteriorly, and narrowed in its middle. The second unequal piece is a pedicle, which is divided behind into many radiating apophyses: the whole of this, again, is very bony, and the two lateral branches are equally so. The first, which is the stoutest, carries the first arch of the branchiæ; the second, which is more slender, carries the three others. These gill-arches are not ossified, but always remain cartilaginous, as in the Axolotl, and are, like those of the Axolotl, denticulated. They are united by ligaments at their external extremity, which a ligament attaches also to the root of the anterior horn. The same pieces, or very nearly the same, may be seen in the *Proteus*.

The *shoulder-blade* of the Siren is slender, nearly cylindrical, narrowed in its middle, and augmented, on the spinal side, by a cartilaginous lamina. The *clavicle* and the *coracoïd* are represented by two cartilaginous lobes, one directed forwards, the other much wider, proceeding upon the breast and crossing upon that of the opposite side. In the external border of this coracoïd cartilage, near and a little behind the articular fossa, is a bony semilunar lamina which is the sole representative of the bony coracoïd: but there is nothing similar for the clavicle. The *humerus* compressed laterally above, from before backwards below, and narrowed in its middle, has its extremities cartilaginous. It is the same with the two bones of the fore-arm, both rather slender, and the internal bone or radius widened below. The bones of the *carpus* remain cartilaginous.

Each of the four *fingers* has a metacarpian and two phalanges only.

Anterior portion of the skeleton of Siren lacertina. *a*, dorsal vertebra seen behind; *b*, the same seen before.

There is no vestige of a pelvis, nor of any posterior extremity, either osseous or cartilaginous.

Cuvier did not find in a large individual more than forty-three *vertebræ* in the trunk and forty-four in the tail: but the individual which he described in 1807 had three more. These vertebræ, all perfectly ossified and complete, do not resemble in his opinion those of any of the reptiles of which he had previously treated, nor indeed of any other animal. Their bodies have their two articular faces hollow and united by a cartilage in the form of a double cone, as in the fishes. Their articular apophyses are horizontal, and the posterior apophyses of one vertebra lie on the anterior apophyses of the other. A horizontal crest on each side goes from the anterior to the posterior. In lieu of a spinous apophysis, they have a vertical crest, which at half its length becomes bifurcated, and the branches go to terminate on the articular posterior apophysis. Their very wide transverse apophyses are composed of two laminæ united at their posterior border up to their common point; the upper, which is oblique, coming from below the anterior articular apophysis and from below the neighbouring part of the lateral crest, the lower coming from the sides of the body, to which it adheres by a horizontal line. The body below is also compressed into a sharp ridge (arête).

In the *vertebræ* which carry the *ribs*, the upper lamina of the transverse apophysis is but little marked, and the point is stout and divided into two lobes for the two tubercles of the rib, as in the salamanders. Cuvier only found eight of these vestiges of ribs on each side, commencing from the second vertebra. The two last have the head simple. At the tail, the transverse apophyses, which have already become rather small, promptly disappear: the articular apophyses diminish also by degrees. The body of the vertebra takes a very compressed form, and gives below two small laminæ, which intercept a canal for the vessels, like the chevron bones in the lizards.

Entire skeleton of Siren lacertina.

*Respiratory Organs.*—John Hunter in 1766 gave the following accurate and interesting description of the two-fold respiratory apparatus of the Siren:—"On the posterior and lateral parts of the mouth are three openings on each side; these are similar to the slits of the gills in fish, but the partitions do not resemble gills on their outer edges, for they have not the comb-like structure. Above and close to the extremity of each of these openings, externally, so many processes arise, the anterior the smallest, the posterior the longest; their interior and inferior edges and extremity are serrated, or formed into fimbriæ: these processes fold down and cover the slits externally, and would seem to answer the purposes of the comb-like part of the gill in fish. At the root of the tongue, nearly as far back as these openings reach, the trachea begins, much in the same manner as in birds. It passes backwards above the heart, and there divides into two branches, one going to each lobe of the lungs. The lungs are two long bags, one on each side; which begin just behind the heart, and pass back through the whole length of the abdomen, nearly as far as the anus. They are largest in the middle, and honeycombed on their internal surface through their whole length.' (*Phil. Trans.*, lvi., 1766.)

In the Museum of the Royal College of Surgeons in London this part of the organization is well illustrated. No. 1062 presents a *Siren lacertina*, with the ventral parietes of the abdomen removed, together with all the viscera, except the lungs, which have been distended with spirit. These commence immediately below the pericardium, and extend almost to the anus. A bristle is passed through the trachea, and the laryngeal orifice is exposed by the removal of the cranium. The branchiæ are external, three on each side, and suspended to four cartilaginous arches of the hyoïd bone. The three internal branchial apertures of the left side may be seen. No. 1063 exhibits the right side of the head of a larger specimen of *Siren lacertina*, showing the branchial arches and gills of that side. The first and fourth branchial arches are fixed, the intermediate ones only being free. Their concave margins are provided, as in many fishes, with small pointed processes, which look into one another and defend the branchial passages. The gills increase in size from the first to the third, which is suspended to both the third and fourth arches. They are subdivided and fimbriated inferiorly, where the surface is most vascular: the branchial arteries may be seen injected on the convex side of the cartilaginous arches. The origin and subsequent reunion of the branchial vessels to form the aorta are shown in the preparation No. 914 (from which the present was taken), noticed below. No. 1064 is a portion of the lungs of the same *Siren*, laid open to show the ramifications of the pulmonary artery, which form a vascular network upon the internal surface of this simple respiratory bag. (*Catalogue*, vol. ii.)

*Circulating System.*—John Hunter describes (1766) the heart of the Siren as consisting of one auricle and ventricle. 'What answers,' says Hunter, 'to the inferior vena cava, passes forwards above, but in a sulcus of the liver, and opens into a bag similar to the pericardium: this bag surrounds the heart and aorta as the pericardium does in other animals; from this there is an opening into a vein which lies above, and upon the left of the auricle, which vein seems to receive the blood from the lungs, gills, and head, is analogous to the superior vena cava, and opens into the auricle which is upon the left ventricle. The aorta goes out, passing for a little way in a loose spiral turn, then becomes straight, where it seems to be muscular: at this part the branches go off, between which there is a rising within the area of the aorta like a bird's tongue, with its tip turned towards the heart. This account of the venæ cavæ opening into the cavity of the pericardium may appear incredible; and it might be supposed that, in the natural state of the parts, there is a canal of communication going from one cava to the other, which being broken or nipt through in the act of catching or killing the animal, would give the appearance above described. I can only say that the appearances were what have been described in three different subjects which I have dissected, and in all of them the pericardium was full of coagulated blood. But besides the smallness of the subjects, it may be observed that they had been long preserved in spirits, which made them more unfit for anatomical inquiries. They had been in my possession above seven years.' (*Phil. Trans.*, lvi.)

In the Museum of the College of Surgeons the preparation No. 912 shows the anterior part of the body of a *Siren lacertina*. The ventral parietes have been removed, together with the pericardium, to show the heart *in situ*. It is of an elongated form, and consists of a large fimbriated auricle, divided internally into two chambers, and of a flattened oblong ventricle, giving off a single artery, which, after a half-spiral twist, dilates into an elongated fleshy bulbus arteriosus. The blood from the body passes into a large membranous sinus formed by the union of the two anterior venæ cavæ with the large posterior cava. The latter vessel pours its blood into the sinus by two orifices on either side a septum, which extends forwards as far as the openings of the anterior cavæ, where it terminates in a free semilunar margin; the sinus is then continued forwards, and terminates in the chamber analogous to the right auricle. White bristles pass from the posterior cava through the sinus on either side the septum into the anterior cavæ. A black bristle is passed through the right pulmonary vein into the trunk common to the two, which traverses but does not communicate with the sinus proper to the veins of the body, and terminates in the chamber analogous to the left auricle.

The bulbus arteriosus is laid open, to show the valvular protuberance which projects into it from the dorsal aspect. On the opposite side of the preparation the cranium and upper jaw are removed to show the apertures leading from the mouth to the lungs and gills, the simultaneous existence of which through life forms the chief characteristic of this tribe of truly amphibious reptiles. No. 913 is the heart of a Siren. The auricle, consisting of two chambers, appears as one cavity externally. It is remarkable for its large size, its weak parietes, and the number of fimbriated follicular processes which it sends off, and which gives it an appearance similar to the branchial divisions of the vena cava in the cephalopods. The ventricle is here seen to be slightly bifid at the apex. The artery is membranous at its commencement. The bulb is here laid open to show the internal valvular projection. No. 913 A presents the heart and pericardium of a *Siren lacertina*, prepared to show the internal structure of the auricles and ventricle. White bristles pass from the veins of the body into the right auricle, and black ones through the pulmonary veins into the left auricle. This is much smaller than the right auricle, corresponding to the quantity of blood which it receives. The pulmonary veins unite into a common trunk, which seems to pass through the great sinus of the veins of the body, but it adheres to the parietes of that sinus by its posterior surface. Here Professor Owen remarks that it is probably this remarkable structure which led Hunter to suppose that the sinus was part of the pericardium, and that the venæ cavæ opened into it. The Professor then quotes Hunter's description, above given, and adds, with truth, that all anatomists since Hunter's time have concurred in ascribing but one auricle to the heart of the Siren, and that Cuvier regards this simple structure of the central organ of the circulation as common to the Batrachian order of reptiles. The outward form of the auricle, observes Mr. Owen, naturally suggests such an idea, and it is only in favourable specimens that the true structure, as it is shown in this preparation (made by him), can be made out. The ventricle is connected to the pericardium, not only by the reflection of the serous layer from the bulbus arteriosus, but by a duplicature of the same membrane, which passes from the lower third of the posterior edge of the ventricle, and incloses the coronary vein: this vein is continued from the apex of the ventricle to the sinus. The muscular parietes of the ventricle are about a line in thickness, and of a loose fascicular structure. The cavity is partially divided by a rudimentary septum, which extends from the apex half way towards the base of the ventricle, and there terminates in a concave edge directed towards the orifice of the artery. The whole inner surface is reticulated by decussating carneæ columnæ, one of which has been detached from its connection to the septum, which intervenes to the two auricular apertures, and which supports the valvular structure that closes them from within. The artery and bulbus arteriosus are laid open, showing in the latter the remarkable valvular projection described by Hunter. In conclusion, Professor Owen remarks that the vessels on the back part of the talc, which supports the preparation, are, the inner ones, the pulmonary arteries, the outer ones, the jugular veins or anterior cavæ. No. 914 is the anterior part of the body of a large *Siren lacertina*, prepared to show the heart and principal vessels injected. The fimbriated structure and magnitude of the auricles are well seen when thus distended, and they then advance forwards on both sides of the ventricle and bulb, so as almost to encompass those parts. The two divisions of the venous sinus may be observed below the ventricle, with the termination of the coronary vein and the attachment of the ventricle to the sinus. Behind the ventricle appear two superior cavæ which terminate at the sides of the sinus. The portions of the lungs which remain are laid open to show their reticulate structure, and the relative positions of the pulmonary arteries and veins: white bristles are placed in the former, and black ones in the lateral vessels. On the left side of the preparation, the origin of the pulmonary artery, from the posterior branchial arch, is shown. The remainder of the branchial vessels, with the exception of small branches to the head, are collected into one trunk, which unites with the corresponding vessels of the opposite side to form the aorta or systemic artery. The tongue, the interior of the air tube, the internal branchial aperture, and the branchiæ of the left side, the eye and nostril, and structure of the integument are also favourably displayed in this preparation. [PROTEUS and PROTOPTERUS.]

We now proceed to lay before our readers such other preparations in this noble collection as illustrate the circulating system in animals approximating to the perennibranchiate batrachians, so that the student may compare this part of their organization with that of the Siren.

No. 915 shows the anterior part of the body of an AMPHIUMA (*Amph. means*, Garden), prepared to show the heart and great vessels *in situ*. Professor Owen states that the blood is returned from the body, as in the preceding species, by two anterior venæ cavæ, and one large posterior cava, which form by their union a membranous sinus. The auricles or venous chambers of the heart are proportionately smaller and less fimbriated, and are situated more to the left and superior part of the ventricle. The ventricle is connected to the pericardium at its apex, and gives off from its opposite extremity a single artery, which, after a half-spiral turn, dilates into a large bulb, which is broader and shorter than in *Siren lacertina*, and is grooved externally. The two pulmonary arteries are given off from the posterior part of the extremity of the bulb, which then divides into two branches, each of which again subdivides on the side of the œsophagus. As there are no external gills, so there are no lateral branches sent off from the branchial arteries; but these, after winding round the arches of the hyoïd bone, terminate in a single trunk on either side, and form by their union the aorta, which is seen, injected, behind the pharynx. On the left side of this preparation the internal branchial aperture is preserved, and on the right side the branchial arches of the hyoïd bone are shown. The lungs are laid open so as to display their reticulate and longitudinally plicate structure, and the relative positions of the pulmonary arteries and veins.

Professor Owen further observes that this preparation is figured by Rusconi (*Amours des Salamandres Aquatiques*, pl. v., fig. 8) as a portion of the adult *Siren lacertina*, which he supposes to have lost the external branchiæ, and to have acquired the posterior extremities in a manner analogous to the salamanders; and that Rusconi endeavours to invalidate the opinion which Hunter, after an extensive and minute comparison of their entire structure, had formed of the specific difference of the *Amphiuma* and *Siren*, as well from each other as from the *Kattewagoe* or *Menopoma* of Harlan. The manuscript alluded to by Rusconi, and which contains detailed accounts of the anatomy of *Amphiuma* and *Menopoma*, as well as of the *Siren*, is given entire in the description of the plates illustrative of the 2nd vol. of the Museum Catalogue, where (plates xxiii. and xxiv.) the circulating and respiratory organs of the 'Chuah Chisstannah, or Crawfish-eater, or Kattewagoe' (*Menopoma Alleghaniensis*, Harlan [SALAMANDRIDÆ, vol. xx., p. 332], are beautifully displayed; and Professor Owen remarks that the conclusions as to the distinctions of these amphibia to which Hunter arrived, have been subsequently confirmed by a similar series of investigations instituted by Cuvier, and above noticed.

No. 916 of the same museum exhibits the lower jaw, tongue, fauces, with part of the abdominal viscera, and the heart *in situ* of *Menopoma Alleghaniensis*. The greater part of the pericardium has been removed. The ventricle is of a flattened triangular form, resembling that of osseous fishes: the auricles are smaller in proportion than in the *Siren*, and are situated wholly to the left of the ventricle. The veins of the body terminate in a membranous sinus situated below the auricles. The aorta, after making a spiral turn to the left side, dilates into a large bulb which gives off four vessels on each side. The first or posterior pair are the smallest, and ramify on the œsophagus and lungs; but they are not distinctly shown in this preparation. The second and third pairs are the largest: they are seen passing outwards, and winding round the arches of the hyoïd bone. The two branches unite on each side, and, after sending off small arteries to the head, converge on the posterior part of the œsophagus, and unite to form the descending aorta. The fourth small pair of arteries pass outwards, and wind over the anterior part of the first hyoïdian arch: they send off in this course some small arteries to the head, and ultimately unite with a cephalic branch given off from the united trunk of the third and second branchial arteries. The right lung is here preserved, and a black bristle is inserted into it from the trachea. White bristles are placed in the right branchial aperture, which is left entire, showing the absence in this form, as in *Amphiuma*, of external gills. On the left side the branchial arches of the hyoïd bone are preserved. Besides the parts concerned in the circulatory and respiratory functions, the stomach, duodenum, liver, pancreas, and spleen are well shown in this preparation. No. 917 exhibits the heart, pericardium, and trachea of the last-noticed species. Here the ventricle is laid open to show the loose, fasciculate, muscular structure, which, as in the *Testudo Indica*, occupies the whole of its cavity. The bulb of the aorta is laid open to show the two rows of semilunar valves, three in each row, and the origins of the branchial arteries. The preparation is suspended by the pericardium, behind which is the flattened air-tube, in which distinct cartilaginous rings may be seen. (*Catalogue*, vol. ii.)

*Generative System.*—No. 2695 exhibits the posterior part of a *Siren lacertina*, with the ventral parietes of the abdominal cavity removed to display the female organs of generation. The ovaria are seen as two irregular elongated bodies, situated on each side of the root of the mesentery, and bearing impressions of the convolutions of the intestines. They contain innumerable minute ovisacs of a greyish colour, with a few others of a larger size, and of a very dark colour. The oviducts are external to the ovaria, and are attached to the sides of the spine, each by a broad duplicature of peritoneum: they commence anteriorly by a simple, elongated, slit-like aperture, without fimbriated margins, and are immediately disposed in about twenty parallel transverse folds, which gradually diminish, and finally cease about three inches from the cloaca, where the oviducts open behind the rectum upon small prominences: bristles are placed in these outlets. The contracted allantoïd bladder is seen anterior to the rectum: the posterior extremity of the kidney extends behind the oviducts, a short way beyond the cloaca. No. 2696 shows the anterior extremity of the oviducts and liver of a Siren. The oviducts are much attenuated at their commencement, but soon increase in size, and become thicker in their parietes. (*Catalogue*, vol. ii.)

No preparation of the male organs of the *Siren* appears to exist in the College Museum; but there are two illustrative of those of *Amphiuma* and *Menopoma*, which we proceed to lay before our readers.

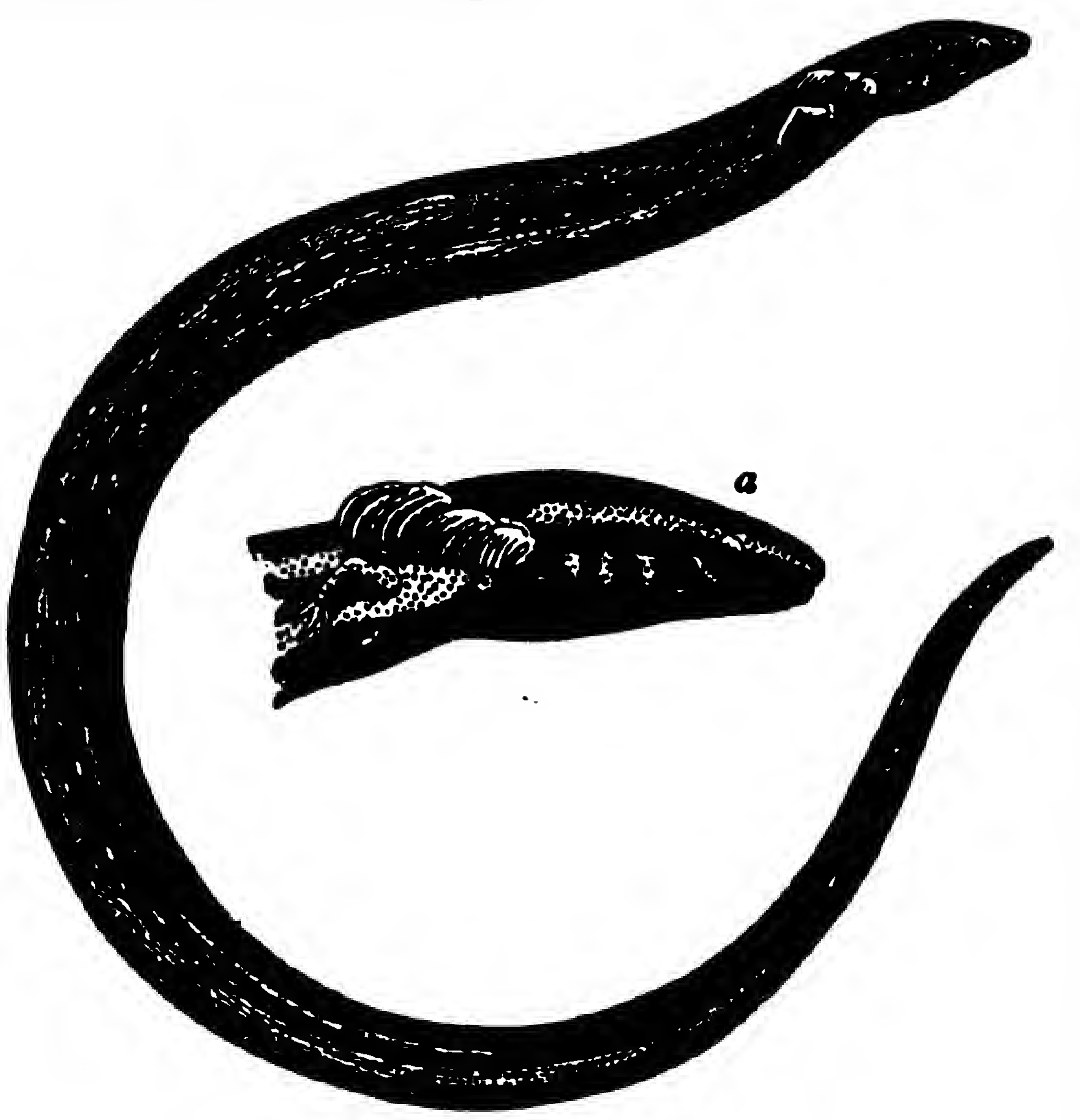
No. 2397 is the posterior moiety of an Amphiuma (*Amphiuma didactylum*), with the abdominal cavity laid open, and exposing to view the termination of the intestinal canal, supported by its broad and simple mesentery, the termination of the right lung, the long allantoïd bladder attached by a duplicature of the peritoneum to the mesial line of the abdomen, and the testes with their adipose appendages: the latter may be observed projecting on each side of the root of the mesentery; and behind them are the testes, elongated, subcylindrical, ash-coloured bodies, tapering at both extremities: the vasa deferentia descend in the form of white ligamentous tubes, and finally open into the posterior part of the termination of the rectum, which is laid open. The renal organs are almost concealed by the parts above described: they have been injected. No. 2938 exhibits the male organs, kidneys, allantoïd bladder, and large intestine of the Menopome (*Menopoma Alleghaniensis*). The testes in this subject are less elongated, and of a more compact oval, thus indicating a further stage of advancement above the class of fishes. The efferent vessels leave the testis at a longitudinal groove at their posterior and internal surfaces, at the line of reflection of the supporting processes of peritoneum, and on each side unite to form a vas deferens, which descends along the edge of a process of peritoneum external to the kidneys, and finally opens into the termination of the rectum, as in the Amphiume. The kidneys are opake white bodies, which, beginning by small extremities near the lower end of the testes, slightly enlarge as they descend to the cloaca. The injected aorta occupies their posterior interspace, and there sends off the arteries for the hinder extremities. (*Catalogue*, vol. ii.)

*Siren lacertina* grows to the length of three feet: its colour is blackish. The feet have four toes, and the tail is compressed into an obtuse fin.

This Siren inhabits the marshy grounds of Carolina, especially those where rice is cultivated. It lives in the mud, from whence it makes excursions, sometimes on land and sometimes in the water. From the swampy places by the sides of pools and under the overhanging trunks of old trees where it is found, it was called by the inhabitants 'the Mud Iguana.' Garden was of opinion that it feeds on serpents, and that it uttered a cry similar to that of a young duck; but Barton contests these statements. Its food is generally believed to consist of earth-worms, insects,

&c. There is now (Sept., 1841) a fine lively specimen in the parrot-house in the garden of the Zoological Society in the Regent's Park. It is kept in a vessel of pond-water with a deep bottom of mud, in which it bides itself, and is twenty inches long, as large as the wrist of a stout child of six months old, and very eel-like in its movements and appearance. About a dozen and a half of earth-worms are supplied to it as food every other day.

*Siren striata* is blackish, with two longitudinal yellow stripes on each side; has only three toes on each foot, and is about nine inches in length.




Siren striata.

*a*, head and anterior part seen in profile, showing the branchiæ and foot.

Whilst the article was passing through the press, Professor Owen was so good as to send the following highly interesting observations on the blood-globules of the *Siren* for insertion in this work:—

'Among the important generalizations which the numerous observations of recent microscopical anatomists have enabled the physiologist to establish respecting the form and size of the blood-discs in different classes of animals, the most interesting seems to be that which Professor Wagner has enunciated respecting the relation of the magnitude of the blood-disc to the persistence of the branchial apparatus in the Batrachian order of reptiles on the occasion of his description of the blood-discs of the *Proteus anguinus*.

The absolute size of these particles in that perennibranchiate reptile, in which they may be distinguished by the naked eye, renders them peculiarly adapted for minute investigations into the structure of the nucleus and capsule of the blood-disc: but the value of the relation between their size and the persistency of the external gills must depend upon the correspondence of other perennibranchiate reptiles with the Proteus in this respect. The superior size of the blood-discs of the newts to those of the land-salamanders and tailless Batrachians has been confirmed by Professor van der Hoeven's observations on the blood-discs of the gigantic newt of Japan (*Sieboldtia*, SALAMANDRIDÆ, vol. xx.. pp. 331, 332), of which a fine specimen has been for several years kept alive at Leyden; and I have been able to add another instance of the still greater relative size of the blood-discs in the perennibranchiate reptiles by the examination of those of the largest existing species of that family, the *Siren lacertina*, of which a specimen twenty inches in length is now (October 15th) living at the Zoological Gardens. The blood was obtained from one of the external gills, and immediately subjected to examination. The blood-discs presented the elliptical form which hitherto without exception has been found to prevail among the air-breathing oviparous vertebrated animals: the ellipse was not quite regular in all the blood-discs; several were sub-ovate, a few slightly reniform and thicker at the more convex side: all were as compressed, or disc-shaped, as in other Batrachians, with the nucleus slightly projecting from each of the flattened surfaces.

'The nucleus did not partake in the same degree with these varieties of form, but maintained a more regular elliptical form; the varieties in question appearing to depend on pressure acting upon the capsule and the coloured fluid surrounding the nucleus. Yet when the ellipse of the blood-disc was, as it happened in a few cases to be, longer and narrower than the average, the form of the nucleus presented a similar modification of size.

'The following is a table of the averages of many admeasurements of these blood-discs, made with the screw micrometer*:—

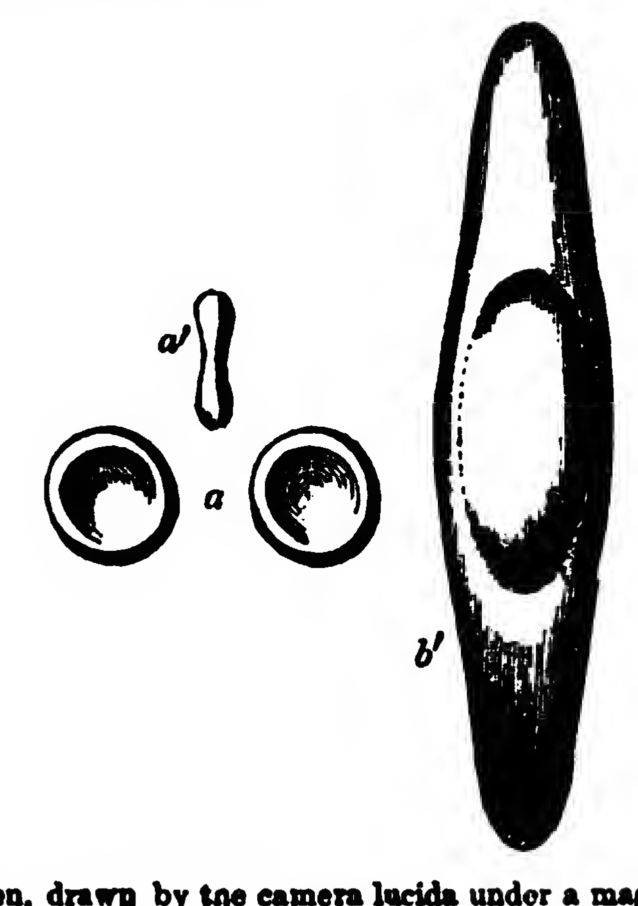
| | English inch. |
|---|---|
| 'Long diameter . . . . . | 1-450th |
| Short diameter . . . . | 1-850th to 1-870th |
| Long diameter of nucleus . . | 1-1000th |
| Short diameter of ditto . . . | 1-2000th |
| Thickness of ditto . . . . . | 1-3800th |

(as viewed edgeways covered by the capsule).

'The nucleus was circumscribed by a double line, the outer one more regular than the inner one, which appeared crenated. This appearance was due to the structure of the nucleus, or the contents of the nucleolar capsule, which was indicated by the outer line. These contents consisted, in every blood-disc examined, of a number of moderately bright spherical nucleoli, sufficiently distinct to be counted, when viewed by a Powell's 1-10th inch objective, with the eye-piece, magnifying 700 linear diameters: the ordinary number of nucleoli seen in one plane or focus being from twenty to thirty, the total number was of course much greater. The facility as well as certainty of the demonstration of such a structure in a good microscope of the present day will be readily admitted when it is remembered that the nucleus of the blood-disc of the Siren is three times the size of the entire human blood-disc. These tuberculate nuclei, when removed from the capsule, were colourless; the component granules or cells have a high refracting power: viewed *in situ* they present a tinge of colour lighter than that of the surrounding fluid, and dependent upon the thin layer of that fluid interposed between the nucleus and the capsule.

'The external capsule of the blood-disc is smooth, moderately resisting, elastic, as was easily seen by the flattening of the parts of two blood-discs that might come in contact, and the recovery of form when they were floated apart.

'As the fluid contents of the blood-disc in part evaporated during the process of desiccation, the capsule fell into folds in the interspace between the nucleus and the outer contour, these folds generally taking the direction of straight lines, three to seven in number, radiating from the nucleus.' (R. Owen, Sept. 25, 1841.)




Blood-discs of Man and Siren, drawn by the camera lucida under a magnifying power of 700 linear dimensions.

*a*, Human blood-discs; *a'*, ditto viewed edgewise; *b*, Siren's blood-disc; *b'*, ditto viewed edgewise; *c*, folds of external capsule, produced by desiccation; *d*, capsule of nucleus; *e*, nucleoli.

SIRENS (Σειρῆνες) are described in the 'Odyssey' as two maidens who sat by the sea and so charmed with their music all who sailed by, that they remained on the spot till they died. Ulysses, by the direction of Circe, had himself tied to the mast, and stopped the ears of his companions with wax, by which means he was able to hear their music, and escape from its influence. (*Od.*, xii. 39, &c., 169.) The

* 'I was indebted to Mr. Stokes for the use of the one attached to his admirable microscope by Powell.

ship of Ulysses, with himself tied to the mast, is frequently represented on gems, and other works of antient art. (See *Dictionary of Greek and Roman Antiquities*, p. 52.) The number of the Sirens was afterwards increased to three, and various names were given to them by different writers. They were usually called the daughters of Melpomene and Achelous (Apollod., i. 3, § 4), and were represented by artists with the feathers and wings of birds (compare Ovid, *Met.*, v. 522, &c.) They were urged by Hera to contend with the Muses, who conquered them, and tore off their wings. (Paus., ix. 34, § 2.)

SIRHIND, a district of northern Hindustan, which extends from 29° 27′ to 31° N. lat., and from 73° 38′ to 77° 38′ E. long. The northern boundary is formed by the Sutlej, and the Jumna forms a part of the eastern boundary. The principal river is the Gagur. Most of the other rivers are affluents of the Gagur. Sirhind constitutes a portion of what are called the Hill States, and is inhabited by the Sikhs. [HINDUSTAN, p. 233.] The town of Sirhind, from which the district derives its name, though formerly a place of importance, is now little else than a heap of ruins.

SIRI, VITTO'RIO, born at Parma in 1625, became a priest, and afterwards went to Paris, where he found favour with Louis XIV., who appointed him his almoner and historiographer. Siri wrote a journal in Italian, entitled 'Mercurio Politico,' which he continued for many years, and as Louis acted for a long period the principal part on the political stage of Europe, he was flattered at having by him a writer who contributed to spread his fame in a foreign language. Siri however was not a fulsome flatterer, and although he often praised Louis, he did not always spare his ministers and other powerful men of that and the preceding reign, and this freedom passed unheeded chiefly from the circumstance of his writing in a language foreign to France, and which was not understood by the people in general. Besides the 'Mercurio Politico,' the collection of which consists of fifteen thick volumes, Siri wrote another journal, entitled 'Memorie Recondite,' which fills eight volumes. Le Clerc (*Bibliothèque Choisie*, vol. iv., p. 138) observes that both these works contain a vast number of valuable authentic documents. The general style of the writer is however prolix and heavy. Siri died at Paris, in 1685. (Corniani, *Secoli della Letteratura Italiana*.)

SIRI'CIUS, a native of Rome, succeeded Damasus I. as bishop of that city, A.D. 384, under the reign of Valentinian II. We have several letters by him written to various churches on matters both of dogma and of discipline. Some of them are in condemnation of the Priscillianists, Donatists, and other heretics; one is directed to Anycius, bishop of Thessalonica, on matters of jurisdiction; another to Himerius, bishop of Tarracona, which is one of the oldest instances of a bishop of Rome sending mandates to other churches to be received as ecclesiastical laws. Siricius is also one of the first bishops of Rome who wrote concerning the celibacy of the clergy. He directed that a priest who married a second wife after the death of the first should be expelled from his office. (Platina, *Lives of the Popes*; Dupin, *Nouvelle Bibliothèque, Vie de Sirice.*) The council of Nicæa had already decreed that all clerks who had been married before they took orders, should be allowed to retain their wives according to the antient tradition of the church, but that priests and deacons should not marry after their ordination. Siricius died A.D. 398.

SI'RIUS and PRO'CYON (Σείριος and Προκύων), the Greek names of the bright stars in the constellations of the Great and Little Dog [CANIS MAJOR and MINOR]. These are Orion's dogs, according to some, and those of minor personages, according to others: the whole of their mythic explanations form a strong proof, in addition to those already noticed, that the constellations are not Greek in their origin. In a passage of Hesiod he has been supposed to speak of the sun under the name of Sirius; and Hesychius defines the word to mean both the sun and the dog-star. Dr. Hutton informs us that the Egyptians 'called the Nile Siris, and hence their Osiris,' which he has copied from Sir John Hill, who derives Sirius from Siris, but does not say where he got his information: probably from some writer of his own calibre. The Egyptians called the dog-star Sothis [SOTHIAC PERIOD], and from its HELIACAL rising had warning that the overflow of the Nile was about to commence. Now the overflow of the Nile follows the summer solstice; whereas, by the precession of the equinoxes, the heliacal rising of Sirius is now about the tenth of August. This heliacal rising is a very indefinite phenomenon, and will serve any system: by it Bailly, from Bainbridge's calculations, was able to carry back the settlement of Egypt 2800 years before Christ: while Newton, by a reckoning made on the same principles, made many antient events seem later than was generally supposed.

The greatest heats of summer generally follow the summer solstice, and in the Mediterranean latitudes, and in antient times, it was observed that the unhealthy and oppressive period coincided with the heliacal rising of the dog-star. We say *the* dog-star, without specifying whether it was Sirius or Procyon; it is uncertain which it was, and may have been both, for the heliacal risings do not differ by many days. The star itself was in Latin *canicula*, which should seem to apply to the lesser dog, and Horace says—

> 'Jam *Procyon* furit
> Et stella vesani Leonis [sc. Regulus]
> Sole dies referente siccos.'

Pliny supports the same meaning of canicula, and perhaps Hyginus; also the framers of the Alphonsine Tables, and Bede and Kepler, among the older moderns: while Germanicus and Julius Firmicus, with Apian, Magini, Argoli, H. Stephens, and Petavius, among the moderns, contend for Sirius, which is the more common opinion. All antiquity attributed an evil influence to the star; and though Geminus among the antients, and Petavius among the moderns, thought that the effects were to be attributed to the sun alone, they had hardly any followers until the fall of judicial astrology. Even at this day, when the heats of the latter part of the summer are excessive, we are gravely told that we are in the dog-days; and the almanacs, in which an absurdity has the lives of a cat, persist to this very year in informing us that the dog-days begin on the 3rd of July, and end on the 11th of August. Now as the heliacal rising of Sirius takes place about the very end of this period, it is clear that the cart has got before the horse, or the mischief before the dog. Moreover it is notorious that in our island the oppressive heats of the summer, during which dogs are apt to run mad (which is what many people think the name arises from, as indeed it was antiently recorded among the effects of the star), generally fall about the middle or end of August. The real classical dog-days are the twenty days preceding and the twenty days following the heliacal rising of whichever star it was, Sirius or Procyon. It is perfectly useless to retain this period: surely these dogs have had their day.

SIRMOND, JACQUES, was born at Riom, in France, October 22, 1559. Having completed his studies at the Jesuits' college at Billom, the first which that Society had in France, he adopted the rule of St. Ignatius, and prepared himself, by a diligent study of the antient languages, for fulfilling the duties of a teacher. When he had finished his noviciate, his superiors required him to come to Paris as professor of rhetoric, in which city he remained till 1590, when he repaired to Rome, on the invitation of the Père Aquaviva, General of the society of Jesuits, who chose Sirmond as his secretary. In this employment he continued sixteen years, during which he examined diligently the manuscripts in the Vatican library, as well as the inscriptions and other remains of antiquity, of which Rome possessed such an abundant supply.

In 1608 the Père Sirmond returned to Paris, and soon afterwards commenced a visitation of the libraries and archives of the convents, and was thereby enabled to save from destruction a great number of documents of the highest value for the history of the middle ages. Sirmond's first publication was the 'Opuscules' of Geoffroi, abbé de Vendôme, in 1610; from which time he continued to add to his reputation by other publications almost every year. Pope Urban VII. invited him to return to Rome, but Louis XIII. retained him in France, and in 1637 made him his confessor.

The Père Sirmond, having left the court on the death of Louis XIII. in 1643, recommenced his literary labours, which had been somewhat interrupted by attention to the duties of his late dignified office, and continued with unabated ardour to occupy himself in the same way till his death, October 7, 1651, when he was 92 years of age.

Sirmond's 'Ouvrages' were collected and published in 1696, in 5 vols. folio. The first three volumes contain the 'Opuscules' of those Fathers and other ecclesiastical writers which had been published by Sirmond, with prefaces and notes; the fourth volume contains his Dissertations; and the fifth volume contains the works of Théodore Studite. This edition of Sirmond's Works is by the Père La Baume, and is preceded by a Life of Sirmond by the editor, his Funeral Oration by Henri de Valois, and a list of Sirmond's Works in manuscript as well as printed. In this edition are included the Works of Ennodius bishop of Pavia, of Sidonius Apollinaris, of Eugenius bishop of Toledo, the Chronicles of Idatius and Marcellinus, the Collections of Anastasius the Librarian, the Capitularies of Charles-le-Chauve and his successors, the works of St. Avit, of Théodulphe bishop of Orleans, &c. Father Sirmond published other ecclesiastical writers besides those included in the above edition, among which are 'L'Histoire de Reims,' by Flodoard, the 'Lettres de Pierre de Celles,' the 'Œuvres' of Radbert, of Theodoret, of Hincmar archbishop of Reims, &c. Sirmond published also a Collection of the Councils of France, 'Concilia Antiqua Galliæ,' Paris, 1629, folio.

(*Biographie Universelle.*)

SIROCCO. [WIND.]

SISIN'NIUS, a Syrian by birth, succeeded John VII. as bishop of Rome, A.D. 707, and died twenty days after his election. He was succeeded by Constantine.

SISON, the name of a genus of plants belonging to the natural order Umbelliferæ. It possesses the following characters:—calyx obsolete; petals broadly obcordate, deeply notched, and curved with an inflexed point; styles very short; fruit ovate, laterally compressed; carpels with five filiform equal ridges, of which the lateral ones are marginal; interstices with single, short, club-shaped vittæ; seed gibbous, convex, plane in front; universal and partial involucre of few leaves.

Several species were formerly referred to this genus which are now placed under various genera. The only species that is now decidedly referred to Sison is the *S. Amomum*, hedge bastard stone parsley. It is a native of France, Sicily, Italy, Greece, and Great Britain. It is not unfrequent in this country, especially in chalk soils in rather moist ground, under hedges, &c. It is known by its erect, terete, paniculately branched stem; pinnate leaves, the lower leaflets rather toothed and lobed, upper ones cut into narrow segments. The flowers are cream-coloured. The green plant when bruised has a peculiarly nauseous smell, something like that of bugs. The seeds are pungent and aromatic, and were formerly celebrated as a diuretic, but are now little used.

SISSOO, a tree well known throughout the Bengal presidency, and highly valued on account of its timber. It is common chiefly in the forests and beds of rivers which extend all along the foot of the Himalayas up to 30° N. lat. The trunk is generally more or less crooked, lofty, and often from three to four feet in diameter. The branches are numerous and spreading; the leaves pinnate, with 5 alternate roundish acute leaflets, which from their small size and drooping nature give the tree a very light and elegant appearance.

The Sissoo yields the Bengal shipbuilders their crooked timbers and knees. Dr. Roxburgh describes it as being tolerably light, remarkably strong, but not so durable as could be wished; the colour is light greyish-brown, with dark veins: he says that upon the whole he scarcely knows any other tree more deserving of attention, from its rapid growth in almost every soil, its beauty, and uses. Captain Baker, in his 'Experiments on the Elasticity and Strength of Indian Timbers,' describes the Sissoo in structure somewhat resembling the finer species of teak, but as being tougher and more elastic, and as employed by the natives for house furniture, beams, cheeks, spokes, naves and fellies of wheels, keels and frames of boats, blocks, and printing-presses. It is universally employed both by Europeans and natives of the north-west provinces where strength is required.

The Sissoo belongs to a genus Dalbergia, which abounds in valuable timber-trees, as *D. latifolia*, which is usually called Blackwood-tree by the English, and of which the wood is exported as a kind of ebony: sometimes also called Black Rose-wood. It is one of the largest timber-trees of India, being 15 feet in circumference, with the wood of a greenish-black colour, with lighter-coloured veins running in various directions, and admitting a fine polish, and therefore much admired as furniture-wood. Captain Baker found it, like the Sissoo, able to sustain a weight of 1800 pounds, when teak broke with 1128 lbs. S. Dalbergia Ougeinensis, found in central India, is also highly valued for timber: the pillars of Sindia's palace at Ougein are made of it.

SISTERON, the chief town of an arrondissement in the department of Basses Alpes in France, on the right bank of the Durance, at the junction of the Buech, 437 miles from Paris by Lyon, Grenoble, and Gap. Sisteron was known to the Romans by the name of Segustero (*Itinerarium Antoninini*, and *Peutinger Table*) or the town of the Segesterii (*Notitia Provinciarum*), afterwards altered into Segesterium, Sistericum, and Sisteron. It is not known to what people it belonged. In the sixth century it became the seat of a bishopric, and was the object of attack in the ninth century to the Saracens and the Hungarians. The townsmen embraced the Huguenot party in the religious contests of the sixteenth century. The Catholics in consequence attacked the town and took it, A.D. 1562; but it was afterwards retaken by Lesdiguières. The town is calculated to be 479 metres, or 1570 feet, above the level of the sea. It is situated at the foot of a rock, upon which is an old citadel, and is surrounded by an embattled wall flanked with towers, but is commanded by the surrounding heights, so as to be little defensible in modern warfare. There are two bridges, one of a single arch over the Durance, the other over the Buech. The ex-cathedral has a fine altar-piece by Vanloo; there are two other churches, an hospital, and a prison. The population in 1831 was 3937 for the town, or 4429 for the whole commune. The townsmen manufacture hats, leather, and pottery; there are lime-kilns; and trade is carried on in almonds, wool, oil, and truffles: there are ten yearly fairs. The surrounding country produces a great quantity of walnuts and almonds, and some good wine. Urns, vases, lamps, medals, and other Roman antiquities have been dug up here.

SISTRUM, a musical instrument of percussion, of the highest antiquity, constructed of brass, and shaped like the frame and handle of a racket, the head part of which had three, and sometimes four, horizontal bars placed loosely on it, which were tuned, most probably, by some scale, and allowed to play freely, so that when the instrument was shaken, piercing, ringing sounds must have been produced. Some writers have confounded the sistrum with the cymbals, though the instruments could have had nothing in common except their harsh metallic sounds.

SISY'MBRIUM (from Σισύμβριον), the name of a genus of plants belonging to the natural order Cruciferæ. It possesses a roundish silique seated upon a torus; two stigmas, somewhat distinct, or connate into a head; calyx equal at the base; ovate or oblong seeds; flat, incumbent, sometimes oblique cotyledons; stamens not toothed. The species are mostly perennial or annual herbs, with yellow or white flowers, and leaves very variable on the same plant. About fifty-eight species are enumerated, but comparatively few of these are cultivated. The genus however belongs to an order that possesses no injurious plants, and a few of the species are well known on account of their uses.

*S. officinarum*, Common Hedge-Mustard, has muricate pilose leaves, a pilose stem, and subolate pods pressed to the rachis. It is a native of Europe, and grows in waste places and way-sides, among rubbish, and along the sides of walls. It is plentiful in Britain, and also the north of Africa. The whole plant is warm and acrid, and is often cultivated for use as a pot-herb. It is eaten by sheep and goats; but cows, horses, and swine refuse it. In medicine it was formerly much used as an expectorant in chronic coughs and asthma. It was also recommended in ulcerations of the mouth and throat. The stimulant properties of this and other plants belonging to the order would make them undoubtedly valuable remedies in many diseases in the absence of other means, but in modern medicine more powerful and certain remedies have thrown into disuse many agents formerly highly valued.

*S. Irio*, London Rocket or Broad-leaved Hedge-Mustard: stem and leaves smooth; leaves runcinate; lobes toothed; pod erect. It is a native of waste places throughout Europe, but especially about London. It is said to have entirely covered the ground in the following spring of the great fire of London in 1666. The former species is also remarkable for appearing on the ground where fires have existed. In such cases the ashes of the fires constitute a nutriment peculiarly adapted for the growth and development of these plants. The whole of this plant possesses the hot biting character of the mustard. Several varieties have been recorded.

*S. Sophia*, Five-leaved Hedge-Mustard, or Flixweed: leaves doubly pinnatifid, slightly hairy; lobes linear or oval; pedicels four times longer than the calyx; petals shorter. It grows on dry banks, waste ground, dunghills, and among rubbish in most parts of Europe. It is frequent in Great Britain. It has derived its name of flixweed and that of 'wisdom of surgeons' from its supposed power of controlling diarrhœa, dysentery, &c. Whatever may have been its former reputation, it is now almost entirely fallen into disuse.

*S. millefolium*, Millfoil-leaved Flixweed: leaves somewhat tripinnate, hoary; lobules blunt, small; stems shrubby; petals larger than the calyx. A native of Teneriffe, on the rocks in the lower parts of the island. It is a small branched shrub, with corymbose flowers. It is a greenhouse species, growing well in a rich light soil; and young cuttings will readily root under a hand-glass when placed in a sheltered situation.

*S. strictissimum*, Spear-leaved Hedge-Mustard: leaves lanceolate, stalked, toothed, pubescent. It has intensely yellow flowers, with pods two inches long; the stem is erect, and branching at the top. It is a hardy perennial, adapted for shrubberies, and may be easily increased by division of the root.

This genus at one time included that now known under the name of *Nasturtium*. The latter was originally separated by Brown, and is principally distinguished by the position of the cotyledons, a point of primary importance in the whole order of Brassicaceæ. In Sisymbrium the cotyledons are folded with their back upon the radicle, whilst in Nasturtium their edges are presented to it; in the former the cotyledons are said to be incumbent, in the latter accumbent.

A well known species of *Nasturtium* is the *N. officinale*, formerly *Sisymbrium Nasturtium*, the common water-cress. In addition to the characters of the genus, this plant is known principally by the form of its leaves. The leaf is composed of from 5 to 7 leaflets, which are arranged opposite each other on a common petiole with a terminal leaflet. The leaflets are somewhat heart-shaped and slightly waved and toothed; they are succulent, and their surface is smooth. The terminal leaflet is always largest. The upper leaves do not separate into distinct leaflets, being pinnatifid with narrow segments. The petiole of the leaf does not in any manner embrace the stem. The flowers are white, and the pods, when ripe, are about an inch long. This plant is a native of rivulets throughout the world, and is very plentiful in Great Britain. It has a warm agreeable flavour, and has long been one of the most popular plants as a salad. It was formerly much used in medicine as a diuretic and antiscorbutic, but its great consumption now is as an article of diet. As it frequently grows amongst plants that are not wholesome, and that bear to it a general resemblance, it would be well for every one to be acquainted with its characters. The plant most frequently mistaken for it, especially when out of flower, is the fool's water-cress. [SIUM.] From this it may be always distinguished, and in fact from all other Umbelliferæ, by the petioles of the leaves not forming a sheath round the stem.

The water-cress is cultivated to a very great extent in the neighbourhood of London. The plants are placed out in rows in the bed of a clear stream in the direction of the current, and all that is required for their successful growth is replanting occasionally and keeping the plants clear of mud and weeds; sandy and gravelly bottoms are best. 'Some market-gardeners who can command only a small stream of water, grow the water-cress in beds sunk about two feet in a retentive soil, with a very gentle slope from one end to the other. Then, according to the slope and length of the bed, dams are made six inches high across it, at intervals, so that when these dams are full, the water may rise not less than three inches on all the plants included in each. The water, being turned on, will circulate from dam to dam, and the plants, if not allowed to run to flower, will afford abundance of young tops in all but the winter months.' (G. Don.) Water-cresses grown in this way have not so fine a flavour as those from natural streams.

SITKHA is the name of the most important of the Russian settlements on the west coast of North America, though its proper name is New Arkhanghelsk. This place lies in 57° 2′ 50″ N. lat. and 135° 18′ W. long., and is built on one of the group of islands which received from Vancouver the name of King George III.'s Archipelago. The outward coast of this extensive group had been seen before by Cook in his third voyage, who called a very elevated island, which had the appearance of a cape, Mount Edgecombe, but he afterwards suspected that it was an island. The space between this small island of Edgecombe and the larger island which lies east of it, forms the harbour of the settlement. When Vancouver surveyed this coast, he thought that the outward coast, which extends from Chatham Sound on the south (56° N. lat.) to Cross Sound (58° N. lat.) on the north, constituted one large island, which he called King George III.'s Island; but it was afterwards ascertained that it was divided by a narrow strait into two islands, and since that time the northern island has been called by the native name of Sitkha, while the southern has received the name of Baranoff Island, in honour of the founder of the Russian settlement. On the last-mentioned island Baranoff built a small fort in 1799, which was destroyed in 1802 by the natives of the tribe of the Koloshes. But in 1804 Baranoff expelled them from the strait which constitutes the harbour of New Arkhanghelsk, and founded in the vicinity of one of their villages the present town. The harbour, which Vancouver named Norfolk Sound, but which is now better known as the Bay of Sitkha, is spacious and safe, and offers excellent anchorage opposite the settlement. The place itself is surrounded by a wooden wall, and enclosed by mountains of considerable elevation, which are almost covered with forests, in which excellent timber is found. Ship-building constitutes the most important of the branches of industry, and all the vessels of the American Company are now built at this place, since ship-building has been discontinued at Okhotsk. New Arkhanghelsk is the centre of the administration of the Russian territories in America, over which the American Company exercises sovereign powers, nearly in the same way as the Hudson's Bay Company over a much more extensive portion of North America. The collecting of furs is the exclusive object of both companies, and New Arkhanghelsk may be compared with Fort York, which lies nearly under the same latitude on the eastern coast of America. But New Arkhanghelsk is larger: its population in 1833 amounted to 847 individuals, of whom 406 were Europeans, and 307 descendants of Europeans and native women, and 134 only Aleutes and Koloshes. New Arkhanghelsk has also a much greater commerce by sea, and the vessels of the Company visit California, whence they import grain and salt, and dried meat; and the Sandwich Islands, where they obtain salt for curing their fish. The number of vessels employed by the Company in this commerce and in the transport of the furs which have been collected in the different smaller settlements amounts to twelve; their tonnage is stated not to exceed (1833) 1565 tons.

Wrangell continued to make meteorological observations during his stay at New Arkhanghelsk (1833 and 1835), and Baer has taken advantage of his work to compare the climate of Nain on the coast of Labrador with that of Sitkha. The result is contained in the following table, which expresses the mean temperature of the seasons and of the year:—

| | New Arkhanghelsk. | Nain. |
|---|---|---|
| Winter (Dec.—Feb.) | +34·74 | −1·26 |
| Spring (March—May) | 42·28 | +22·38 |
| Summer (June—Aug.) | 56·30 | 45·62 |
| Autumn (Sept.—Nov.) | 47·89 | 36·00 |
| Annual mean temper. | +45·30 | +25·50 |

Thus it appears that the mean annual temperature of these two places, situated respectively on the eastern and western coasts of North America, differs nearly 20 degrees of Fahrenheit; in winter the difference amounts to 36 degrees, and in summer to nearly 11½ degrees. But though these observations prove the great superiority of the western coast of North America over the eastern in respect to climate, a comparison between Sitkha and Bergen in Norway shows that the western coast of the old continent is much more favoured by nature. For though Bergen is 3 degrees and 20 minutes nearer the pole, the mean temperature of the winter is +36°, of the spring +45°, of the summer +58°, and of the autumn +48°, and the mean annual temperature nearly 47°. The climate of the last-mentioned place may also in other respects be compared with that of Sitkha, especially in regard to humidity. Sitkha however is certainly more humid; for in 1828 there occurred 120 days in which rain fell without interruption, and 180 days in which showers were frequent, so that only 66 days were free from rain. Snow is frequent during three or four months, but it does not lie long on the ground. It is considered rare if the frost continues for ten days together. It is to this great degree of humidity that the failure of all attempts to cultivate grain is attributed; for there are many other places in which it succeeds, and in which the mean temperature of summer is from 8° to 10° lower. The prevailing winds are from the south-east and the south-west. Thunder-storms occur only in November and December, and never in summer.

(Langsdorf's *Voyages and Travels in various parts of the World;* Lütke's *Voyage autour du Monde;* and Wrangel's *Statistische und Ethnographische Nachrichten über die Russischen Besitzungen an der Nordwestküste von America.*)

SITKOPF. [JAPAN.]

SITTA. [NUTHATCH.]

SITTINGBOURNE. [KENT.]

SIUM, the name of a genus of plants belonging to the natural order Umbelliferæ. The calyx possesses 5 teeth or is obsolete; petals obcordate with an inflexed point, or entire and ovate; fruit laterally compressed or contracted, and subdidymous, crowned with the reflexed styles with their depressed bases; carpels with 5 equal, filiform, rather obtuse ridges, of which the lateral ones are marginal; interstices with one or many vittæ; seed subterete. The universal involucre varies; the partial one is composed of many leaves.

*S. Sisarum*, Skirret, is the best-known plant of this genus. The root is composed of fascicles of fusiform tubers; stem terete; leaves pinnate, upper ones ternate, leaflets ovato-lanceolate, acute, serrated; involucre of 5 reflexed leaves; commissure, according to Koch, with 4 vittæ. It has white flowers. The tubers of the root are about the size of the finger, and were formerly greatly esteemed in cookery, but are now gone much into disuse. The French call this plant *Chervis*, the Germans *Zucker-wurzel*, and in the north of Scotland, where it is much eaten when cooked, it is called *crummock*. When eaten, the tubers are boiled and served up with butter, forming, according to an old writer, 'the sweetest, whitest, and most pleasant of roots.'

The Skirret is a native of China, and is reputed to possess in that country peculiar medicinal virtues. Sir J. E. Smith observes that the Chinese have long been in the habit of sending this root to Japan as the true Ginseng of Tartary, or *Panax quinquefolia* of Linnæus, a plant possessing very different properties.

The Skirret may be propagated by seeds and offshoots. The seeds should be sown in the months of March and April, in small drills eight inches apart, in an open space of lightish ground. When the plants are one or two inches high, they should be thinned, and they may be used as they attain size till August, September, or October. Plants of the last year will always afford offsets, which may be broken off the old roots and planted in rows. For procuring seed the plants should be left till the following autumn.

*S. nodiflorum*, Fool's Water-cress, or procumbent Water-parsnip, possesses a rooting, procumbent, striated stem; pinnate leaves, oblong equally serrated leaflets; umbels sessile, opposite the leaves. It is a native of Europe, in ditches and rivulets, and is common in Great Britain. A small and large variety are recorded, the one not attaining more than three or four inches in height, the other as many feet. It was formerly admitted into the 'London Pharmacopœia,' on account of its efficacy in cutaneous diseases and scrofula. Dr. Withering has recorded his opinion in its favour, and related a remarkable case in which benefit was derived from its use. He administered three or four ounces of the juice in milk daily. This plant has often been represented as very poisonous; but if thus much of the juice can be taken with impunity, it can hardly be very active. This, with some other species of Sium, has been placed by Koch under a new genus, *Helosciadium*. The principal difference consists in the number of vittæ found in the interstices of the carpels; *Sium* having several vittæ, *Helosciadium* only one.

There are many other species of Sium, four of which are British, but none of them are cultivated for their beauty or applied to any particular uses.

SIVA, the personification of the destroying principle, forms, with the two other gods, Brahma and Vishnu, the Trimûrti, or triad, of the Hindus; and although, in allusion to his office as destroyer, he is classed third, yet he is generally allowed to occupy the second place among the Hindu deities, or even (according to Kindersley) the first, as his supremacy appears to have obtained more general assent than that of Vishnu. Indeed the worship of Siva is so predominant, that Brahma, who is the only one of the three mentioned by Manu, and who seems to have enjoyed a larger share of adoration in antient times, has now only one temple in India, while Mahâdeva (a name of Siva) and the adventurous Vishnu, whose incarnations attract so much of the veneration of the Hindus, are, in fact, the only gods of the whole Hindu pantheon who have numerous worshippers. This however is no proof that Siva or Vishnu dates from a later period. The personification of the three divine attributes originates, no doubt, with the Vedas, and the names of the three gods are mentioned, though rarely, and without the least allusion to their pre-eminence over the elemental gods or over each other; but we do not find that the two great sects of India, the Vaishnavas (followers of Vishnu) and the Saivas (worshippers of Siva) came into existence before the seventh or eighth century of our æra. It is therefore to the Purânas (the scriptures of the modern Hindu religion) that we must ascribe the extension of the worship of Siva and the character which now distinguishes this god. We cannot however point out the difference between the mode of worshipping Siva now and in the time of Manu, the Vedas being too little known, and the extracts from them, which have been hitherto published, unsatisfactory. We must therefore limit ourselves to the description of the present popular form of Siva worship, which in all probability had not assumed its actual state before the great Saiva reformer, Sankara Acharya, who lived in the eighth or ninth century. (*Vishnu Purâna*, pref., p. x.) This opinion is supported by the well-founded assertion that the Saiva faith was instituted by Paramata Kalânala, who is described in the 'Sankara Vijaya' of Ananda Giri as teaching at Benares, and assuming the insignia that characterize the Dandis, a sect of Saivas of modern times. (*As. Res.*, xvi. 22.) No allusion is made in the Purânas to the original power of this god as destroyer; that power not being called into exercise till after the expiration of twelve millions of years, when according to Pauranic accounts, the Kaliyuga will come to a close together with the universe; and Mahâdeva is rather the representative of regeneration than of destruction. Indeed the worship of the type which represents him as the vivifying principle, the *linga* (phallus, a smooth black stone in the form of a sugar-loaf, with a projection at the base like the mouth of a spoon) is spread all over India, and the number of worshippers of this image is far greater than the worshippers of all the other gods. (Ward, i. 16.) There are however a few legends in Hindu mythology in which Siva appears as the actor without any reference to the worship of the *linga*. The linga is indeed the only form under which Siva is now adored in most parts of India. According to Professor Wilson (*Vishnu Purâna*, xliv.), 'There is nothing like the phallic orgies of antiquity; it is all mystical and spiritual. The linga is twofold, external and internal. The ignorant, who need a visible sign, worship Siva through 'a mark' or 'type,' which is the proper meaning of the word 'linga,' of wood or stone; but the wise look upon this outward emblem as nothing, and contemplate in their minds the invisible inscrutable type, which is Siva himself. Whatever may have been the origin of this form of worship in India, the notion upon which it was founded, according to the impure fancies of European writers, is not to be read even in the Saiva Purâna.' Indeed the emblems under which the Hindus exhibit the elements and operations of nature are not indecorous, and the low cylinder of stone, which is meant for the symbol of the creative power, suggests no suspicion of its original import; and nothing whatever belongs to the worship of the linga, or to the terms in which this is mentioned, which has the slightest tendency to lead the thoughts from the contemplation of the god to an undue consideration of the object by which he is typified. The best refutation however of the injurious suppositions to which the accounts of many travellers have given rise, will be the words which Siva himself is supposed to say in the Saiva Purâna: 'From the supreme spirit proceed Purusha (the generating principle), Prakriti (the generative nature), and Time; and by them was produced this universe, the manifestation of the one god. . . . . Of all organs of sense and intellect the best is mind, which proceeds from

Ahankâra;* Ahankâra, from intellect; intellect, from the supreme being, who is in fact Purusha. It is the primeval male, whose form constitutes this universe, and whose breath is the sky; and though incorporeal, that male am I.' This doctrine is pure enough, and the few aberrations which remind one of the orgies practised in honour of Bacchus, are not sufficient to justify us in stigmatizing it as vile and infamous.

The linga however is only the type of Siva as the god who presides over generation. His other forms are many, and they vary in so far as they attribute to him the qualities of creator, preserver, destroyer, and regenerator, and represent him in his various *avatâras* (incarnations, eight of which are called by the common name of Bhairava, and are severally termed Asitânga, Ruru, Chandra, Krodha, Unmatta, Kûpati, Bhîshana, and Sanhâra, all alluding to terrific properties of mind or body. He is sometimes seen with two hands, at others with four, eight, or ten, and with five faces; he has a third eye in his forehead, the corners of which are perpendicular, which is peculiar to him; a crescent in his hair, or on his forehead, encircling the third eye; he wears earrings of snakes, and a collar of skulls. Mahâdeva, when represented thus, but with one head, has four hands, in one of which he holds a pâsa, the use of which is to extract the souls out of the bodies of men, when their time is come, and is a common attribute of Yama, the god of death (*S. Sâvitryupakhyana*, ed. Bopp., p. 25), a tris'ula is upheld by the other, and the two other hands are in a position of benediction. As Bhairava (the lord of dread) he is frightful to behold; great tusks burst through his thick lips; the hair, which is stiff and erect, gives his face a dreadful aspect; the fall of the necklace is impeded by numerous snakes which twine round his body. This is also the idol which shows him as Mahâ-kâla, or god of time. It is in this character that he is supposed to delight in bloody sacrifices, and that the Saiva Sannyâsis (followers of Siva who practise the yoga to the highest degree) inflict on themselves the cruelties which have rendered so conspicuous the temple of Jaggernaut (Jagannâtha, the lord of the world). [YOGA.] A very minute account of the fortitude and self-denial of the deluded Yogis is given in Ward's 'View on the Religion of the Hindus' (i. 19). His consort Sakti, who in her corresponding character is celebrated as the goddess Durgâ or Kâlî, participates in these horrible sacrifices, and has lately become more notorious by the exposure of the homicidal practices of the Thugs, who recognise in her their tutelary divinity. Siva is also the god of justice. In that character he rides a white bull, the symbol of divine justice (Manu, viii. 16), and is often seen with the *parashu* (battle-axe) in his hand, and the sacred string. On pictures he is often represented as if rubbed over with ashes, and with a blue neck; the epithet of Nîlakanta (blue-necked) was given to him in commemoration of his having drunk the poison which arose from the sea, and threatened to destroy mankind. But the character in which he is more generally known, and which his followers imitate, is that of the Kapâla-bhrit (skull-bearer). Skanda-Purâna makes him describe himself in the following words:—'Pârvatî (his bride) must be foolish to practise so severe a penance in order to obtain me, Rudra (one of his 1000 names), a wandering mendicant, a bearer of a human skull, a delighter in cemeteries, one ornamented with bones and serpents, covered with ashes and with no garments but an elephant's skin, riding on a bull, and accompanied by ghosts and goblins.' Now this, except that the unearthly beings who follow him are represented by a crowd of dirty people, is exactly the description of a Saiva digambara (sky-clad, *i.e.* naked—a kind of religious mendicants), if, instead of the god's third eye, we add a round dot on the nose, made of clay or cow-dung, and a mark on the forehead, composed of three curved lines, instead of the *chandra* (half-moon) which Rudra obtained at the churning of the ocean. When asked for the reason why they and their god carry a human skull, they refer to the Vâmana-Purâna: 'Formerly, when all things moveable and immoveable had been destroyed, and nought remained but one vast ocean; while universal darkness reigned, that lord who is incomprehensible and subject to neither birth nor death reposed in slumber on the abyss of the waters for a thousand divine years; but when his night had passed, desirous of creating the three worlds, he, investing himself with the quality of impurity, assumed a corporeal form with five heads. Then also was produced from the darkness another form, with three eyes and twisted locks, and bearing a rosary and trident. Brahma next created *Ahankâra* (self-consciousness), which immediately pervaded both Siva and himself, and under its impression Rudra thus said to Pitâ-Mahâ:—"Say, O lord! how camest thou here, and by whom wert thou created?" Brahma replied, "And whence art thou?" and instantly caused the new-made sky to reverberate with a wondrous sound. Sambhu (Siva) was thus subdued, and stood with a countenance downcast and humbled, like the moon in an eclipse, and the fifth head of Brahma thus addressed him rendered red-dark with anger at his defeat:—"I know thee well, thou form of darkness! with three eyes, clothed with the four quarters of the sky (*i.e.* naked), mounted on a bull, the destroyer of the universe." On hearing these words Sambhu became incensed with anger, and while he viewed the head with the terrible glances of his world-consuming eye, his five heads, from his wrath, grew white, red, golden, black, and yellow, and fearful to behold. But Brahma, on observing these heads glowing like the sun, thus said:—"Why dost thou agitate thyself and attempt to appear powerful? for, if I choose, I could this instant make thy heads become like bubbles of water." This heard, Siva, inflamed with anger, cut off with the nail of his right hand the head of Brahma which had uttered such fierce and boasting words; but when he would have thrown it on the ground, it would not, nor ever shall it, fall from his hand.' The beautiful idea which is obscured by the extravagances of this passage, namely, that the creation in itself involves subsequent destruction, need hardly be pointed out. In nearly all the representations of Siva, the Ganga (Ganges) is seen either flowing from his head or beaming on his head-piece. There is an interesting fable which makes it flow from Pârvatî's fingers, but for which we refer our readers to Moore's 'Hindu Pantheon' (p. 41).

The origin of the linga worship is, we find, differently accounted for in different Purânas. The 'Linga-Purâna,' which contains 11,000 verses (*Mackenzie Coll.*, i. 39), states that the primitive linga is a pillar of radiance in which Mahâdeva is present. The appearance of the great fiery linga takes place, in the interval of a creation, to separate Vishnu and Brahma, who not only dispute the place of supremacy, but fight for it, when the linga suddenly springs up, and puts them to shame; after travelling upwards and downwards for a thousand years in each direction, neither of them can approach its termination. Upon the linga, the sacred monosyllable *Om* is visible, and the Vedas proceed from it, by which Brahma and Vishnu become enlightened, and acknowledge the superior might and glory of Siva (*Vishnu-Purâna*, xliii.). This legend, by which, in its Tamul version, the circumstance of Brahma having neither temple nor worshippers is accounted for, is given in Kindersley's 'Specimen of Hindu Mythology' (p. 21). In his travels in search of the head of the column, Brahma is said to have found a Cauldairy flower which Siva had purposely dropt from his head. He entreated it to bear false witness for him, that he had actually found the top of the column. The flower rashly consenting to the fraud, both returned to Siva, and asserting the falsehood agreed on, Siva, in his just resentment, decreed that Brahma should never receive any external worship. A very fanciful story about the linga is given in the 4th volume of the 'As. Res.,' p. 368; and another, which Abbé Dubois states to be derived from the 'Lainga,' but which, in fact, is from the 'Padma-Purâna,' may be found in this author's 'Moeurs, &c. des Peuples de l'Inde,' vol. ii., p. 417. But the pure, original, mystical idea, which must undoubtedly have been expressed in the Vedas, is poorly preserved in the Purânas, and almost entirely lost in the daily worship of the present Hindus, who, although without any admixture of obscene thoughts, adore their stone, or the image which they make themselves from the clay of the sacred river where they perform their ablutions, in much the same way as an African venerates his fetish. Siva, who as the type of the regenerating principle is also that of fire, which quality is represented by a triangle with the apex upwards ($\Delta$), is the object of a very ludicrous ceremony when the heat is great. Fearing lest he should set on fire the whole world, they put above his idol a basin full of water with a small aperture at the bottom, in order that the water which drops on him may moderate his ardour. (Dubois, ii., 304.) We need not wonder if the linga worship has given rise to sects whose practices are far from admitting

* Literally the 'I-Maker' is the Hindu term for the power of self-consciousness, or, what is implied by this, individuality; for further information see YOGA.

any apology There is, according to Dubois (i. 154), a sect called *Vîra-Saiva*, who reject altogether the authority of the Vedas and the other sacred works of the Hindus, who deny the distinction of casts, maintaining that the linga renders all men equal; even a Vaisya, who embraces this doctrine, is, in their opinion, equal to a Brâhmana. They state that where the linga exists, there is also the throne of the deity, without distinction of ranks and persons; and that the humble hut of the labourer where this sacred sign exists, is much above the sumptuous palace where it is not to be found. This doctrine, which is in direct opposition to the customs of the Hindus, has never had many followers.

To continue the account of his adventures: Siva marries Pârvatî, and lives with her in the midst of the eternal snows of Mount Kailâsa. His heaven is however one of the most splendid in Hindu mythology, and a description of it may be found in Ward's 'View' (i. 30); it is a translation from the Kritya Tatwa. There also are his two sons; Ganesa, the leader of the heavenly choristers, and, as Vigneswara, the god of difficulties, whose head is that of an elephant; and Kartikeya, the six-faced god of war. It is there that he was thus addressed by Brahma and the other gods:—'I know that thou, O Lord, art the eternal Brahm, that seed which, being received in the womb of thy Sakti (aptitude to conceive), produced this universe; that thou, united with thy Sakti, dost in sport create the universe from thy own substance, like the web from the spider.' Here it was that he reduced to ashes the 'flowery-bowed mind-bewitcher' Kâma (the god of love), pierced by whose arrows he had neglected to avenge the wrong done to him and his consort by his father-in-law Daksha. On the top of Kailâsa it is that the worshippers of Siva will be admitted to the sports of the inhabitants, where Mahâdeva invented for the amusement of his bride the heavenly dance, to which his faithful attendant Nandi plays the musical accompaniment. There lie before the door his vehicle, the white bull, and the tiger on which his consort rides. Though wanting all the splendours of the Swarga (Indra's heaven), the abode of Siva, when drawn in the glowing colours of the East, is no less gratifying. From thence he is supposed to bless his worshippers, 'when, with Pârvatî on his knees, he, the lord of the world, on whose brow shines the moon throwing its beams over the mountain of the north, deigns to allow the Suras and Asuras (gods and dæmons) to wear for their frontal ornament the reflection of the radiance of the nails of his feet, and the Ganga, rushing from the top of his head, refreshes the air of his sacred dwelling' (*Kathâ Sarit Sâgara*). This is a favourite subject among the Hindu painters, and we must allow that their conception of it is generally good and well executed.

The religious service is the same as that which is used at the worship of Siva under his other names. In performing the linga-pûja, for that is the Sanscrit name for sacrifice or worship, all its various parts are performed in due order. The directions for it may be found in the Lainga-Purâna (i. 25), translated by Kennedy (p. 306):—'Having bathed in the prescribed manner, enter the place of worship; and having performed three suppressions of breath [YOGA], meditate on that god who has three eyes, five heads, ten arms, and is of the colour of pure crystal, arrayed in costly garments, and adorned with all kinds of ornaments: and having thus fixed in thy mind the real form of Maheswara, proceed to worship him with the proper prayers and hymns. First sprinkle the place and utensils of worship with a bunch of *darbha* dipped in perfumed water, repeating at the same time the sacred monosyllable *Om*, and arrange all the utensils and other things required in the prescribed order; then in due manner repeating the proper invocations, prayers, and hymns, preceded by the sacred word *Om*, prepare the offerings. For the *Padiam*, they should consist of Ushiram (root of the Andropogon muricatus), sandal and similar sweet-smelling woods, &c. Having then with due rites prepared a seat, invoke with the prescribed prayers the presence of Parameswara, and present to him the *padiam*, the *âchamanîyam*, and *argyha*. Next bathe the linga with perfumed waters, the *panchagavyam* (five produces of the cow), clarified butter, honey, the juice of the sugar-cane, and, lastly, pour over it a pot of pure water consecrated by the requisite prayers. Having thus purified it, adorn it with clean garments and a sacrificial string, and then offer flowers, perfumes, frankincense, lamps, fruits, and different kinds of prepared eatables and ornaments. Thus worship the lingam with the prescribed offerings, invocations, prayers, and hymns, and by circumambulating it, and by prostrating thyself before Siva represented under this symbol.' For an explanation of the technical terms here employed, we refer to Dubois (i. 199).

The Purânas which the worshippers of Siva are most acquainted with, and which have more or less of a Saiva bias, are the Mâtsya, Kaurma, Saiva, Lainga, Skhandâ, and Agneya, to all of which the term of Tâmasa, or works of darkness, is given. The Padma-Purâna contains the thousand names of Siva at length, and is better known than the others. None of them however have yet been published, and the reader will have to judge of the general tendency of these works from the extracts that we have given. It is remarked that they are not so popular as the Purânas, which contain the narratives of Vishnu's wonderous deeds, and that they have not found their way into the modern literature of India. If therefore the thousand visible manifestations of Siva's presence on earth, under as many different names, are known to the present Hindus by tradition only, we shall not be surprised that they united them all in one common typification by means of the linga. There are however a few exceptions. A form of Siva which is especially worshipped by the lower orders, who consider him as the destroyer of children, is known under the name of *Panchânana;* it is a misshapen stone, anointed and painted, and then placed under trees. Another form which is still preserved is that of the *Kâlurâya*, the god of forests. He is represented as sitting on a tiger, and carrying a bow and arrows. The woodcutters worship him to insure protection from wild beasts. These numerous names of Siva have led Europeans into a notion contrary to that which induced the Hindus to make the linga the general type for all the forms of this god; they naturally enough supposed each of his numerous names and pagodas to belong to a distinct and separate deity. Hence the erroneous notion about polytheism in India, whilst it is evident, even from the few passages we have quoted, that the original monotheism of Hindu religion had in the progress of time become pantheism, which is prevalent all over the East. Even at present the follower of Siva denies the divinity of Vishnu, and *vice versâ;* although both these gods, now representing the Supreme Being, were only types of divine qualities attributed to the Trimûrti. But the allegory eventually acted too strongly on the imagination of the people. Brahma, as creator, had finished his work, and could not with propriety act any more. Siva therefore and Vishnu were destined to do all that fancy could suggest; but still Mahâdeva is the only god to the Saivas, whilst Narâyana is the one chosen by the Vaishnavas. For this we have the express words of the Radha Tantra, which says that the form of Arddhanareswara (half man, half woman) was assumed by Siva in order to prove that he was the one Brahma, in whom both the female and male powers are united. (Rolle, i. 15; Bohlen, i. 150.) This notion of the animating and recipient principles being united in one, has been embodied in the statue termed Arddhanarî; one half of Siva, from head to foot, bears all the ornaments of Pârvatî or Bhâvanî; the other is exactly the same as that in which he is usually exhibited. The Vyaghra (tiger) of Kâlî is also seen under the female half of this symbol, and the bull Nandi lies at the foot of the man portion of Siva.

*Sects of Saivas.*—The *Dandis* are separated into two classes. 1, The *Dandis* proper are the only legitimate representatives of the fourth asrama, or mendicant life, into which the Hindu is to enter after passing through the previous stages of student, householder, and hermit. (Manu, vi. 33.) They worship Siva as Bhairava; the ceremony of initiation consists in a small incision being made in the inner part of the knee, and in drawing the blood of the novice as an acceptable offering to the god. 2, The *Dasnâmi Dandis* admit only Brahmans into their fraternity, and are the primitive members of the Dandi order. Sânkara, the teacher of the caste, has perpetuated his influence by writings, the best of which are his Bhâshyas, or Commentaries on the Sûtras (aphorisms) of Vyâsa, and on the Bhagavad-Gîta. They are distinguished by carrying a small dand (or wand), whence they derive their name, and a piece of cloth dyed with red ochre. They shave their hair and beard; wear only a cloth round their loins; and subsist upon food obtained ready dressed from the houses of the Brahmanas. Their principal study is that of the Vedanta works. (*As. Res.*, xvii. 169.)

The other sects are the *Raudras, Ugras, Bhâktas, Jangamas, Pâsupatas*, and others, each of which wears the linga on some part of the dress or person, and are distinguished from each other accordingly. This sign is often worn in small cases of silver or brass. (Dubois, i. 147.) Their occupations are generally similar to those of the Dandis (for the principal points in which they differ, see VISHNU). Their scriptural authorities are the Síva-Gîta, Siva-sanhita, Siva-harasya, Rudra Samoha Tantra, and a great number of Tantras which are little known.

Among the sects of Siva there are women who are devoted to the service of their gods, under the name of spouses of the gods. They are called linga-vadhvas, and wear the stamp of the linga on their thigh. Although known to be the concubines of the priests, they enjoy considerable respect. (Dubois, i. 179.)

Among the chief places of pilgrimage sacred to Siva, is Kasi, or Benares, which contains the finest temple, known under the name of the Pagoda of Vis'wes'wara. Chandra Sekhara, a mountain near Chittaganga, on which stands a temple of Siva, is another place of pilgrimage. The surface of a pool of water at this place is said to emit inflammable air, from the fire of which pilgrims kindle their burnt offerings. According to a statement of Ward (ii. 130), Ekamrakanana, a place on the borders of Orissa, contains 6000 temples. Not less than 70,000 or 80,000 people are said to visit this place at the drawing of the car of Jagannâtha, when all castes eat together.

Of the festivals of Siva the chief is that called Sivarâtri. It lasts three days, which are employed in performing various rites before the linga, which they wash four times. The occasion of this is the Bhavishya-Purâna: 'A bird-catcher detained in a forest in a dark night climbed a Bilwa-tree, under which was an image of the linga; by shaking the boughs of the tree the leaves and drops of dew fell upon the image; with which Siva was so much pleased, that he declared the worship of the linga on that night should be received as an act of unbounded merit.' (Ward, ii. 20; Dubois, ii. 328 and 530.) This takes place on the 14th of the increase of the moon in February. For the other festivals common to both sects, see VISHNU. The Monday is generally consecrated to Nandi (Siva's bull), and no work is done.

The shape of the temples of Siva does not differ from those of the other gods. The chief entrance into the great temple is by a high massive pyramid, the top of which has generally the form of a crescent; it invariably faces the east. Beyond the gate there is a large court, at the farther extremity of which another gate leads through a pyramid of less height, but of the same form. A small yard separates it from the temple of the idol. In the middle of it there is either a huge bull or a linga carved in stone, raised on a pedestal, or put under a canopy supported by four pillars. This is the first object of adoration to the visitors, who then pass through a low narrow door into the inside of the temple. This door is the only passage for light and air, there being no windows. A lamp, which burns night and day, gives a tolerable light. The interior of the building is generally divided into two parts, sometimes into three, the first of which is the most spacious, and is destined to receive the people; the second, or the *adytum*, in which the idol resides, is much smaller and darker, and generally shut, the door being opened only by the officiating priest, who, with some of his attendants, has alone the right of entering this mysterious place for the purpose of washing the image, and dressing and bringing offerings to it. This part is often built in the shape of a vault, but it is so low as to make a prolonged stay in it rather oppressive.

Among the trees sacred to Siva the chief are the Vepu and the Bilwa, the leaves of which are often brought as offerings to the god. The first of these trees has to undergo the singular ceremony of being married to the Aswata (the holy fig-tree); the formalities are much the same as those which take place at the marriages of the Brâhmanas. Siva himself is said to be the stem of the Aswata-tree, of which Brahma is the root and Vishnu the branches. Besides the Vepu and the Bilwa, there are numberless inanimate objects sacred to Siva.

It has already been mentioned that the bull is the animal which enjoys the greatest veneration from the Saivas, and to which a day in the week is consecrated.

The worshippers of Siva are distinguished from the rest of the Hindus by burying their dead bodies, instead of burning them. The obsequies are performed in the following manner, if the deceased is a Saiva Sanhyâsi:—The corpse is deposited, with its legs crossed, in a large basket made of bamboo, which four Brâhmanas carry to the grave, which is dug in the neighbourhood of a river or pond. It is about six feet deep, and of a circular form. They cover the bottom of it with a thick layer of salt, upon which the deceased is placed in a sitting position; the space between him and the sides of the grave is then filled with salt up to the chin of the corpse, with the view of holding up the head so as not to allow of its being moved. A great number of cocoa-nuts are then thrown against it until the skull is quite broken, when they throw salt upon the place so as to hide entirely the fractured head. They then erect over the grave a kind of tumulus, an elevation about three feet high, on the top of which a linga of two feet, made of clay, is placed, and immediately consecrated by the *mantras* (incantations) of the Brâhmanas, who present to it kindled lamps, flowers, incense, bananas, and other offerings. This ceremony is performed with the accompaniment of sacred hymns, which are sung by those who are present at the burial. At the termination of this discordant concert, as it is termed by Dubois, he who presides at the ceremony goes three times round the linga, inclines himself before it, and expresses his hope 'that by virtue of the sacrifice offered to the linga, the deceased may be agreeable to Siva, and that being once received by Brahma (*paramâtma*, the universal soul) he may not be obliged to be born again.' During two days which follow this ceremony, offerings are brought to the linga every morning, and the sacred mantras are repeated. A year afterwards the ceremony is performed again, but with less expense to the family of the deceased.

It has been mentioned in the course of this article, that nothing indecent occurred at the festivals in honour of Siva, or in worshipping his type the sacred linga; but since so much has been said in support of an assertion tending to throw doubt upon the strict observance of all the rules of decency, and to identify the practices of the linga worshippers with the phallic ceremonies of the Greeks, it seems proper to state what may have occasioned this report.

There is indeed in India a sect, which some writers have stated to belong to the Saivas, whilst others describe them as votaries of Vishnu; others again, and apparently with more reason, speak of them as independent of either: they are called Sâktas, and adore the female organ of generation under the type of the *yoni* (pudendum muliebre, a figure of stone or wood in the shape of a heart). Their name Sâkta is derived from Sakti, which means power, aptitude, and is the name of Siva's consort.

These Sâktas seem to found their religious belief on a passage in one of the Upanishads to the Atharvan-Veda, quoted by Windischmann, p. 847: 'Voluptatem in amplexu foeminæ, et voluptatem emissionis et voluptatem acquirendi nati fausti, qui desiderium patris post mortem ejus adimpleat, et gaudium quod in illo tempore simul provenit, etiam Brahma esse qui scit oportet eum meditari de illa (*i.e.* cum illa yogam inire);' and certainly in some of their festivals they commit great excesses. Dubois, an eye-witness, states expressly that they are held in honour of Vishnu (i. 402). The ceremony of the Sakti-pûja is performed at night with more or less secrecy, a minute description of which is given by Dubois. We shall content ourselves with observing that the least odious of these orgies are those where they limit themselves to drinking and eating all that is forbidden them by their Sâstras, and where men and women violate the most sacred rules of decency. This is the only instance where the worship of the generating principle has been made the pretext for the most revolting orgies, where the idea degenerated in the same manner as it did in Rome and Greece. There too the principle was the same—a highly philosophical and moral idea. The doctrines of the Egyptians laid the foundation of the Eleusinian mysteries; Isis became Demeter, Orus the Bacchus Iacchus. That same Isis was the Sakti of the Hindus: the notion which this Sanscrit word conveys suits exactly the description of the Egyptian goddess by Plutarch. According to him Isis was the generative power (δύναμις), which lay dormant until Osiris's vivifying principle had reproduced himself by her in his son Horus. The same idea was in Plato's mind when he said that nature was composed of three things, and could be represented by a triangle. There are still some passages of Greek and Roman writers which prove that the worship of the phallus had in other places been as pure as that of the linga. Tacitus, for instance (*Hist.*, ii. 3), describes a linga in the temple of Paphian Venus without being aware of it; these are his words:—'Simulacrum deæ non effigie humana; continuus orbis latiore initio tenuem in ambitum, metæ modo exsurgens, et ratio in obscuro;' and Rolle, ii. 342, says, without mentioning his authority, 'It was the custom of the Greeks to put phalli on the tombs, that the productivity of nature, extinct, or rather, stopped for a short time by death, might take a new life.' This coincides exactly with the ceremony observed by the Saivas at their funerals; it does not appear however what kind of images were used upon this occasion; but those which Pliny (xix. 4) mentions, and which he calls *satyrica signa*, must have differed from those which are described as belonging to the Greeks. Another circumstance which is remarkably like the practice of the Hindus which we have mentioned, is the custom of wearing phalli in small silver cases to protect children against *fascinations*, as stated by Varro (*Ling. Lat.*, vi. 5, p. 99, Blp.). Other traces of the linga, as considered by the Hindus, may be found in Socrates (*Hist. Eccl.*, 5, 17), where he relates that at the destruction of a temple of Serapis in Alexandria a number of signs were found, the purpose of which was not understood; among them there was one in the shape of a cross, which the heathens stated to be the symbol of a future life. The Christians, he continues, by the means of this cross made a great number of proselytes. Now this cross is the same by which we mark the planet Venus (♀), and which, when first seen, was supposed to mean the key to the mysteries. Jablonsky was the first who understood its real import, when he expressed himself thus: 'Cruci ansatæ sive phallo adeo similis est lingam illud Brahmanum ut ovum ovo similius esse nequeat.'

For the description of the degraded phallic worship we must refer to the 2nd vol., pp. 257-274, of the 'Indian Antiquities' of T. Maurice, who traces the origin of the linga worship back to Egypt, and gives a faithful paraphrase of the account contained in Diodorus Siculus, by which he only proved how little he knew the Hindu view of the subject.

The rage for identifying the gods of the Eastern nations with those of the West has not spared Siva. He was Bacchus, and Saturn, and Pluto; in fact, he was said to be almost the entire pantheon of Greece and Rome and Egypt. Neither is this to be wondered at, seeing that the Greeks and Latins ascribed different attributes to different deities. The Hindus have only one to whom to ascribe all attributes. Siva is also, and it appears originally, the representative of fire. This element penetrates earth and water, represented by Brahma and Vishnu, imparts to them some of its vigour, develops their qualities, and brings everything in nature to that state of increase, maturity, and perfection which they would not attain without it. But ceasing to act beneficially on the created things, they perish: this agent of reproduction, when free and visible, consumes the body, the composition of which he himself had effected: to this quality he owes his title of god of destruction.

The reader who may wish to see the connection of the Hindu gods with those of Greece and Rome will find ample materials in the papers which Col. Wilford inserted in the earlier volumes of the 'Asiatic Researches:' they cannot however be implicitly relied on.

(Vans Kennedy, *Researches into Ancient and Hindu Mythology*; Ward, *View of the Religion, Literature, &c. of India*; Wilson, *Vishnu Purâna*—*Oxford Lectures*; Rolle, *Recherches sur Bacchus et les Mystères*; P. von Bohlen, *Das Alte Indien*; Kindersley, *Specimen of Hindu Literature*; Moore, *Hindu Pantheon*; *Asiatic Researches*; Dubois, *Mœurs, &c. des Peuples de l'Inde.*)

SIVAS, or SIWAS, a town in Asia Minor, on the north bank of the river Kizil-Irmák, in 39° 25′ N. lat. and 36° 55′ E. long.; 165 geographical miles south-west by west from Trebizond, and 87 north-east from Kaisariyeh. It is the capital of a pashalic which comprehends the whole eastern part of Asia Minor, and which still bears the name of Rúm, or Rúmiyah, which was applied to the whole Turkish empire before its expansion. The valley of the Kizil-Irmák, the antient Halys, here spreads out into a broad and fertile plain. The situation being level, with the exception of only one small circular elevation in the south-west, the whole city is seen to much advantage when approached from the north. It is interspersed with trees, without being buried in them, like most of the towns in these parts. The great number of chimneys seen above the house-tops indicate that the winter is severe; and the inhabitants affirm that it is as cold as at Erz-rúm. The houses are well-built, partly tiled, partly flat-roofed, and intermingled with gardens. These, with the numerous minarets, give a cheerful aspect to the place. The bazaars are extensive and well stocked with goods, including many of British manufacture. The consumption of Sivas itself, and the circumstance of its furnishing supplies to many places, causes its transit-trade to be extensive. Sivas is inhabited by about 6000 families, of whom 1000 or 1100 are Armenians, and the rest Moslems. The place was once called Cabira, a name that was changed to Diopolis by Pompey, and subsequently to Sebaste. Sivas is a corruption of the word Sebaste. It was the theatre of the great contest, in 1401 A.D., between Bajazet and Timour, in which the former was defeated. An Armenian historian states that the town then contained 120,000 souls; and that it capitulated to Timour, on condition that their lives should be spared, which condition he most barbarously violated.

(Mr. Johnston's *Journal*, in the *American Missionary Herald*, Oct. 1837; and Mr. Consul Suter's *Journal*, in *London Geographical Journal*, 1841.)

SIWAH is the modern name of the oasis in the Sahara, which was called by the Greeks and Romans Ammonium, Ammonia, or Ammoniaca, from the celebrated oracle and temple of Jupiter Ammon, with whose worship the Greeks became acquainted through the Cyrenæans. The town of Siwah is in 29° 12′ N. lat. and 26° 17′ E. long., and is about 160 English miles from the sea-coast, and twelve days journey from Cairo. The distances between the temple of Ammon and several of the Egyptian towns are stated by the antients thus: from Memphis it was twelve days journey (Plin., *Hist. Nat.*, v. 5.); from the village of Apis, five days' (Strabo, xvii., p. 799); and from Thebes, ten days' journey (Herod., iv., 181). The whole oasis is about fifteen geographical miles in length and twelve in breadth; but Diodorus (xvii. 50) says that the length and breadth are about 50 stadia, which would only make a little more than five geographical miles. Nearly the whole of the oasis has a fruitful soil, and is watered by many springs of fresh as well as of salt water, the latter of which probably arise from the masses of salt mentioned by Herodotus. The aspect of the oasis is that of an undulating country, and in the north it is surrounded by high limestone hills. The antients speak of three things as remarkable in this oasis: first, a well, called the Well of the Sun, of which the water was warm in the morning and evening, and cold at mid-day (Herod., iv. 181; Diodor., xvii. 50; Lucr., vi. 849, &c.; Pomp. Mela, i. 8); secondly, a large palace of the antient kings of the Ammonians, which was surrounded by a triple wall, and situated in the centre of the oasis (Diodor., xvii. 50); and thirdly, the temple of Jupiter Ammon, which was surrounded by a shady grove. Cambyses made an unsuccessful attempt to take the Ammonium (Herod., iii., 25); and it was visited by Alexander the Great. [ALEXANDER.] In the reign of the Ptolemies and under the Romans the oasis belonged to that nomos or province which was called Libya (Ptolem., iv. 5). In the time of Strabo (xvii., p. 813) the oracle was almost entirely neglected. In the middle ages the Arabs called this oasis Santariah.

The Ammonium, during its most flourishing state in antient times, seems to have been well peopled; and the inhabitants are said to have consisted of three distinct tribes. The southern and western parts were inhabited by Æthiopians, the middle part by the Nasamones, and the north by a nomadic tribe of Libyans. No town however is mentioned in the oasis, but it is stated that its inhabitants lived in villages (Diodor., xxvii. 50). The description which Diodorus gives of the beautiful climate of the oasis, and of its fertility, especially in fruit, is still applicable to it: nearly the whole oasis forms one uninterrupted succession of meadows, fields, and palm-groves; and the gardens produce an abundance of the most delicious fruits. The water however is said to be injurious to camels.

The present inhabitants consist chiefly of Berbers mixed with negroes, and all are very zealous Mohammedans. Since the year 1820 they have been subject to the viceroy of Egypt, to whom they pay an annual tribute of 2000 camel-loads of dates and 10,000 Spanish piasters. Their jealousy of foreigners has frustrated several attempts of Europeans to investigate the interior of the oasis. The principal place in it bears the name of Siwah, and has about 8000 inhabit ants. This, as well as the several other smaller places in the oasis, are built upon eminences, and surrounded by walls to protect them from hostile inroads. The houses are all wretched huts, and the streets narrow and dark.

Ruins of the antient temple of Ammon, as well as of a wall by which it appears to have been surrounded, are still visible. The paintings, sculptures, and hieroglyphics which are still preserved on the walls, are copied and described in the work of Minutoli. There are also ruins of other places, especially in the neighbourhood of the modern village of Shargiah, which probably mark the sites of the antient villages. The Well of the Sun is also near Shargiah, and is still remarkable for its varying temperature. Catacombs cut in the rocks have been discovered in four different parts of the oasis.

In the year 1820 Baron Minutoli undertook a journey to Upper Egypt and the oasis of Siwah; and some years after, his account of it was edited by Tölken, under the title 'Reise zu dem Tempel des Jupiter Ammon und nach Oberägypten,' Berlin, 1824, 4to. This work contains a map of the oasis. In 1827 Tölken published a supplement to this work, in which he endeavours to explain the archæological and mythological points which are mentioned in the work of Minutoli.

SIX CLERKS. The office of Six Clerks is an office of great antiquity connected with the Court of Chancery, proprobably as antient as the Court itself. The number of the Six Clerks was limited to six as long ago as the 12th Rich. II. The history of this office illustrates the mischief of attempting to regulate the supply of legal services to the client. It exhibits an instance of the principles of interference and monopoly destroying two successive classes of officers, in spite of the strongest support which the law and the courts could give to them.

The Six Clerks were originally the only attorneys of the Court. By the common law any person who was impleaded in any of the courts of law was bound to appear in person, unless he obtained the king's warrant, or a writ from Chancery enabling him to appear by attorney, 'by reason whereof,' says Lord Coke (1 *Inst.*, 128), 'there were but few suits.' There are many early statutes still in force enacted for the purpose of empowering the subject to appoint an attorney. The earliest statute is that of Merton (A.D. 1235), whereby it is 'provided and granted that every freeman which oweth suit to the county, tithing, hundred, and wapentake, or to the court of his lord, may freely make his attorney to do those suits for him.' Subsequent Acts extended this privilege to other parties and other courts; but to this day it would appear that by the strict law of the land, except so far as it has fallen into desuetude, persons in good health, in pleas relating to money, are bound to appear in person. None of these statutes however extended to Courts of Equity, but, as far as appears, every person who was desirous of relief, or compelled to defend himself in the Court of Chancery, was obliged to employ one of the Six Clerks as his representative.

In early times great exertions were made to limit the number of attorneys who were allowed to practise in each court. The increase of litigation which accompanied the increase of property was looked on as an evil to be checked in every possible method; and the method most relied on was that of limiting the number of legal practitioners. The well-known statute of 1455 (33 Hen. VI., c. 7., which is still in force) may be referred to as an instance. It recites a practice of contentious attorneys to stir up suits for their private profits, and enacts that there shall be but six common attorneys in Norfolk, six in Suffolk, and two in Norwich, to be elected and admitted by the chief-justice. In 1564 a rule was made by the Court of Common Pleas, that every attorney of that court 'should satisfie himself with the suits in the same, and forbear to be towards any causes as plaintiff in any other the Queen's Majestie's courts here at Westminster.' As late as the year 1616 a rule was made, 'that the number of attorneys of each court be viewed, to have them drawn to a competent number in each court, and the superfluous number to be removed.' These various regulations, so far as they were enforced, could only have been detrimental to the public; and as regards the Courts of King's Bench and Common Pleas, they seem not to have been long insisted on. As to the Exchequer, the principle of monopoly was continued in force down to the year 1830, until which time eighteen attorneys only were admitted to practise in it. As a consequence, that court was, before the year 1830, scarcely at all resorted to. Since that time more actions are commenced in it than in any other court. In the year 1632 a new principle was introduced into the Common-Law Courts, and all persons wishing to be attorneys were required to serve an attorney under articles for six years (since reduced to five). The Six Clerks' Office however did not adopt this method until long after. They got over the difficulty by admitting under-clerks, afterwards called sworn clerks, to practise in their names, and they shared in some way or other the profits with them. In 1548 an inquisition was appointed, to inquire into the supposed exactions and abuses of the Court of Chancery, and the fees then payable for the business of this office. A copy of their presentment was printed by order of the House of Commons, 8th February, 1831. It shows that all the fees payable for business done in this office were at that time payable to the Six Clerks; and it contains no allusion whatever to the under-clerks as being in any way known as officers of the court. They seem at that time to have held a position with regard to the Six Clerks, quite analogous to that the solicitors for a long period were under with regard to the sworn clerks, and to have been the real persons who prosecuted the causes. They must have been numerous, as in 1596 an order was made limiting the number that each Six-Clerk should be allowed to have under him. Soon after this the Six Clerks, instead of taking clients according to the clients' choice, agreed to divide the business coming from time to time into court among themselves alphabetically. This arrangement shows that the scheme of a limited number of legalised attorneys for the Court of Chancery had now entirely ceased to operate, and had been converted into a mere legal pretext to enable these officers to tax all who were driven to such Chancery Court for justice. This regulation for dividing the business was, after some years, set aside on petition of the master of the rolls to the crown, as a monopoly and a breach of the liberty of the subject. In 1630 the office of Six-Clerk was, if not a sinecure, at least an appointment of great value. From a ridiculous story told about Sir Julius Cæsar, the master of the rolls, in Clarendon's 'Rebellion' (vol. i., p. 52), it appears that the appointment at that time sold for so large a sum as 6000*l.* About this time the under or sworn clerks, or clerks in court (for all these names apply to them), began to be frequently mentioned in the orders regulating the court, and soon grew into a very important body. The under-clerks were the parties who knew the merits of the different causes, and were interested in getting the work done, so as to gain the fees from the clients. The Six Clerks had begun to sink into the lethargy of sinecurists. Many orders were made to spur them into activity, but all in vain. The following may be instanced — the 10th of Lord Coventry's orders (1635): 'The Six Clerks, who are the only attorneys of this court, ought to inform themselves continually of the state and proceeding of their clients' causes, whereby they may be able to defend their clients, and to give account to the court, as the attorneys in all other courts do, and not leave the care and knowledge thereof upon their under-clerks, who attend not in court; and the clients, and such as follow their cause, are to acquaint their attorneys for that purpose.' Order of 1650: 'Whereas only Mr. Hales, one of the Six Clerks of this court, gave his attendance this morning at the sitting of the court, at the entering into the hearing of the cause wherein Kitchin is plaintiff against Meredith defendant, and the rest of the Six Clerks made default: it is therefore this present day ordered, that such of the six clerks who so made default of their attendance and service to this court, at the beginning of that cause, be fined ten shillings a-piece to the poor, and the usher of the court is to receive the same to the use aforesaid.'

The Six Clerks, in a paper given in by them to the Chancery Commissioners of 1825 (*Rept.*, Appx. B, No. 20), after communicating their present duties, state that 'From the first establishment of the Six Clerks, up to the Rebellion in the reign of King Charles I., many other important duties were attached to their office. During the usurpation however a part of the duties was assigned to certain new officers entitled the sworn clerks, who have ever since continued the execution thereof.' The Six Clerks in this statement have fixed rather too early a date to the legal transfer. Great efforts were made for reform of legal procedure during the Commonwealth. Among others there was an ordinance for abolishing the office of Six-Clerk in 1654, but it terminated with the other ordinances of the Commonwealth, at the Re toration, and the judges endeavoured vigorously to reinstate the Six Clerks in their old position. By an order of Lord Clarendon, of 1665, made 'On taking into consideration the manifold disorders and undue practices which of the late times have crept into the Six Clerks' Office, to the great dishonour of this court, the obstruction of justice, and the damage of the client,' the alphabetical division was re-enacted. 'And because it is very manifest that these misdemeanors and enormities are gotten into the office of the Six Clerks by the liberty and licence which the inferior clerks have of late assumed to themselves,' the numbers were to be limited to twelve under-clerks to each Six-Clerk. It is obvious however that the decrepitude of a rotten constitution rendered these efforts nugatory. In orders about this time the under-clerks are sometimes referred to incidentally as the 'attorneys of the parties,' though it is strongly repeated that 'the Six Clerks are the only attorneys of this court.' In 1668 the Six Clerks submitted to their fate; an order was made fully recognising the under-clerks, and dividing the office-fees between them and the Six Clerks. The Six Clerks, having secured their own monopoly, had, by the year 1688, become the agressors, and had schemed to increase their income by admitting other persons, as well as the sworn or under clerks, to practise in their names. This was a bone of contention for many years. Before 1693 the under-clerks had obtained the privilege of filling up all the vacancies in the office by taking articled clerks themselves. From this time the office of Six-Clerk has become a complete sinecure, and the Six Clerks are only mentioned in the court's annals with respect to the fees that they are entitled to demand from suitors, as door-keepers, as it were, to the court. Their business, such as it is, for a long time has been managed by one or two private clerks, employed as clerks to the whole body of Six Clerks; and the Six Clerks have signed the necessary documents for each other, each being at the offices for two months only in the year. The office is virtually abolished by Lord Brougham's Act, 3 & 4 Wm. IV., c. 94, s. 28, which enacts that vacancies shall not be filled up till the number of Six Clerks is reduced to two. Nearly the same story has to be told over again with reference to the sworn clerks. For a long time these under-clerks were the principal solicitors of the court; and until the middle of the last century the chief business of the court was transacted by them without the intervention of a solicitor. The same principle of monopoly has with them led to nearly the results that it did with their titular superiors. A vested right to fees in the various stages of equity proceedings brought about an inattention to business, which has led to the transfer of the prosecution of suits to the solicitors.

In 1693 a new half-official character was given to the articled clerks of the under-clerks. They were legalised under the name of 'waiting clerks.' This new body soon began, as the following extract from an order of the master of the rolls of 1693 will show, to imitate towards their own masters the insolence which the sworn clerks had thirty years before shown to their superiors the Six Clerks:—'Whereas complaint hath been made by the petition of the sworn clerks of this court to the right hon. the master of the rolls, that divers of their under-clerks have of late behaved themselves after a bold, insolent, rude, and disorderly manner in the Six Clerks' Office, as well towards their respective masters as to others the sworn clerks, and to the suitors of the court attending the despatch of their business there, by unmannerly and abusive language, breaking of windows, cutting desks, breaking down seats, throwing stones and other things at the said sworn clerks and their clients, whereby, and by making rude and indecent noises, they often forced them to leave the said office, and caused the same to be shut up in the most usual time of business, and when the court hath been sitting, to the great scandal thereof, and damage of the said sworn clerks and their clients, and contrary to the duty of the said under-clerks, and the antient and laudable usage of the said office: and whereas complaint hath been likewise made to His Honor by petition of the under-clerks that the Six Clerks do take and employ persons to be their waiting-clerks who have not been articled clerks, or ever educated and employed in the said office; and that several of the sworn clerks have and do not only take more than one articled clerk, which they, by the rules and orders of the said court for the government of the said office, ought not to do, but do likewise carry the records out of the said office, and cause the same to be copied at under-rates by persons out of the office, rather than to allow to their under-clerks their due fees for copying thereof.' It was accordingly, amongst other things, ordered 'that no under-clerk in the said office shall from henceforth during the time of his clerkship presume to wear any sword, either in or out of the said office, within the cities of London or Westminster, or the liberties thereof; or to be covered, or wear his hat in the said office, in the presence of any one of the sworn clerks; but that all the said under-clerks shall, during all the time of their respective clerkships, as well in their masters' seats as elsewhere in the said office, be uncovered, and behave themselves orderly, soberly, and with respect towards all the said sworn clerks and suitors of the said court: and in case any of the said under-clerks shall be idle in the said office, out of their masters' seats, they shall, upon the admonition or command of any of the said sworn clerks, immediately repair to their masters' seats, and quietly sit and attend their business there, from seven of the clock in the morning in summer, and eight in the winter, till twelve of the clock at noon, and from two of the clock in the afternoon until such time at night as their respective masters shall think fit.'

There is still another class of workers of a semi-semi-official character, even now not recognised by the court—the sworn clerks' agents. These gentlemen really now perform almost all the remaining duties of the office which the intrusion of the office of solicitor has left to it, except taxing the costs; and are paid (it would appear illegally) by some share of the fees received. The necessity for these agents seems to prove that a monopoly officer cannot work. After so many successive attempts by the court to have each successive class of officers do their duty in person, it is at last in the main done by gentlemen who are mere private persons, hold no official situation, and are liable in point of law to be turned away at any moment.

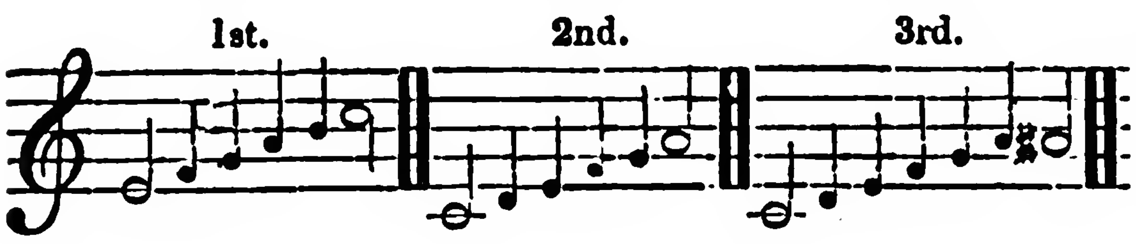
An effort was made on the occasion of the Chancery Commission of 1825 by several eminent solicitors to get the offices of Six-Clerk and clerk in court abolished. It was broadly stated in evidence by a solicitor of celebrity that Mr. S. (a gentleman whose mind had failed him) was 'quite as good a clerk in court after he was a lunatic;' and the expense of the office to the suitor was insisted on. The commission, influenced (as one of their number has lately declared) by Lord Eldon, stated they saw no reason to interfere with these offices; and they have remained to the present day. It is now however condemned by the unanimous voice of the whole profession, and its fall may be shortly expected. At present the client has still to use the Six-Clerk's name as his attorney. He therefore pays his own solicitor for his services; he pays a clerk in court (and his partner, the real working agent) for letting the solicitor get, in his name, to the Six-Clerk for liberty to use the Six-Clerk's name, and he pays the Six-Clerk for this liberty also. Therefore what was once fair emolument has now become plunder. It is mainly to the existence of such legal abuses as have here been pointed out, that we must look to account for the astonishing fact that more suitors annually applied to the Court of Chancery for aid 100 years ago than do now. So little does personal talent affect the office of clerk in court, that an executor of a clerk in court can sell the practice of his testator to another clerk in court, almost with a certainty that not a client will be lost, however mean may be the talents of the purchaser.

The emoluments of the office have long been a subject of speculation among the profession of the law. They were represented by Lord Eldon's commission as causing 'a very trifling expense to the suitors.' The accuracy of this representation was suspected, and orders were made on various occasions by the House of Commons for the Six Clerks and clerks in court to return the amount of their receipts, but the return could never be procured, until, in the year 1840, a solicitor, by a variety of calculations, demonstrated that the amount must be between 58,000*l.* and 63,000*l.* a year. The return at last has been obtained, and it turns out to have been, for the year 1839, 59,967*l.* 6*s.* 9*d.*, with some extra fees received by the Six Clerks not included in the return. (See *Return*, printed by order of the House of Commons, 1840.) The Six Clerks receive only a small amount of the whole sum, about 1300*l.* a year each. One of the clerks in court alone appears to be in the gross annual receipt of above 10,000*l.*

For further information as to this office, the reader is referred to the case 'Ex-parte the Six Clerks,' 3 Vesey's 'Reports,' 519; to the 'Reports of the Commissioners on the Offices of Courts of Justice' of 1816; to the 'Report of 1825 of the Chancery Commission;' to Beames's 'Orders of the Court of Chancery;' and to several recent pamphlets by Mr. Spence, Mr. Field, Mr. Merivale, and Mr. Wainewright; and to a powerful speech on Equity Reform, made in the end of the session of 1840, by Mr. Pemberton, since published in a separate form.

SIXTH, a musical interval, a concord, the ratio of which is 5 : 3. [CONCORD; HARMONY.]

Of the Sixth there are three kinds; the *Minor Sixth*, the *Major Sixth*, and the *Extreme Sharp Sixth*. The first (E, C) is composed of three tones and two semitones; the second (C, A), of four tones and one semitone; the third (C, A ♯), of four tones and two semitones. Ex.:—




SIXTUS I. is recorded as bishop of Rome after Alexander I., about the beginning of the second century of our æra, but the precise epoch is not ascertained, and nothing more is known of him.

SIXTUS II. succeeded Stephen I., A.D. 257. He is said to have been by birth an Athenian, and a philosopher of the Academy until he became a convert to Christianity. He suffered martyrdom in the persecution of the Christians under the emperor Valerianus, A.D. 258.

SIXTUS III. succeeded Celestine I., A.D. 431. He endeavoured, though with little success, to settle the dispute between Cyril, bishop of Alexandria, and John, bishop of Antioch, concerning the Nestorians. Several of his letters are contained in Constant's collection. He died in 440.

SIXTUS IV. (Cardinal Francesco della Rovere), a Franciscan monk, succeeded Paul II. in 1471. He greatly enriched his nephews, or sons, according to some, one of whom was afterwards pope under the name of Julius II. He seized Città di Castello from its lord, Niccolò Vitelli, and took Forli, Imola, and other places. He afterwards supported the conspiracy of the Pazzi against Lorenzo de' Medici, and his nephew Cardinal Riario was present in the church when Giuliano, Lorenzo's brother, was assassinated. The conspiracy however failed of its principal object, for Lorenzo was saved, and the conspirators were put to death, including Salviati, archbishop of Pisa, who was one of the leaders. Riario was saved by Lorenzo's interposition, and merely confined for a time. Sixtus, on hearing the news, excommunicated Lorenzo, and all the magistrates of Florence and their abettors, for having hung the archbishop. The clergy of Florence took the part of Lorenzo, and being assembled in convocation or synod held for the occasion, they signed an act of accusation grounded upon depositions and statements of facts proving Sixtus to have been accessory to the conspiracy and the murder of Giuliano. This curious document, the original of which, in the hand-writing of Gentile d'Urbino, bishop of Arezzo, exists in the archives of Florence, is given by Fabroni and Roscoe in their respective biographies of Lorenzo. The expressions used by the clergy of Florence, in speaking of the head of the church, are stronger than any of those used half a century later by Luther and the other reformers. Another document, drawn up by Bartolomeo Scala, chancellor of the republic of Florence, corroborates the statements in the Florentine synod, by giving an historical memorial of all the proceedings of that celebrated conspiracy. Pope Sixtus induced Ferdinand, king of Naples, to join his troops to the papal forces against Florence, but the Florentines braved the storm, until Lorenzo took the bold resolution of proceeding to Naples alone, to plead the cause of his country before King Ferdinand, in which he succeeded. Sixtus, being forsaken by his ally, and alarmed at the same time at the progress of the Turks, who had landed at Otranto, was fain to agree to a reconciliation with the Florentines. In 1482 Sixtus entered into another intrigue with the Venetians, for the purpose of depriving Duke Ercole of Este of his dominion of Ferrara, which he wished to bestow upon Count Girolamo Riario, another of his nephews. This led to a war, in which the king of Naples and the Florentines supported the duke of Ferrara against the pope and the Venetians. The emperor however interposed, threatening to call together a general council of the church, upon which Sixtus thought it advisable to detach himself from the Venetians, and make a separate peace with the duke of Ferrara. He then advised the Venetians to do the same, and as they disregarded his counsel, he solemnly excommunicated his late allies. In 1484 however the Venetians made peace also, and a few days after Sixtus died. He was one of the most turbulent and unscrupulous in the long list of pontiffs.

SIXTUS V. (Cardinal Felice Peretti of Montalto) succeeded Gregory XIII. in 1585. His first care was to purge the city and neighbourhood of Rome of the numerous outlaws which the supineness of his predecessors had encouraged. He resorted to summary means, he employed spies and armed men, and he soon extirpated by the sword and the halter the noxious brood. The name of 'Papa Sisto,' as connected with his summary justice, has continued proverbial at Rome to the present day. Being a shrewd politician, he disliked the overgrown power of Spain, and was not displeased at the staunch opposition which Philip II. received from Elizabeth of England, whom Sixtus however formally excommunicated as a heretic. He embellished Rome with numerous and useful structures, among others the present building of the Vatican library (Bocca, *De Sixti V. Edificiis*, in his *Bibliotheca Vaticana*. He published a new edition of the Septuagint, 1587, and one of the Vulgate with improvements, 1590; and he himself edited the works of St. Ambrose, and is said also to have superintended an Italian translation of the Bible, which was condemned by the Spanish Inquisition, between which body and Sixtus there was little sympathy. Sixtus died in August, 1589. His life has been written by Leti, Tempesti, Robardi, and others. As a temporal prince he was distinguished in his age.

SIZAR, a term used in the University of Cambridge for a class of students who are admitted on easier terms as to pecuniary matters than others. These pecuniary advantages arise from different sources in different Colleges, and are of different value. Originally certain duties were required of the students so admitted, approaching to the character of menial, but these have been long discontinued. A similar class of students at Oxford are called Servitors. The word is supposed to be derived from *size*, which is used in the University to denote an allowance of provisions at the college buttery; and that from the verb to *assize*, which is much the same as the modern *assess*, which means *apportion*.

SKATE. This name, as well as the term Ray, is used in England to designate numerous fishes with cartilaginous skeletons, having the body much depressed and more or less approaching to a rhomboidal form. The eyes and temporal orifices are on the upper surface, and the mouth, nostrils, branchial and anal apertures are situated on the under surface of the body; the tail is long and slender, generally furnished with two (analogues of the dorsal fins) and sometimes three fins, and usually armed with spines. The peculiar form of the skate arises chiefly from the great size and expansion of the pectoral fins; these extend from the head to the base of the tail, and are dilated in or near the middle in such a manner as to give (combined with the pointed snout) that rhomboidal form so peculiar to these fishes. The jaws are as it were paved with teeth, and these approach more or less to a rhomboidal form, and are flat, but in the adult males (at least of many of the species) those nearest the centre assume a pointed form.

The young of the skate, says Mr. Yarrell, are produced towards the latter part of the spring or during summer. They are deposited by the parent fish in their horny cases, like those of some of the sharks; but they are more square in form. These horny cases of the young skates are by some called purses, and on the coast of Cumberland have the name of skate-barrows, from the resemblance they bear to a four-handed machine by which two men carry goods. As the young skate increases in size, the angular parts of the body are curved over.

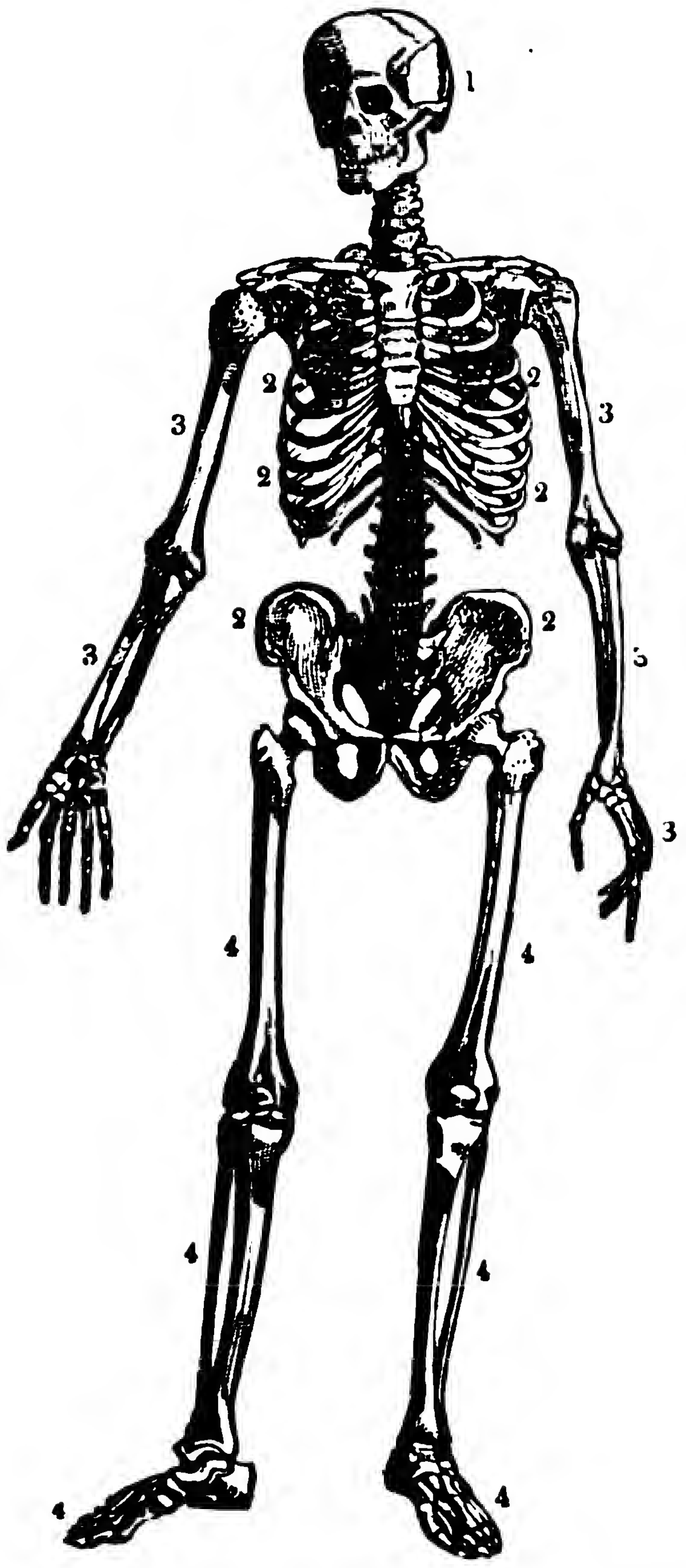
Nine species of skates, or rays, are found on the British coast, the distinguishing characters of which are carefully pointed out in Mr. Yarrell's *History of British Fishes*

SKEEN. [CHRISTIANIA.]

**SKELETON** (from σκελλω, 'I dry'), is the name applied to those harder parts of organized bodies which form the framework upon which the softer tissues are fixed. It is more particularly applied to the collection of bones which in an animal either serve as fixed points for the attachment of the soft parts, or form cavities for enclosing and protecting important organs, or constitute the apparatus of support and the passive instruments of voluntary motion.

The present article will treat of the skeleton of man, as a standard with which to compare those of other animals described in the several articles on natural history and comparative anatomy. On this comparison of skeletons many of the most important facts of the latter science depend; for the bones, being the least destructible of the tissues, are the most convenient organs to examine in the different classes of the higher animals; and in accordance with the rule of the exact adaptation of all the parts of an organized body to each other, the skeleton of each animal affords general indications of the characters of every other organ in its body. And not only so; but each bone, according to the same rule, affords indications of the characters of the rest of the skeleton, and therefore, though less certainly, of the other organs of the body. Hence it is that, by an examination of a part of the skeleton of an extinct animal, geologists are enabled to form very probable suppositions of the form of the whole; knowing by certain marks on the bones, that they served for the attachment of muscles of corresponding form and strength, and that these muscles were adapted for peculiar movements, which again were most probably employed for certain purposes closely connected with the mode of life and the whole adapted organization of the animal.

*Fig.* 1.




The human skeleton is divided into three principal parts: the trunk (2), the head (1), and the extremities (3 and 4). Neither the whole number of bones composing it, nor that in each main division, can be exactly stated, for many which are in early life separated, are subsequently united; but as an approximation, the following enumeration may be adopted:—Cranium, 8; face, 14; internal ears, 8; vertebral column, 24; chest, 26; pelvis, 11; upper extremities, 68; lower extremities, 64: in the whole, 223.

The trunk is composed of the spine or vertebral column (extending from *a* to *d* in the annexed *Fig*. 2), the chest, including the ribs and sternum or breast-bone (*e*), and the pelvis, the circle of bones on which the spine rests. The spine is the column of bones which, in the erect posture, supports the head on its summit (*a*), and rests with its base (*d*) upon the sacrum. It consists of 24 bones called vertebræ (from *verto*, I turn), because it is their motion upon each other which enables the trunk to be turned round. Of the 24, the 7 upper (*a* to *b*) are called cervical, the 12 middle (*b* to *c*) dorsal, and the 5 lowest (*c* to *d*) lumbar, vertebræ. With the exception of the two first, they are all connected by interposed discs of a very elastic substance, the intervertebral cartilages.

The general characters of the vertebræ may be best studied on one from the lumbar region; in which the following parts, common to nearly all of the 24, are well marked:—a body, a ring, a spinous process, two transverse processes, four articulating processes, and four notches. In the annexed plate two lumbar vertebræ are represented: that in the figure A, as seen obliquely from behind, from above, and from the right side; and that in the figure B, as seen from above and behind.

*Fig*. 3.

The body (1) is a disk of bone with a nearly oval outline, larger above and below than at its middle, and having its greatest dimension from side to side. Its texture is spongy, invested with a thin layer of compact tissue. Its upper and lower surfaces, by which it is affixed to the two adjacent intervertebral cartilages, are nearly flat, and slightly marked by radiating lines. At its posterior border the oval outline is interrupted by a slight concavity (2), which forms a portion of the ring surrounding the spinal marrow, and in which there are several apertures larger than those on the rest of the body, for the exit of the veins from the interior

To either side of the posterior part of the body, and near its upper border, is affixed one of the extremities of the arch (3) by which the ring is completed behind. It is composed of two flat laminæ, which spring from the sides of the body, and meet at an obtuse rounded angle in the middle line behind, where they bear the spinous process (5). The space (4) included between the body and these laminæ is called the vertebral foramen; it is occupied by the spinal chord; it is of a somewhat triangular form, and in the lumbar vertebræ is of large size.

Close to the attachments of the laminæ to the body there is in each of their borders a rounded notch (6); and when the vertebræ are applied one on another, these notches form oval holes (the intervertebral foramina, see next figure (8), through which the spinal nerves pass, one pair going out between each two vertebræ. [NERVE.] To the rest of the laminæ are attached the interlaminar ligaments, or ligamenta subflava, bands of very elastic tissue by which the spaces between the adjacent arches are filled up, and the spinal canal completed behind, as it is by the intervertebral cartilages before.

The spinous process (5) is a broad flat quadrilateral portion of bone directed horizontally backwards from the meeting of the laminæ. Its posterior border is thickened, and to it, as well as to the upper and lower borders, are attached strong ligaments binding the spinous process of each vertebra to those next above and below it. The transverse processes (7) project horizontally outwards on either side; they are thin and long, and are enlarged and rough at their ends, to which several strong muscles and ligaments are attached. The articulating processes are flat and oval; each has a smooth surface, by which it is connected with the corresponding part of the next vertebra above or below. The upper pair (8) are set most widely apart, and their articulating surfaces are concave and turned inwards; the lower pair (9) are nearer together, and have their articulating surfaces turned outwards. When the lumbar vertebræ are put together, the lower processes of each are locked within the upper processes of the one next below, so that scarcely any lateral or rotatory motion is in this part of the spine possible.

The dorsal vertebræ, which in the adjacent plate are drawn, as seen in A and B, from behind and from the left side, and in C from before and from the same side, have the same general characters as the lumbar, but are distinguished from them by the following:—

*Fig.* 4.

1

1

1

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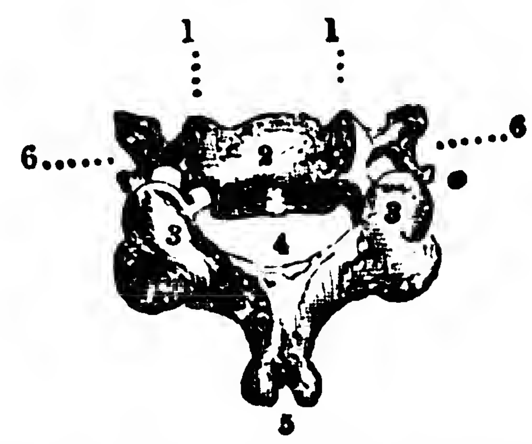
The body (1) is small but deep, and longer from before backwards than in any other direction; its general outline is heart-shaped; it has at each border, just in front of the attachment of the laminæ, a shallow depression (2); and when the vertebræ are set together, the depressions on either side of each adjacent pair form one cavity, into which the head of one of the ribs (C 3) is received for articulation. The laminæ are broad and thick; the vertebral foramen is oval and small. The spinous process (5) is long and narrow, and projects obliquely downwards; those of adjacent vertebræ are imbricated at their bases (*Fig.* B). The transverse processes (6) are long and directed backwards as well as outwards; each of them (except those of the two last vertebræ) has a smooth surface in front of its outer extremity, by which it articulates with the tubercle of the corresponding rib. The articulating processes (7), both superior and inferior, are equally wide apart; the former have their smooth surfaces turned backwards, the latter theirs forwards. The notches and foramina are smaller than in the lumbar vertebræ.

The cervical vertebræ, of which one is represented in the adjacent cut, as seen from behind and above, are distinguished by the body (2) being small, broad, and shallow

*Fig.* 5.




and wider above than below. In its upper surface also it has two elevations (1) between which the lower part of the vertebra next above is received. The laminæ (3) of the arch are long and narrow, and enclose a large somewhat triangular vertebral foramen (4). The spinous process is short and bifurcated. The transverse processes (6) are short, horizontal, and bifurcated; and each has a foramen at its base, through which the vertebral artery passes. The superior articular processes have their smooth oval surfaces directed backwards and inwards, and they receive between them the inferior processes of the vertebra next above, whose articular surfaces are turned in the opposite direction.

But these distinctive characters of the several sets of vertebræ are only general: they are merged at the extremes of each set, the lowest dorsal being very like the upper lumbar, and the upper dorsal like the lowest cervical. Some single vertebræ, moreover, have particular characters. The first of the cervical set, or Atlas, is scarcely more than a flat ring of bone with two long transverse processes, two superior articulating processes, with large oval concave surfaces opposed to those of the occipital bone, and two inferior, with large flat horizontal surfaces, which articulate with those of the second vertebra. By the former joint the chief movements of depression and elevation of the head upon the neck are permitted; by the latter, those of rotation. The second cervical vertebra (named axis, or V. dentata) has a large pointed process, which rises from the upper part of its body, and is enclosed in a ring formed by the anterior half of the Atlas, and a transverse ligament passing from one side to the other of its body. In this ring the process of the axis rotates freely; or rather, the Atlas, with the head supported on it, moves round that process, and upon the flat superior articulating surfaces of the axis. The seventh cervical vertebra has a remarkably long spinous process, to which is attached the ligamentum nuchæ, a strong elastic band for the support of the head when inclined forwards, but which, as well as the spinous processes of all the adjacent vertebræ, is much more developed in animals that move horizontally and graze, than in man. This vertebra is also marked by having a small rib-like process in front of its transverse process; it is a rudimental rib, and is analogous to the cervical ribs of serpents and many other animals in whom the chest is more elongated than in man. The first and the three last dorsal vertebræ have each, at the upper borders of the body, surfaces for articulation with the whole head of the corresponding rib. The fifth lumbar has its lower surface cut obliquely upwards to articulate with the top of the sacrum and form the promontory of the pelvis.

Viewed as a whole, the human vertebral column forms a kind of pyramid with its base at the sacrum, and its truncated summit at the head. It is not however regularly pyramidal; for, as seen from the front, it becomes gradually smaller from the base to the fourth dorsal vertebra; then it widens to the seventh cervical, and then again becomes narrower to the second. In the adult it has well-marked curvatures. (See *Fig.* 2.) From the head it is first curved slightly forwards to the last cervical vertebra; then its dorsal portion forms an arch with its convexity backwards and ending at the last dorsal; and then again in the lumbar region it arches forwards to the base of the last lumbar vertebra. These directions of the column have relations to the naturally erect posture of the human body [MAN]: in correspondence with them the bodies of the cervical and lumbar vertebræ, and their intervertebral cartilages, are thicker before than behind, and those of the dorsal thicker behind than before.

The spine serves several offices in the economy. One is that of guarding the spinal marrow, which, with the roots of its nerves, is enclosed in the long canal formed by the superposed rings of the several vertebræ. The spini-cerebrate form of nervous system, which consists of a brain and longitudinal axis, both placed on the same side of the digestive canal, is intimately connected with all the rest of the organization of the animals in which it exists; and being always enclosed in a skull and spinal canal, the vertebral column is taken as the most obvious character of the four classes of animals which have this plan of nervous system. These therefore, namely, mammals, birds, fish, and reptiles, are called vertebrata; and the other portion of the animal kingdom, whatever be the plan of their nervous centres, invertebrata.

The spine is also the main support of all the rest of the skeleton. The head, the ribs, and the pelvis directly articulate with it; and through the medium of the pelvis and sternum, it suspends both the lower and upper extremities. It is the passive instrument of all the motions of the trunk, and the centre about which each of the limbs as a whole is moved. For these purposes it is adapted by combining firmness with flexibility and lightness. Flexibility is obtained by its being composed of so many pieces separated from each other by layers of elastic tissue; and its strength is secured by these layers, which are at the same time firm bonds of union, and by numerous other strong ligaments passing from bone to bone. In its own movements, extent is combined with security by each vertebra (except the first) having but little motion on those next to it; the larger movements being the result of the combination of a number of such small ones. The directions of the processes and the diverse modes in which they are locked one within another, determine the degrees in which, in each part of the column, the several motions of flexion and extension in all directions, and of rotation, can be performed. The pyramidal form of the whole is adapted to the accumulated weight which the lower vertebræ have to bear. The curvature in the back increases the capacity of the chest. The spinous and transverse processes especially serve for the attachments of muscles of the head, chest, back, shoulders, and pelvis. The elastic cartilages interposed between the bodies break the shock of any violence upon one end of the body, and both they and the interlaminar ligaments tend to keep the spine straight, and so diminish the muscular action necessary to hold the body erect.

The base of the spinal column rests on the top of the sacrum (*Fig.* 2, *g*), which, though commonly described as part of the pelvis, is indeed a continuation of the column, and is composed of five or six rudimental vertebræ, which after about the tenth year become consolidated. The sacrum (*Fig.* 6, A) has a triangular outline, the base being above; and it articulates with the last lumbar vertebra, so as to form an obtuse angle, the promontory, by means of an intervertebral substance and the other parts common to the rest of the vertebral joints. Its anterior surface, which in the erect posture looks obliquely downwards, is concave, and on it are four or five transverse lines, the traces of the divisions between the bodies of the original vertebræ. At each end of these lines are as many holes (the anterior sacral foramina), which give passage to the anterior branches of the sacral nerves. Outside these holes the sacrum has a smooth surface composed of the coalesced transverse processes of its several vertebræ. Along the posterior convex surface, the sacrum presents corresponding traces of its composition. Its upper border is surmounted by two regularly-formed articular processes which are connected with those of the last lumbar vertebra, and leading downwards from these, in converging lines on either side of the middle, is a series of slight elevations, the traces of other rudimental articular processes. Along the middle line are three or four higher ridges, the traces of spinous processes, and between these and the former are on either side four or five foramina, which give passage to the posterior branches of the sacral nerves. These and the anterior sacral foramina already mentioned are analogous to the intervertebral foramina; and they both lead into the sacral canal, which runs through the whole length of the sacrum, and contains the cauda equina, or tuft of the last roots of the spinal nerves. The outline of the sacral canal is triangular; it grows smaller from above downwards, and is closed in behind by a layer analogous to the arches of the regular vertebræ. It is continuous above with the spinal canal, and below is, in the dry bones, open in the middle line, the arch of the last sacral vertebra being deficient; but in the recent subject is closed by dura mater and dense ligament. The sides of the sacrum are thick above, and become gradually thinner below. In the former situation they are marked by large rough oval surfaces, directed backwards and somewhat outwards, by which the sacrum is on either side articulated immoveably with the iliac bones to form the sacro-iliac symphyses. The lower end of the sacrum has a plain oval surface, which is fitted to the upper surface of the first bone of the coccyx.

The coccyx is the lowest part of the whole vertebral column. Its bones form the interior frame of the tail in brutes, but in man are small, short, and not more than four or five in number. The uppermost is by far the largest, and is surmounted by two processes called cornua, the extremities of which are adapted to those of two similar processes by which the sides of the lower end of the sacral canal are bounded. The three or four lower pieces of the coccyx have a somewhat oval outline, and are rather deeper than they are broad. Up to a late period of life they are articulated moveably with thin layers of interposed cartilage.

The sacrum and coccyx form the middle posterior part of the pelvis; its sides and front are formed by the bones called ossa innominata (*Fig.* 6, B). Each of these is in the young subject composed of three parts, which are usually described separately, as the ilium, or haunch bone (*a*), the ischium (*b*), and the pubes (*c*). These three meet at the acetabulum (1), the hemispherical cavity in which the head of the thigh bone is lodged, and of which the ischium forms nearly three-fifths, the ilium somewhat more than one-fifth, and the pubes rather less than one-fifth.

*Fig.* 6.

B

The ilium forms the upper broad and expanded part of the pelvis. Its outline is somewhat fan-shaped, and in the greater part of its extent it is flat and thin. That surface which is directed forwards and inwards towards the cavity of the pelvis is slightly concave, and gives attachment to the strong iliac muscle by which the thigh is raised towards the pelvis. Its upper border has a thick strong rim (2), the crista ilii, to which parts of the three broad muscles of the abdomen are attached, and which serves for a fixed point towards which the ribs are drawn down by those muscles in strong expirations. The extremities of this rim, and the anterior and posterior edges of the ilium, into which it is continued, have at either end two strong projections for the attachment of muscles of the thigh, which are named spinous processes. In *Fig.* 6, 3 is the anterior superior, and 4 the anterior inferior spinous process; 5 is the posterior superior spinous process, and 6 the posterior inferior. At the posterior part of the inner aspect of the ilium is a rough oval surface, which is fixed behind that at the back of the sacrum, with which its fore part forms the sacro-iliac symphysis (see *Fig.* 2). From the upper part of this symphysis a line, continuous with that of the top of the sacrum and the promontory of the pelvis, passes in a curve across the lower part of the ilium to the upper and inner edge of the pubes, along which it is continued to the middle line at the symphysis pubis. This line, by which the pelvis is divided into an upper and a lower cavity, is called the brim, and the space it encloses is named the upper strait of the pelvis (see *Fig.* 2). At and just below the brim is the thickest part of the ilium; its inner surface, which is opposite the acetabulum, is smooth, and gives attachment to muscles of the pelvis and thigh. The outer and back surface of the ilium (which is represented in *Fig.* 6, B) forms the haunch, that is, that expansion of bone which is felt above the hip-joint. It is marked by curved lines for the attachment of the strong glutei muscles of the buttock, and of the ligaments connecting it with the sacrum and last lumbar vertebra. At its lowest and narrowest part it swells outwards, and is then suddenly and deeply hollowed, to form the upper part of the wall of the acetabulum. In this cavity it is united with the pubes before, and the ischium behind, by flat surfaces, which in the adult bones are indicated only by slightly elevated lines tending to the deepest part of the cavity.

The ischium is the bone on whose lowest part, or tuberosity, the body rests in sitting. It is described as composed of two principal portions: a body (7), consisting of the tuberosity and the thick strong part above it; and a ramus (8), which passes from the tuberosity obliquely upwards, forwards, and inwards. The upper part of the body is united to the lower part of the ilium, and its outer and anterior surface is deeply hollowed to form the lower and back part of the acetabulum. At its posterior and inner border there is a strong pointed process, the spine of the ischium (9), to which one of the main ligaments of the pelvis, the lesser sacro-sciatic, is attached. Above the spine, the body of this bone and the adjacent posterior border of the ilium as far as its posterior inferior spinous process, are cut out in a crescentic form; they thus form the ischiatic notch, and, with the ligament just mentioned and the outer border of the sacrum, enclose an oval aperture, the great ischiatic foramen, through which there pass from the pelvis to the thigh the pyriform muscle, and the gluteal, ischiatic, and pudic blood-vessels and nerves. Below the spine, another foramen, the lesser ischiatic, is enclosed between the same and another stronger ligament, the great sacro-sciatic, and the lower part of the body of the ischium; through this, together with some vessels and nerves, passes the internal obturator muscle, which, on its way to the femur, winds round a smooth oval surface on the back of the ischium directly below its spine. The posterior thick surface of the body is rough for the attachment of muscles, especially those of the ham-strings which form the greater part of the back of the thigh. From the lowest part of the tuberosity, and forming an acute angle with it, ascends the ramus, which at its anterior extremity (10) unites with the descending ramus of the pubes.

The pubes forms the anterior part of each os innominatum, and is composed of a body (11), and a descending ramus (12). The body is the upper, anterior, and larger part. At its outer extremity it articulates with the ilium just below the anterior and inferior spine, from which it descends in an even gentle curve, over which the iliac and psoas muscles, the chief vessels, and one of the principal nerves of the thigh, pass beneath the crural arch. Its outer end is hollowed to form part of the acetabulum. The horizontal part of the body has a somewhat pyramidal form with three sides. Along its posterior and upper border is the line which forms part of the brim of the pelvis. Near the termination of this line is an elevation, the spine of the pubes, for the attachment of one end of the crural arch, the strong ligament already mentioned, whose other end is fixed to the anterior superior spine of the ilium. The inner ends of the bodies of the two pubic bones are opposed by flat oval surfaces, which, with ligaments and a strong intermediate cartilage, form the symphysis pubis. From below and the side of this, the ramus descends outwards and backwards to meet the ascending ramus of the ischium, with which it forms one flat and thin beam. Between these rami below, the body of the pubes above and on the inner side, and the meeting of the pubes and ischium at the acetabulum on the outer side, is an oval aperture, the foramen ovale or obturatorium (13), which in the recent body is nearly closed by the obturator ligament, and of which the borders, as well as the surfaces of the ligament, give attachment to the two obturator muscles, which thence proceed to the back of the thigh-bone, which it is their office to rotate outwards. The space included between the rami of the pubes and ischia on either side and in front, and the great sacro-sciatic ligaments, passing from both borders of the sacrum and coccyx to the tuberosities of the ischia, behind, is named the lesser aperture or strait of the pelvis. The meeting of the two rami in the middle line makes the angle of the pubes.

The general purposes served by the pelvis are—to support the abdominal viscera, to enclose and guard those in its own cavity, to give insertion to muscles of the abdomen, back, and thighs, and to be such an intermedium between the rest of the trunk and the lower limbs that the latter may move freely and yet firmly support the body. For the three first of these purposes its adaptation is obvious. For the last, the pelvis is fitted by its posterior half forming an arch on whose summit the spine is supported, and whose pillars rest on the heads of the thigh bones. Of this arch the sacrum, impacted between the ilia and held firmly by the ligaments of the symphysis, forms a kind of key-stone, fitted tightly enough to bear, through the medium of the spine, the weight of the trunk and of great additional burdens The pillars of the arch are terminated by the acetabula, which rest on the femora; and the direction in which the weight is thus transmitted from the sacrum to the thighs is that in which the strongest and thickest part of the ilium (in the line of the brim of the pelvis) is placed. Each acetabulum forms part of a sphere hollowed out at the meeting of the three component bones of the os innominatum. Its depth is increased at the upper and back part (where the chief pressure falls) by the swelling out of the ilium; and all round, by the cotyloid ligament, a band of tough fibrous tissue, by which the bone is bordered. It in a measure envelopes the head of the femur, which is fitted into it air-tight, and so closely that even after all the ligaments are removed, they cannot without much force be separated. In the dry bones however the border of the acetabulum is not a complete circle; there is a notch where the ischium and pubes meet at the fore and lower part, to which the round ligament is in part attached. The head of the femur thus moves in the freest manner in the acetabulum by a perfect ball-and-socket joint; and if the thigh-bones be fixed, then it is by the rolling of the pelvis on their heads that the body is swayed *en masse*.

The particular circumstances in the structure of the pelvis which are especially adapted to the erect posture, such as its hollow expanded sides, the oblique direction of its cavity, its width, the strength and position of the tuberosities of the ischia, &c., are described in the article MAN. Its relation to gestation and parturition may also be here omitted, except to say that it is in reference to its share in these processes that the pelvis is larger in all its dimensions in women than in men.

The last main division of the trunk is the Chest or Thorax, composed of the dorsal vertebræ behind, the sternum in front, and the 12 ribs and their cartilages on either side. (See *Fig.* 7.) All the ribs articulate with the spine, but only the 7 uppermost on each side have distinct connections with the sternum; these are therefore called True ribs, and the five lower on each side False ribs.—Of these last, the 3 upper have their cartilages united before they reach the sternum; and the two lower, which are sometimes called floating ribs, have short cartilages which are not attached to the sternum at all.

In each of the greater number of the ribs there are a head, a neck, a tuberosity, an angle, a body or shaft, and a cartilage. The head is that part which articulates with the vertebral column. It is larger than the neck, and its articulating surface has a somewhat oval outline, and is divided into two parts by a transverse elevation. This elevated line corresponds to the intervertebral cartilage, to which it is affixed

*Fig.* 7.

by a ligament. The motion permitted at the joint between the head of the rib and the border of each of the vertebræ next above and below it is not extensive; but it is sufficient to give the body of each rib, which has the relation of a long lever to the joint as a fulcrum, a wide sweep outwards and upwards in the act of deep inspiration. Proceeding onwards from the head, and passing over the neck, which is the smallest and roundest part of the rib, the next object is the tubercle, an elevation on the posterior surface, by which the rib is articulated with the end of the transverse process of the vertebra next below it. Farther outward is the angle, an oblique projecting line at which each rib turns somewhat more upwards and becomes flatter. The remainder of the rib is its shaft. This is thin and flat; its surfaces are both nearly smooth, the outer being slightly convex, the inner as slightly concave; the upper edge is rounded; the lower (which is also directed somewhat outwards) is sharp, and, from the angle inwards, is grooved on its inner aspect, where the intercostal vessels and nerves lie. The end of the osseous part of each rib has a rough surface, to which is adapted one end of the costal cartilage, of which the other end (except in the instances already mentioned) is attached to the sternum. The costal cartilages have each the same general form and direction as the part of the rib to which they are appended; they may be regarded as mere prolongations of the ribs, the purpose of their being cartilaginous instead of bony being that of giving more elasticity to the walls of the chest. Each of them, except the first, is articulated with a slight capacity of motion to a depression on the border of the sternum.

The direction of the body of the rib is first downwards and backwards, forming an arc of a small circle, to the angle, at or near which it seems twisted on itself, and then sweeps round forwards and a little upwards in the arc of a larger circle. The distance from the head to the part at which this change of direction takes place, is greater in the lower than in the upper ribs, and in the same progression is gradually increased the obliquity of the ascent of the cartilages towards the sternum. The length of the ribs and their cartilages together becomes regularly greater from the first, that is, the uppermost, to the seventh or eigthth, the rest become gradually shorter, especially in their osseous parts.

Some of the ribs have particular characters in which they deviate from the general description. The heads of the first, eleventh, and twelfth, have but one articular surface, being each connected with but one vertebra; the first and twelfth have no angles, the second and eleventh scarcely any. The first forms nearly the half of a circle of a very small radius compared with those of the ribs below it; its surfaces are horizontal; the upper is marked by two grooves over which the subclavian artery and vein pass, and by an impression between them to which the anterior scalenus muscle is attached; the lower surface has no groove; the sternal end is very broad; the head is small. The second rib presents characters intermediate between those of the first and those of the true ribs below it.

The Sternum, or breast bone, is single only in the adult; in youth it is composed of at least two pieces (of which the upper (*Fig.* 7*, A) is named manubrium), and in the fœtus of many more. Considered as one bone, its form is elongated, broader and thicker above than below, where it terminates in

*Fig.* 7*.

A

2

B

a long narrow process, which is generally cartilaginous, and is named the ensiform or xiphoid cartilage (B). The anterior surface of the sternum is marked by four transverse lines (3, 4, 5, 6) which indicate the divisions between the five principal parts of which it is composed. These marks are repeated on the posterior surface. Along its borders there are (proceeding from above downwards), first, at each of the angles between its upper and lateral edges, a shallow depression (1) into which the extremity of the clavicle is received; then immediately below this an oval depressed surface (2) to which the cartilage of the first rib is fixed; and lastly, along each side six other similar surfaces separated by notches with which the cartilages of the six following ribs articulate. Of these six, the four upper are placed at the ends of the transverse lines; so that each of these ribs articulates at its sternal end with two pieces of the sternum, just as, at its other extremity, it articulates with two vertebræ.

The general structure of the chest, and its adaptation to the movements of breathing, the most important function in which it is particularly engaged, are described in the article RESPIRATION.

The Bones of the Skull are divided into two chief sets

*Fig.* 8.

those of the Cranium, or case for the brain, and those of the Face. They are represented in the annexed sketches separated, yet in their natural relative positions, in three different aspects: in *Fig.* 8, as seen from the front; in *Fig.* 9, as seen in profile; in *Fig.* 10, as seen when, after removing the top of the skull, one looks from above upon the bottom of its interior

*Fig.* 10

The Bones of the Cranium are, the Frontal (*a*), the two Parietal (*b*), the two Temporal (*c*), the Occipital (*d*), the Sphenoid (*e*), the Ethmoid (*f*); those of the face are, the two Nasal (*g*), the two superior Maxillary, or upper Jaw-bones (*h*), the two Palate, the two Malar (*i*), the two Lacrymal (*j*), the two inferior Turbinated, the Vomer (*k*), and the inferior Maxillary (*l*).

The frontal bone (*Fig.* 11, *a*, *b*) forms the forehead and the roof of the orbit. The front or frontal portion is the larger. Its anterior surface, which is represented in *Fig. a*, is convex and smooth: it is bounded below by two arched, thick, and rounded borders, separated by a rough notch in the middle line. The borders (1, 1) are called the orbital arches or ridges, and they form the front and prominent part of the orbits. The notch (2) is named the nasal notch; on either side of it are fixed parts of the upper jaw, and in the middle the nasal bones, which rest behind on a process called the nasal spine (3). At the outer extremity of each orbital arch is the external angular process (4, 4), and at the inner extremity the internal angular process (5, 5); the former is articulated with the malar, the latter with the upper jaw and lacrymal bones. Near the internal process is the Supra-orbital Foramen or notch (6, 6), through which the frontal vessels and nerve pass from the orbit to the forehead. Just above it and by its side is a rounded elevation, the frontal protuberance (7), which marks the situation of the subjacent frontal sinuses, air-cavities, between the two layers of which the bone is composed. They vary much in size in different persons, and communicate with the interior of the nose. On either side of the middle line, and extending above the orbital ridge, the surface of the bone is again elevated in the superciliary ridge (8, 8), an arched prominence behind the eyebrow. The rest of this anterior surface is smooth and even, but in different persons its form is as varied as that of any other feature. On either side it terminates rather abruptly with a curved border (9), which forms the front boundary of the Temporal fossa (10), and behind which there is a smooth surface, to which the fore part of the temporal muscle is attached.

*Fig.* 11.

*a*

*b*

The posterior or cerebral surface of the Frontal bone (*Fig.* 11, *b*) is concave. Along the middle line there is a broad groove (1), in which a part of the longitudinal sinus [Brain] lies; and at the fore and lower end of this a ridge, to which a process of dura mater called the falx is attached. The ridge ends at a hole named the Foramen cæcum. The rest of this surface is marked by depressions and ridges fitting to the convolutions of the surface of the brain.

The orbital portions (*b*, 3, 3,) of the frontal bone are thin plates extending almost horizontally backwards from the orbital arches. Between their inner borders is a space, the ethmoid notch, into which the ethmoid bone fits, and just anterior to which are the apertures (4, 4) leading into the frontal sinuses. The under surface of each plate is concave, smooth, and even; and has at its outer and fore part a shallow depression, in which the lachrymal gland is lodged, and at its inner and fore part a mark to which the pulley of the trochlearis muscle of the eye is attached. The upper surface is marked in correspondence with the irregularities of the under part of the anterior lobe of the brain, which rests upon it.

The posterior and upper margin of the frontal bone (*b*, 5, 5) is joined by the coronal suture to the two parietal bones; and it is cut obliquely in such a manner that its edges rest upon theirs above, and theirs overlap its below. The lower part of this margin is covered by the alæ of the sphenoid, where they rise into the temporal fossæ. The frontal is usually in the adult only a single bone, composed (as all the bones in the middle plane of the skeleton are) of two equal and similar halves: these are developed separately, and they sometimes remain undivided by a continuation of the sagittal suture which passes from between the two parietal straight down the middle of the frontal.

*Fig.* 12.

a

b

3

The construction of the Parietal bones, which form all the upper and middle part of the skull, is very simple. In *Fig.* 12 at *a* the exterior, and at *b* the interior, of the right parietal is represented. They are quadrilateral, and of nearly equal thickness throughout. The outer convex surface is everywhere smooth, except at its lower border (1), where it is overlapped by the Temporal bone in the squamous suture, and just above this part, where there is a slight arched ridge (2), for the attachment of a portion of the temporal muscle. The inner concave surface has impressions of the cerebral convolutions, and a deep branching groove, which, beginning at the fore and lower angle (3), thence ramifies diffusely. It lodges the middle meningeal artery of the dura mater. [Brain.] Along the upper border is a broad shallow groove (4), which lodges part of the longitudinal sinus, and is continuous with that on the interior of the frontal bone. The borders of the parietal bones are all, except the lower, deeply and irregularly indented; and by the dovetailing of such irregular teeth, they form, with the frontal bone in front, the coronal suture, with the occipital behind, the lambdoidal, and, in the middle line at their own meeting, the sagittal.

The Temporal Bones (*Fig.* 13, as seen from without) are placed in the middle, lateral, and inferior parts of the skull. They present each three distinguishable parts, which in the fœtus are separated: namely, a Squamous portion (1), which forms the middle of the side of the skull; a Mastoid portion (2), which forms the thick protuberance that may be felt behind the ear; and a Petrous portion (not visible in *Fig.* 13, but in *Fig.* 10 marked *c*), which passes from the lower part of the squamous forwards and inwards in the

*Fig.* 13.

base of the skull. The squamous bone or portion has a roundish form. Its upper edge covers in the lower border of the parietal. Its exterior surface is smooth, and gives attachment to some of the temporal muscle. At the hinder part of its lower border is an oval aperture (3), leading to the meatus auditorius externus [Ear], a passage which goes forwards and inwards to the tympanum in the interior of the petrous portion. Immediately anterior to this, and under the fore-part of the bone, is the Glenoid cavity (4), a deep transversely oval hollow, with which the condyle of the lower jaw is articulated, and behind which is a narrow chink, the Fissura Glaseri, separating it from a strong ridge which runs along the upper surface of the petrous bone. In front of the glenoid cavity is a prominence, which forms its border, the Tuber articulare (5); and from its outer part there proceeds horizontally forwards, as if springing from the tuber and two other slightly elevated lines running backwards, a long narrow portion of bone, the Zygomatic process (6), the enlarged end of which joins a short process of the malar bone to form the zygoma, an arch beneath which the temporal muscle plays, and whose size and strength are generally in direct proportion to those of that muscle, and to the force with which the lower jaw is worked in gnashing with the teeth.

Behind the metaus auditorius is the mastoid portion. It is prolonged downwards in a strong conical projection, the mastoid process (7) giving insertion to muscles upon and just above it, and of which the interior is occupied by numerous cells communicating with the cavity of the tympanum. Behind and within the mastoid process is the digastric groove, to which the muscle of the same name is attached; and farther back another more shallow groove for the trachelo-mastoid muscle.

The cerebral surface of the squamous portion has a very obliquely cut and groved upper border, which articulates with the lower border of the parietal bone. On the same surface of the mastoid portion is a deep fossa, which lodges part of the lateral sinus. Both are marked by the impressions of the brain.

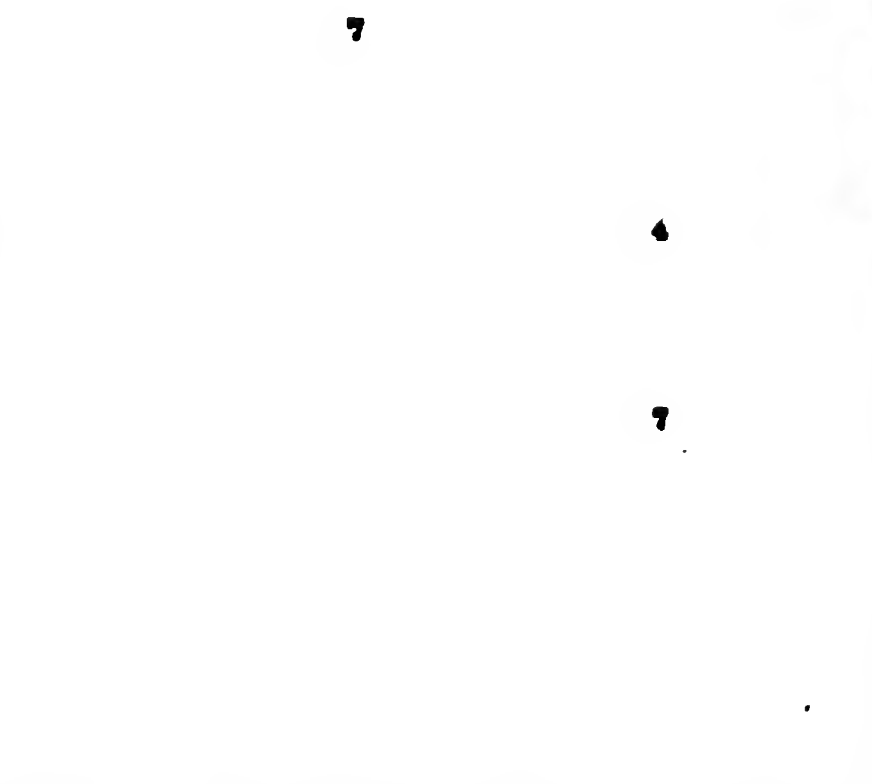
The Petrous process or portion of the temporal bone (*Fig.* 10, *c*), has received its name from the peculiar hardness of its tissue. It has the form of an irregular three-sided pyramid, directed from either side forwards and inwards, and fitting, at the base of the skull, into the angle left between the sphenoid and the occipital bones (*e* and *d*). Its base is affixed to the interior and lower part of the squamous bone; its summit fits in the apex of the angle just mentioned. On its posterior surface the most prominent object is the oval aperture of the meatus auditorius internus, the passage leading to the internal ear, and traversed by the auditory and the facial nerves. On the anterior surface there are a shallow groove leading to a small hole, through which the Vidian nerve and blood-vessels pass, a slight hollow on which the Gasserian ganglion of the fifth pair of nerves lies, and a prominence which indicates the position of the superior semicircular canal of the ear. On the inferior surface, which is placed outside the skull, there are seen, at the posterior and outer border, a deep fossa (the Jugular), in which the upper part of the internal jugular vein is lodged; before and on the inner side of this, and separated from it by a prominent ridge, a large oval aperture, through which the internal carotid artery passes into a tortuous canal, whose other extremity is at the very apex of the bone; between the jugular fossa and the mastoid process a hole, the Stylo-mastoid foramen, through which the facial nerve passes on its way to the face, after penetrating the bottom of the meatus auditorius internus; and just anterior to this, a long-pointed process, the Styloid (8), to which several muscles and ligaments are attached, and whose base is surrounded by an irregular sharp-edged elevation, the Vaginal process (9).

The anterior border of the petrous bone is articulated with the posterior part of the ala of the sphenoid, leaving an intermediate space, named foramen lacerum medium; the posterior border is similarly united with the side of the basilar process of the occipital bone, leaving another space, the foramen lacerum posterius, through which the internal jugular vein and the nerves of the eighth pair pass. Near the angle where the anterior border joins the squamous bone is an irregularly shaped aperture, to which the cartilaginous part of the Eustachian tube is affixed.

The small bones of the internal Ears, and all the other parts of the organ of Hearing, which lie within and near the petrous bone, are already described. [Ear.]

The Occipital Bone (*Fig.* 14 is a view of the internal surface) forms the posterior and lower part of the middle of

*Fig.* 14.



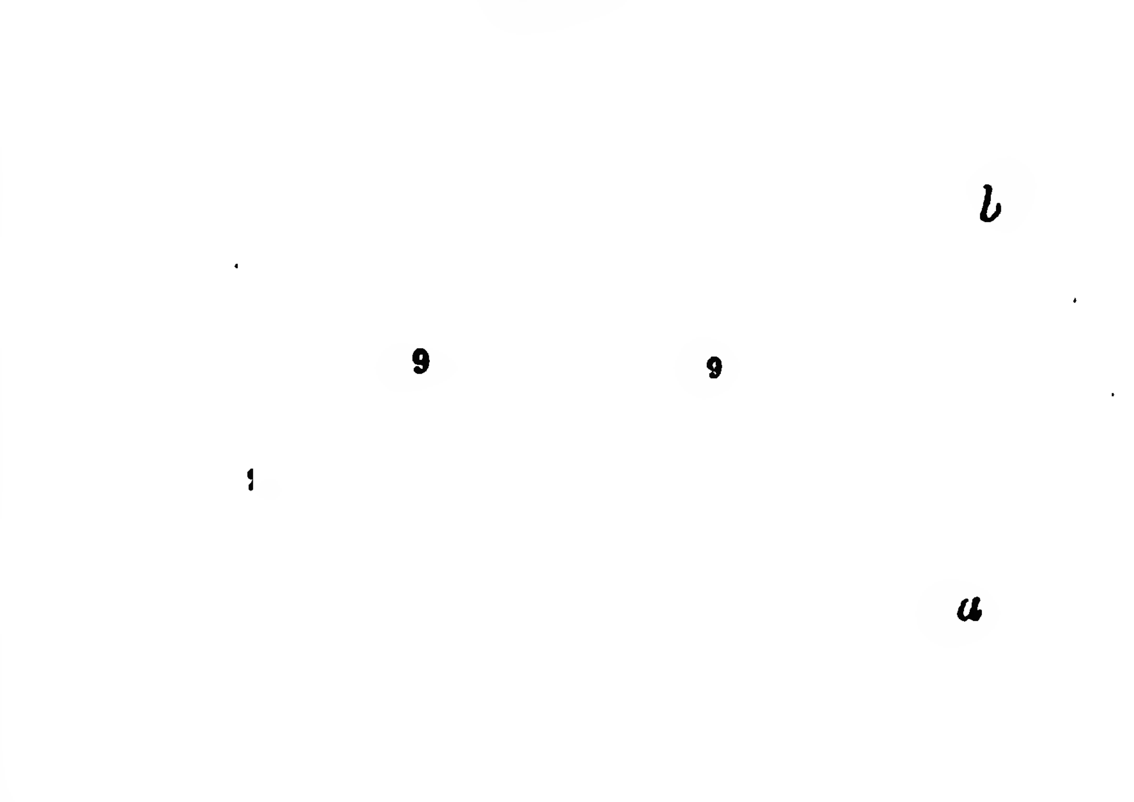

the skull, a portion being at the outer wall and a portion at the base. Its lower and anterior part is narrow, and has a rough surface (1) in front, which is united with the body of the sphenoid bone. Viewing it at its internal surface, it presents, as one proceeds from this surface backwards and upwards, a smooth hollow surface, which gradually widens, and is limited behind by a large oval opening. The surface (2) is that of the Basilar Process, in which the medulla oblongata and pons Varolii [BRAIN] rest; the aperture (3) is the Foramen magnum, through which the medulla passes into the spinal canal, where it is continued into the spinal cord. By the sides of this foramen, near where the basilar process joins the back and expanded part of the bone, there are four foramina, two on either side, the anterior and posterior condyloid foramina, of which the anterior transmit the hypoglossal nerves, on which the motions of the tongue depend, and the latter give passage to veins communicating with the vertebral veins. Opposite the fore part of the foramen magnum the basilar process suddenly widens into the greater portion of the occipital bone, which forms the back of the head. In this part are four large hollows (4, 4, 5, 5), of which the two upper lodge the surfaces of the posterior lobes of the cerebrum, the two lower those of the lobes of the cerebellum. They are separated by two ridges, which bisect each other at nearly right angles. The upper part of that which runs vertically has attached to it a portion of the falx major, and to its lower part is affixed the falx cerebelli; that which runs transversely gives insertion to the back part of the tentorium cerebelli, whose anterior borders are fixed to the upper angles of the petrous bone. By these ridges are broad shallow grooves, which lodge parts of the sinuses of the brain. By the upper half of the vertical ridge is the extremity of the longitudinal sinus, the grooves for which, in the frontal and parietal bones, are already mentioned, and which, at the Internal Occipital spine, where the ridges bisect each other, meets the inferior longitudinal and other sinuses, to form what is named the Torcular Herophili, their common point of meeting. From this there proceed the two lateral sinuses, which run above the transverse ridge on either side, then cross over the posterior inferior angle of each of the parietal bones, then lie for a short distance on the inside of the mastoid portion of the temporal, from which they pass through the foramen lacerum posterius by a special aperture, marked by a deep notch in the border of the occipital bone, near the angle (6), which separates the basilar from the other portion.

The inferior and outer surface presents on the basilar process numerous irregularities, from which the back part of the pharynx is suspended, and into which certain muscles and ligaments of the front of the spine are inserted. The foramen magnum has here an even and grounded border; and by its sides two elevations, each with a smooth convex oval surface, whose larger axis is directed forwards, inwards, and downwards; these are the Condyles, by which the occipital bone articulates moveably with the first vertebra of the spine. Near these also are the outer orifices of the anterior and posterior condyloid foramina, and around them very rough surfaces for the insertion of ligaments and muscles. On the outer surface of the expanded posterior portion of the bone are three ridges, one of which passes from the border of the foramen magnum backwards and upwards in correspondence with the internal vertical ridge, and is crossed on its way by two transverse arched ridges. At the crossing of the upper of these two is a sharp prominence, the occipital spine or protuberance. The two transverse ridges and the spaces below them give attachment to muscles; the spine, to the ligamentum nuchæ. Above the upper ridge the surface is smooth.

The upper and lateral borders (7) of the Occipital bone are deeply toothed, and form the Lambdoidal Suture, with the parietal bones above and the mastoid below. In the course of this suture there occur, more often than in that of any other, insulated portions of bone, of various size and form, called Ossa Wormiana, surrounded by margins toothed as in the regular line of suture.

The Sphenoid Bone (*Fig.* 10, *e*) is placed in the middle of the base of the skull, and has a very complicate form. *Fig.* 15, *a*, gives a front, and *b*, a back and upper view of it. Its principal parts are described as a body (1, 1), two

*Fig.* 15




Greater Alæ (2, 2), two Lesser Alæ (*b*, 3, 3), and, on each side, two Pterygoid Processes (*a*, 4, 4). The body is the central part, and has somewhat the form of a hollow cube. Chief part of its upper or cerebral surface is hollowed, forming what is called the Sella Turcica (*b*, 4), and lodging the pituitary gland. [BRAIN.] It is bounded at its four corners by bluntly pointed prominences called Clinoid Processes (see *Fig.* 10), to which prolongations of dura mater are attached. Between, and a little in front of the two anterior of these, is a level surface (*b*, 5) on which the commissure of the optic nerves rests, and which has behind a slight elevation, the Olivary process, and in front a pointed one, the Ethmoid spine (*b*, 6) which fits into the Ethmoid bone. The sides of the body slope obliquely downwards towards the great alæ, and the cavernous sinus and internal carotid artery of each side rest against them. The posterior surface (*b*, 7) of the body is rough, and unites with the end of the basilar process of the occipital. The anterior presents the openings of large cells which occupy the whole interior. These are divided by a middle septum (*a*, 5), and are partly closed in by two small portions of bone called Sphenoidal Cornua; where not thus closed, they open into the posterior ethmoidal cells. The under surface of the body is chiefly flat, but has a ridge called the azygous process along the middle line, which fits to the Vomer.

The Greater Alæ (2) are affixed by the sides of the body, and project from it outwards, upwards, and forwards. On each there are three principal surfaces, turned towards the brain, the temple, and the orbit, respectively. The inner or cerebral (*b*, 8) is concave, supports part of the middle lobe of the brain, and presents three particular orifices, namely: the foramen rotundum, near its anterior and inner margin, through which the superior maxillary nerve passes from the Gasserian ganglion of the fifth pair; the foramen ovale, much larger and near the posterior and inner border, through which the inferior maxillary nerve goes from the same ganglion; and the foramen spinosum, near the outer and posterior angle, which transmits the middle meningeal artery. This outer angle (*b*, 9), which fits in between the petrous and squamous parts of the temporal bone (see *Fig.* 10), is named the spinous process. The outer or temporal surface (*a*, 6) is slightly hollowed, and forms part of the temporal fossa, rising up at the lower part of the side of the skull as far as the anterior inferior angle of the parietal bone. At its lower border it turns abruptly inwards at a slight ridge, below which it is continued to the pterygoid processes, and forms part of the zygomatic fossa; its posterior border articulates with the squamous, its anterior with the frontal bone. The anterior or orbital surface (*a*, 7) is flat and smooth, and forms part of the outer wall of the orbit, where it articulates with the malar, frontal, and upper jaw bones.

The Lesser Alæ (*b*, 3, 3) are long, narrow, sharp-pointed processes projecting horizontally outwards from the front and upper part of the body. Internally and behind they bear the anterior clinoid processes, beneath which are the Optic foramina for transmitting the ophthalmic arteries and the optic nerves from the commissure to the orbit. The upper surface of these alæ is flat, and supports part of the brain. The anterior border is articulated with the orbital plates of the frontal bone on either side, and in the middle, where the ethmoidal spine projects, with the ethmoid bone. The posterior border lies in the Fissura Sylvii, between the anterior and middle lobes of the brain. The under surface is smooth: between it and the anterior edge of the great ala is a gap, the foramen lacerum anterius, transmitting nerves and a vein to the orbit.

The Pterygoid processes (*a*, 4, 4) are directed downwards from the under and outer part of the body. On each side there are two lamellæ, an external and an internal; they are long and narrow quadrilateral plates nearly meeting in front, where they articulate with the palate bone, and diverging behind so as to leave a space, in which the internal pterygoid and circumflexus palati muscles are attached. The internal and longer of the lamellæ has at its lowest extremity a hook, the Hamular process, round which, as on a pulley, the tendon of the last-mentioned muscle plays. At the upper part, where the pterygoid processes join the body, is a canal, the Vidian, running from before backwards and transmitting the Vidian nerve.

The Ethmoid Bone (*Fig.* 10, *f*) is situated in the front and middle part of the base of the skull, between the orbits. *Fig.* 16 gives a profile view of it from the left side. It presents six different aspects, and for the most part is of a very light spongy texture. Its upper surface, which is presented to the brain, has in front and in its middle line a strong triangular process, the Crista Galli (1), to which the front of the falx cerebri is attached. The apex of this process is directed straight upwards; the base is continuous below

*Fig.* 16.


with the perpendicular or nasal plate (2), which divides the Ethmoid bone into two equal lateral halves, and which, with the Vomer, which it joins below, forms the greater part of the septum of the nose. The Crista Galli, sloping downwards and backwards, is gradually lost behind, where the Ethmoid bone receives the spine of the sphenoid. On either side of it is a narrow quadrangular plate (the Cribriform plate), on which the bulb of one of the olfactory nerves rests. Each is perforated by a number of holes through which the branches of the olfactory and another smaller nerve pass to the interior of the nose. In front, and along part of the border of each plate, are the orifices of numerous cells, which, in the entire skull, are closed in by the frontal bone and its orbitar plates, and communicate with the frontal sinuses.

The surface of the upper part of each side of the ethmoid bone is formed by a thin smooth quadrilateral plate, the orbitar plate (3), which forms great part of the inner wall of the orbit, and unites above with the corresponding plate of the frontal (leaving two small apertures, the anterior and posterior internal orbitar foramina, for the passage of small nerves and vessels), in front with the lacrymal, below with the orbitar portions of the upper jaw and palate bones, and behind with the sphenoid. Between the orbitar and nasal plates, each half of the bone is formed of cells and folds of very thin lamellæ, which form part of the chambers of the nose, and have the olfactory membrane and nerves spread out upon them. [SMELL.] The principal parts are the middle turbinated or spongy bone (4), a roll of thin bone, which forms the lower border of the cells; and a smaller but similar roll higher up, and confined to the back part, called the superior turbinated or spongy bone (5). Under each roll at its posterior part is a passage to the cells, called respectively the Superior and the Middle Meatus of the nose. The ethmoidal cells communicate in front with the frontal, and behind with the sphenoidal cells or sinuses.

The six bones just described enclose the Brain, forming a cavity whose size, compared with that of the crania of brutes, is one of the most distinguishing marks of the human species. To the protection of the important organs within it, as to their chief office, everything in the structure and arrangement of the bones of the cranium is adapted. Those parts of them which lie exposed to direct external injury are formed of three layers, namely, an outer and inner table, and an intermediate diploe.* The outer table is formed of bone of ordinary compactness, such as is not liable to be cracked by moderate shocks; the inner, of much harder and more brittle bone (whence its name of Tabula vitrea), which may be more easily cracked, but less easily cut or pierced. The diploe is of a soft spongy tissue, calculated to lessen the vibrations that are produced by blows on the outer table, before they reach the inner and more brittle one. The arrangement is thus similar to that by which one might safely enclose a substance liable to injury either from being shaken or cut, within an inner case of hard porcelain, a middle one of soft leather, and an outer one of tough wood.

The formation of the sutures seems to have the same end. The outer tables of the exposed bones have their edges finely dovetailed, and are thus so immoveably held together that none but a violently expansive force exercised at once on the whole interior of the cavity can separate them. The inner tables are simply apposed with a very thin intermediate layer of cartilage; an arrangement which, as Sir Charles Bell (who has written most ingeniously on this subject in his 'Animal Mechanics'), says, is often imitated in works of art, in which tough materials, such as wood, are joined by mutually fitting dentations; and brittle ones, such as glass or marble, by smooth edges and a layer of cement. A similar mode of opposition is seen between all the bones of the skull that are not exposed to direct violence.

The top of the skull presents transversely an arch formed by the two parietal bones (see *Fig.* 8), whose most prominent parts, like those of the frontal, occipital, and others, are stronger and thicker than any others; a circumstance adapted for greater resistance to force, whether applied directly against those parts, or to the summit of the arch from whence it would fall chiefly on them. The strength of this arch is further secured by the lower parts of the parietal bones being held in by the overlapping upper borders of the temporal and sphenoidal bones, other parts of which, passing across the base of the skull, hold the parietal bones, which by pressure from above might be made to start outwards or pushed inwards, as beams hold the walls of a house from being driven either in or out by the weight of the roof. Taking the whole upper part of the skull as a dome, the same strength of resistance to superincumbent pressure is obtained at every part by nearly similar means, especially at at the coronal suture, where, as has been already said, the parietal bones overlap the frontal at the suppórts of its arch, and are themselves overlapped by it at the summit of their own. In this regard also may be noticed the strength and thickness of the angular processes, and of the orbitar arches extended between them (see *Fig.* 11), which serve as supports for the front of the dome; and the thickening of the bones along the course of the longitudinal and lateral sinuses, resembling groins in masonry.

The relations of the skull to the erect posture, the adaptations of the ethmoid and sphenoid bones to the sense of smell, and the arrangements of the base of the skull in reference to the ear, the several nerves, &c., are considered elsewhere. [BRAIN; EAR; MAN; SMELL, &c.]

The second chief division of the Skull includes the bones of the Face, the principal of which are represented in *Figs.* 8 and 17.

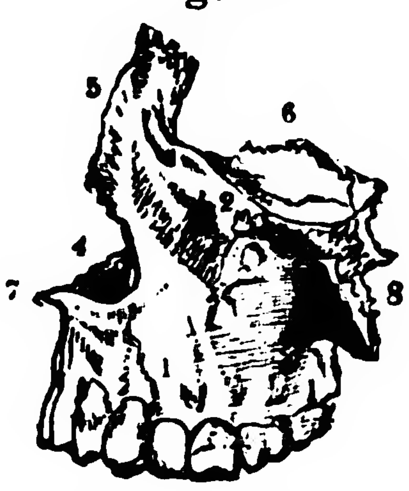
The Nasal Bones (*Figs.* 8, 9, 17, *g*) form the upper part of the bridge of the nose. They are narrow and quadrilateral; thick above, where they fit into the nasal notch of the frontal bone; broad and thin below. The outer border of each articulates with that of the ascending process of the upper jaw-bone; the inner is in contact with that of the other; the lower are in contact with the cartilages that form the rest of the groundwork of the nose. The anterior sur-

* This arrangement does not exist in either the child or the old person. In the former all the bones are tough and elastic; in the latter the diploe is filled up by hard bone, and the whole cranium is therefore more liable to fracture.

*Fig.* 17.

face is concave from above downwards, and convex from side to side; the posterior has opposite directions, and in the middle line, where the two bones are in contact, is applied on the nasal spine of the frontal, and the edge of the perpendicular plate of the ethmoid bone.

*Fig.* 18.



The Superior Maxillary or Upper Jaw bones (*Figs.* 8, 9, 17, *h*) form the greater part of the front of the face. *Fig.* 18 gives a view of the outer part of that of the left side. This surface is bounded below by a narrow border, the Alveolar border or process (1), in which the upper teeth are set in their sockets. Its outline is an elliptical arc, and from it the outer surface ascends to the orbit, of which it forms the inner and great part of the lower margin (2). It is unevenly depressed in two or three places for the attachment of muscles of the face. At the outer part, near the orbit, it presents a rough surface, the Malar eminence (8), by which it is united with the cheek-bone. Below and in front of this is a depression called Fossa canina, and on its inner side, just below the orbital margin, is the Infra-orbital foramen, through which the superior maxillary nerve passes to the face. The anterior border of this external surface first ascends vertically where the two bones are in contact in the middle line (see *Fig.* 8); then is suddenly cut out in a crescentic arch (4) so as to leave between the two the large aperture into the nasal cavities, and then again ascends where the upper maxillary bone unites with the nasal of the same side. This ascending part is called the nasal process (5); its summit is fixed in the nasal notch of the frontal bone; its outer surface looks towards the orbit, is deeply grooved, and with the lacrymal bone, to which its posterior border is attached, forms a channel for the lacrymal duct; its inner surface is directed towards the cavity of the nose, has an oval roughness which is united with the inferior turbinated bone, and above closes some of the anterior ethmoidal cells. Below and behind the malar eminence the surface is excavated to form part of the zygomatic fossa; and above this it swells out and is perforated by numerous foramina, through which the nerves of the upper teeth pass.

The upper, or orbitar, surface (6), consists of a thin plate, forming the floor of the orbit, and presenting a groove which leads to the infra-orbital canal, and a depression for the insertion of the inferior oblique muscle of the eye. The under or palatine surface is rough and concave, and forms part of the roof of the mouth. Its outer border is arched, and bounded by the alveolar process; the inner is straight, and is set against that of the opposite side in the middle line; the posterior is united with the corresponding process of the palate bone. The inner or nasal aspect presents below, a rough surface by which the bone is united to its fellow on the opposite side, and which is deeper in front than behind. It is surmounted by a ridge which extends from before backwards, and between which and that of the other bone is a narrow groove to receive the vomer. The anterior part of the ridge (7) is called the anterior nasal spine, and close by it is the foramen incisivum, which leads down to the roof of the mouth, and transmits the anterior palatine nerve. On the outer side of the ridge is a concave smooth surface, the upper surface of the palatine process, of which the lower surface forms, as already said, the roof of the mouth. From the outer part of this surface, which forms part of the floor of the nostrils, the bone rises almost vertically towards the nasal spine and the inner edge of the orbital plate, and, at about its middle, presents a large aperture leading into the Antrum Highmori, a cavity occupying the whole interior of the body of the bone.

The Palate bones are placed backward between the superior maxillary and the pterygoid processes of the sphenoid. The

*Fig.* 19.

lower, horizontal, or palatine portion (1) of each is attached behind the palatine process of the upper jaw, to which it is similar in form, and it completes the back part of the roof of the mouth or hard palate, and of the floor of the nostrils Its posterior border has the Velum palati [PALATE] attached to it: its under surface presents two foramina, through which the posterior palatine nerves pass. From its outer border a thin plate (2) ascends vertically; where it commences there is, behind, a rough process (3), articulating with and filling up the gap between the pterygoid processes of the sphenoid. (*Fig.* 15, *a*, 4, 4.) The nasal or inner surface of this ascending portion articulates with the inferior turbinated bone, and forms part of the outer wall of the nostrils; the outer surface articulates with the back and inner part of the superior maxillary bone, and forms with it the posterior palatine canal. The upper border has a notch, which, in the entire skull, is completed by the sphenoid bone into a hole, called the spheno-palatine, for the transmission of nerves of the same name: behind it is a triangular process (5), of which one surface articulates with the body of the sphenoid; and before it is another (4), of whose surfaces one closes some of the ethmoid cells, and another forms a small part of the back and floor of the orbit.

The Malar or Cheek Bones (*Figs.* 8, 9, 17, *i*) form the most prominent part of the cheeks. The form of each is quadrangular. The front surface is slightly convex, and has small apertures for vessels and nerves: the back covers the front of the zygomatic fossa: the upper surface is the narrowest, and forms part of the floor of the orbit, of which also part of the front border is formed by the upper margin of this bone. By its posterior surface and inner border the malar is united to the upper jaw-bone, as already described; and by its posterior and outer angle to the zygomatic process of the temporal bone (*Fig.* 13, 6), with which it forms the zygoma.

The Lacrymal Bones (*Fig.* 9, *j*) are two small thin lamellæ of bone at the fore part of the inner wall of the orbit. Each of them in some measure resembles a thumb-nail, whence they are also called Ungual Bones. Each is composed of two parts: the anterior is deeply grooved on the surface turned towards the orbit, and contributes to the formation of the lacrymal canal with the nasal process of the upper jaw-bone, with which its anterior margin articulates. The posterior part is flat, and closes those of the ethmoidal cells which lie anterior to its orbital plate. The posterior margin of this part articulates with the ethmoid bone, the upper with the orbital plate of the frontal, and the lower with that of the upper jaw-bone.

The Inferior Turbinated or Spongy Bones are thin rough lamellæ, whose lower border is rolled up somewhat like a scroll. They lie within the nasal cavities, and, except in being larger, they closely resemble the bones of the same name which are appended to the ethmoid. They are attached at either end to the inner surfaces of the nasal processes of the upper jaw and palate bones, and, in the middle, to the lacrymal and the lower portion of the orbital plate of the ethmoid bone: upon these they are suspended before the aperture of the Antrum, which, in the entire skull, they nearly conceal. Like all the bones which form part of the cavities of the nose, they are covered by mucous membrane. Beneath their outer concave surface runs the inferior meatus of the nose.

The Vomer (*Fig*. 8, *k*) is a thin quadrilateral plate which forms a considerable part of the middle partition of the nose. Its upper border is the thickest, and is articulated with the azygos process and under surface of the sphenoid bone; the lower border fits into the groove between the ridges in the apposed surfaces of the palatine processes of the upper jaw and palate bones; the anterior joins the vertical part of the ethmoid above, and the cartilaginous part of the septum of the nose below: the posterior is free, and divides the passage from the nostrils into the pharynx behind.

*Fig*. 20

7

1

The Inferior Maxillary, or Lower Jaw-Bone (*Figs*. 8, 9, *l*, and *Fig*. 20), has a form something like that of a horse-shoe. It is made up of a body or horizontal portion (1), and a ramus, or ascending portion (2). The former is convex anteriorly, and on its very front presents the prominence which contributes to form the chin (3). This is marked in the middle line by the Symphysis, at which the two portions of which the jaw was first composed are united. On either side of this is a slight depression, the Fossa incisiva; and farther out a hole, the mental (4), through which branches of the inferior dental nerve and vessels pass to the chin. A raised line giving insertion to muscles passes hence obliquely outwards to the upper border; and on the inner surface there is another line corresponding to this, and giving origin to the mylo-hyoideus muscle, from whence it is called the mylo-hyoidean ridge. On the inner surface there are also prominences near the symphysis for the insertion of muscles. The lower border is smooth and rounded; the upper, or Alveolar process, is marked by notches corresponding with the sockets of the lower teeth, which are set in it.

The rami ascend almost vertically from the ends of the two parts of the body. They are broad, flat, and quadrilateral. At the angle (5), where each joins the body, there are on both surfaces rough prominences; the external gives attachment to the masseter, the internal to the internal pterygoid muscle. The internal surface has also, near the end of the mylo-hyoidean ridge, a hole, the inferior dental (6), through which the nerve of the same name passes into the interior of the jaw, from which it again emerges at the mental hole (4). Leading from the dental foramen is a small groove for a branch of the dental nerve. The anterior border of the ramus terminates in a sharp projection, the Coronoid process (7, 7), to which the temporal muscle is attached; the posterior, in a transversely oval process, with a smooth summit, the Condyle (8, 8), which articulates with full freedom of motion in the glenoid cavity of the temporal bone. Below this is the Neck (9), to which the external pterygoïd muscle is in part attached; and the space between the condyle and the coronoid process is the Sigmoid notch (10, 10).

The bones of the face serve as a groundwork to many parts whose structures and functions are already described in separate articles; and since, in each case, the parts which the bones take are at the same time considered, an account of their adaptation to the several offices performed by the different portions of the face is not here necessary. Their relations to the features are described in the article MAN.

The last main division of the Skeleton consists of the Upper and Lower Extremities (*Fig*. 1; 3, 4). The upper are composed of the Scapula, Clavicle, Humerus, Radius, Ulna, Carpus, Metacarpus, and Fingers. The scapula and clavicle are analogous to the Ossa innominata in the lower extremities.

*Fig*. 21.

The Scapula, or shoulder-blade, of which, in *Fig*. 21, the back is represented, with parts of the clavicle and humerus, is triangular in its outline, and flat, being formed of two compact layers, and an intermediate diploe, varied in thickness. It has three borders or Costæ, a superior (1), posterior (2), which lies nearly parallel with the spine, and an inferior (3), which is also the longest. They are all thicker than the body of the bone, and give insertion to various muscles moving the shoulder. From the posterior border, about one-third from the upper and two-thirds from the lower angle, there commences a ridge called the Spine (4), which, as it passes along the back of the scapula towards the outer angle, gradually increases in depth, and at its end, projecting beyond and above the angle, bears a strong arched process, called the Acromion (5), which articulates with the clavicle, overhangs the shoulder-joint, and gives attachment to some of its muscles and ligaments. The spine divides the back of the scapula into two parts, of which the lower is much the larger, and which are named, according to their position, Supra- (6) and Infra- (7) Spinous Fossæ. They give origin to muscles of the same names. The anterior surface, or belly of the scapula, is slightly concave, and gives insertion to the subscapularis muscle, for the attachment of whose several parts it is marked by alternate longitudinal elevations and depressions. At the outer angle the bone is terminated by the Glenoid Cavity (8), an ovate surface slightly hollowed, narrower above than below, and with which the head of the humerus (9) articulates with very extensive freedom of motion. Its border is thick, and is rendered deeper in the recent subject by a rim of fibro-cartilage, the glenoid ligament, similar to that which borders the acetabulum. Between this border and the base of the spine the scapula is narrower than elsewhere; and this part is called the Neck. From the superior costa, near this neck, a long and strong curved process, the Coracoid, projects forwards, and gives attachment to several muscles and ligaments; and at its root there is in the superior costa a hole, or a notch, through which the supra-scapular nerve (and sometimes its accompanying vessels) pass.

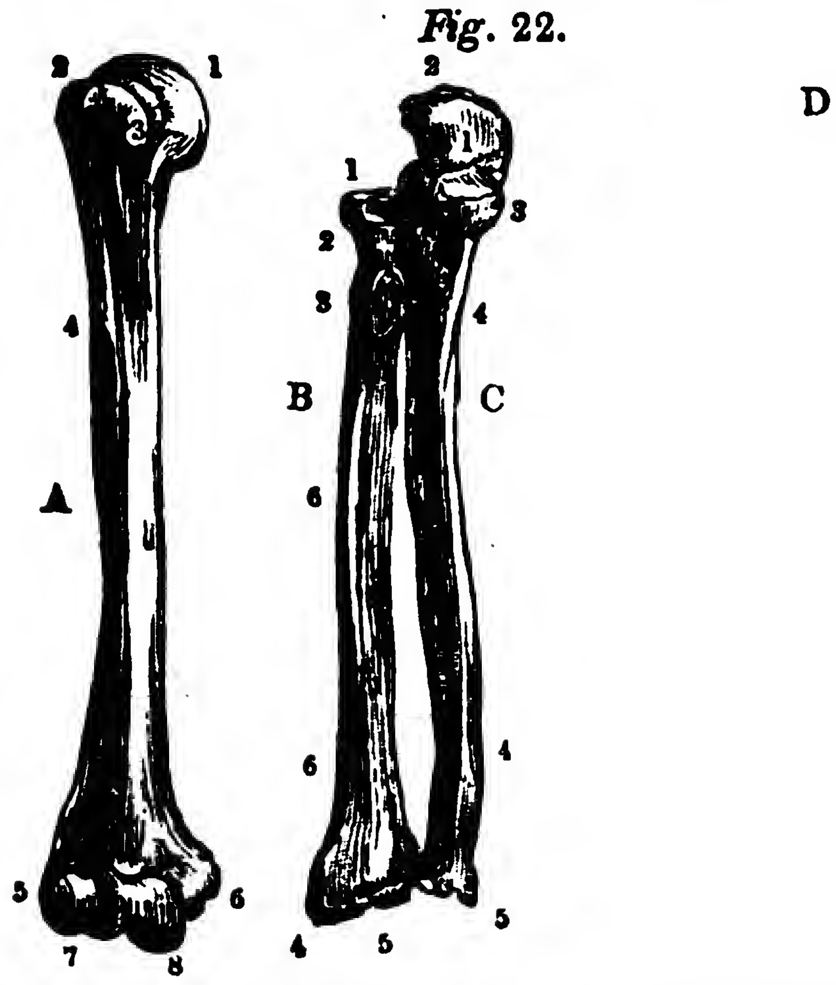
The scapula is attached to the trunk only through the medium of the clavicle, and by the muscles which connect it to the spine and ribs. It can therefore slide freely on the back of the chest; and, to a certain extent, it follows all the larger movements of the humerus, so that its glenoid cavity and the head of that bone, which have but a small surface of mutual contact, almost always preserve the same relation to each other, and are less likely to be dislocated than they would be if the scapula were more closely fixed.

The Clavicle, or Collar-bone, extends transversely from the notch in the upper angle of the sternum to the anterior and outer margin of the acromion (*Fig*. 21). With both of these its ends are articulated with a moderate extent of mobility; with the sternum, by the apex of a broad triangular surface; with the acromion, by a small flat oval surface on its posterior edge. The Clavicle has nearly the directions of the double-curved line of beauty, being slightly arched forwards at the sternal, and backwards at the scapular, half. At the former it is thick, strong, and triangular; in the latter, broad and flattened. On the upper surface, which lies just under the skin, it is smooth; on the lower it has, near its sternal end, a mark where a ligament fixing it to the first rib is attached; farther out a larger elevation, to which the subclavian muscle is fixed: and near the acromial end, other prominences, to which the ligaments connecting it with the coracoid process of the scapula (which projects just below it) are affixed.

The chief purpose of the Clavicle is to keep the arm at a distance from the trunk for all its outward motions; and in adaptation to this, its length and strength form one of the most characteristic features of the human skeleton.

The Humerus, the bone of the upper arm (*Fig.* 22, A), is articulated above with the scapula by a hemispherical

*Fig.* 22.




smooth portion called the Head (1), which is bounded at its outer and lower part by a narrow groove called the Neck. The axis of the head forms with that of the shaft or body of the bone an angle of about 130°. Close by the neck, the upper and outer part of the shaft is surmounted by two Tuberosities: the larger and posterior (2) has three flat surfaces, to each of which a muscle from the scapula is attached; the lesser (3) gives attachment to the subscapularis muscle. The rest of the upper part of the shaft is round and nearly smooth; but just above the middle of its outer surface is a rough elevation (4), to which the deltoid, the chief muscle of the shoulder, is attached. About half-way down, the shaft begins to be flatter and wider, and at either border of it commence sharp ridges, which, as they descend, become prominent, and which terminate below at the External (5) and Internal (6) Condyles. Each of the Condyles gives insertion to a ligament and several muscles of the fore-arm; the inner is the more prominent, but the outer is the larger. Between the condyles is the inferior articular surface, which is composed of two parts for articulating separately with each of the bones of the fore-arm. On the outer side, just within the external condyle, the surface has a smooth rounded prominence or tuberosity (7), against which the summit of the head of the radius is apposed; more inwards there is a deep groove (8) separated from the tuberosity by a slight ridge, and from the inner condyle by one much more prominent, in which the raised portion of the sigmoid cavity of the ulna moves as in a hinge-joint. This part of the joint is named the Trochlea. Both before and behind it is bounded above by a depression: into that on the posterior surface, which is the deeper, the olecranon of the ulna is received when the fore arm is extended; and into the anterior, the coronoid process of the same bone, when the fore-arm is much bent.

The Fore-arm contains two bones, the Radius and the Ulna (*Fig.* 22, B, C): the former being that with which the movements of rotation are effected; the latter, that which takes the chief part in flexion and extension. The radius (B), when the palm of the hand is turned forwards, is on the outer side of the arm; and it is the shorter of the two bones. At its upper end it has a circular disk, the Head (1), hollowed on its upper surface, where it articulates with the tuberosity on the lower end of the Humerus (A, 7), and smooth on its circumference, where it is encircled by a ring within which it rotates, and which is formed in part by the ulna, and in part by a ligament. Just below this is the Neck (2), of which the upper part is similarly encircled; and below it, on the anterior and inner surface is a knob, the Tubercle (3), to which the tendon of the biceps, the chief flexor muscle of the fore-arm, is attached. Yet lower, the shaft (6, 6) of the radius becomes three-sided, and as it descends grows wider. At its lowest part it is much expanded, is flattened before and behind, and terminates with a prominent border to which ligaments of the wrist-joint are attached. The posterior and outer surfaces of this lower end are deeply grooved for the passage of tendons: and the latter is prolonged into a blunt-pointed process, the Styloid (4), to which the external lateral ligament is attached. The inner surface has a small smooth cavity, the Semilunar, which articulates with the outer part of the lower head of the Ulna. The terminal surface (at 5) is smooth, somewhat triangular, and slightly hollowed; it articulates with the carpus, and is continuous over the inner border with that which articulates with the ulna.

The Ulna (C) is situated on the inner side of the fore-arm. At its upper and larger extremity it has a broad and deep crescentic notch, the Greater Sigmoid Cavity (1) whose smooth surface is divided into two parts by a middle ridge, and which is received in the trochlea of the Humerus. It is bounded at either end by a sharp process. The upper and posterior is the larger, and is named the Olecranon (2); it forms the rough prominence behind the elbow; and when the arm is extended, its point, which is curved forwards, rests in the fossa at the back of the humerus. The lower and anterior (3) is the Coronoid Process, whose point, when the arm is fully bent, rests in the anterior fossa of the humerus. On the outer side the smooth surface of the great sigmoid cavity is continued over a small oval concave portion of the side of the bone just behind the coronoid process. This is the Lesser sigmoid cavity; upon which the side of the head of the radius rotates, and to whose borders the coronary ligament by which that head is encircled, is attached. The body or shaft (4, 4) of the ulna grows smaller from above downwards, and is for the most part three-sided; its external and sharp margin giving origin to the interosseous ligament, which, being attached also to the opposed margin of the radius, fills up the space between these bones. At its lower end, the ulna becomes nearly cylindrical and then is a little enlarged: at its termination it presents a double articular surface; one, on the end which is nearly circular, and (through the medium of a fibro-cartilage) articulates with part of the carpus; the other, on the outer border, which is narrow and convex, and is received in the semilunar cavity of the radius. The inner border of this lower extremity bears a short and blunt process, the Styloid (5), to which the internal lateral ligament of the wrist-joint is fixed.

The motions of which the Fore-arm is capable are Flexion and Extension, and Rotation on its axis. The two former are effected at the hinge-like joint between the Greater Sigmoid cavity of the Ulna and the Trochlea of the Humerus; the head of the radius moving at the same time forwards and backwards on the lower tuberosity. The elbow affords the best specimen of a hinge-joint in the body, for no lateral motion is permitted in it, the ulna being locked in the groove between the two side-ridges of the trochlea. Rotation, by which also the rotation of the hand is effected, is performed by the upper head of the radius moving round in the ring formed by the coronary ligament and the lesser sigmoid cavity of the ulna; and by its lower head at the same time being carried round on the outer border of the lower head of the ulna. In this movement the ulna is almost fixed, its lower end only being carried outwards as that of the radius is moved far inwards, when in extreme pronation of the hand the two bones are made to cross each other.

The Hand (22, D) consists of the Carpus, Metacarpus, and Fingers. The Carpus (1, 1) is composed of eight small bones arranged in two rows, and so nearly immoveably united by ligaments, that, except in being more elastic, they serve the purpose of a single bony arch. Those of the first row, which lie nearest to the fore-arm, are (from the outer to the inner side) the Scaphoid, Lunar, Cuneiform, and Pisiform bones: those of the second row, following the same order, are named Trapezium, Trapezoid, Magnum, and Unciform. The three first-named articulate with the radius directly and with the ulna indirectly; the trapezium has a surface of peculiar form, concave from side to side and convex from before backwards, by which the thumb, articulating with it, is permitted to have a very wide extent of motion.

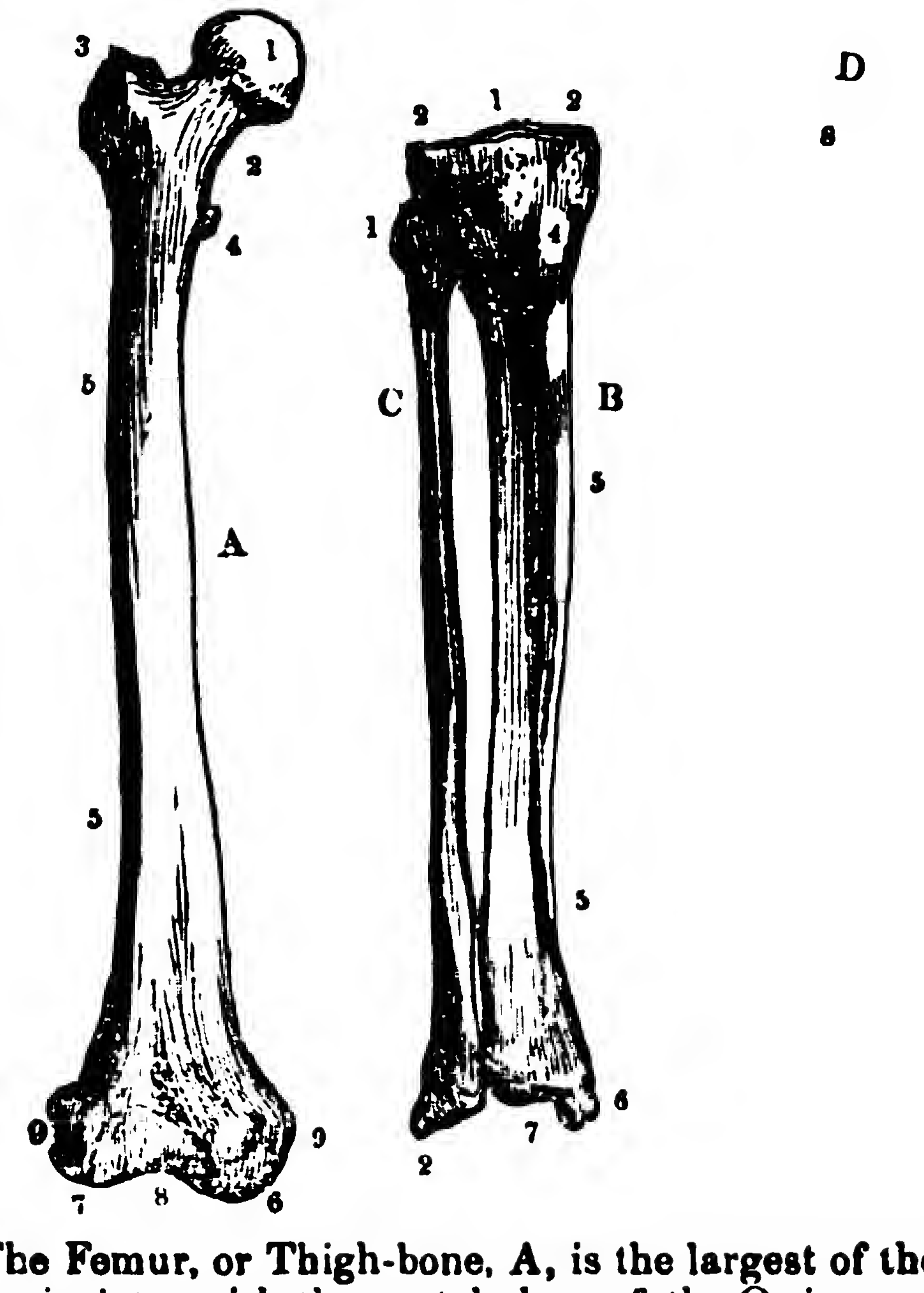
The Metacarpus (between 2 and 2) is composed of five bones, which are called by number according to the order in which they stand; that of the thumb being taken as the first. Each is described as consisting of a body and an upper and lower heads. The form of the upper head is adapted to one or more of the bones of the carpus; that of the lower is in all very convex, and rather narrow. The body is compressed from side to side, and is broader behind than before, and on its dorsal than on its palmar aspect. The first metacarpal bone only has free mobility.

The Bones of the Fingers are called Phalanges. The thumb has two, each of the fingers three. Their form and proportionate sizes are plainly exhibited in *Figure* 22, D. They are articulated with each other, and with the metacarpal bones, so as to permit free extension and flexion, and at the joints between the phalanges and metacarpus there is also permitted a certain extent of lateral motion. At that between the carpus and fore-arm there is a very extensive hinge-like motion of flexion and extension, as well as a wide lateral motion.

The general arrangement of the bones of the human upper extremity is adapted to a far more extensive and varied set of movements than exists in the corresponding member of any other animal; they have all relation to the office of the hand, as an instrument not of support, but of prehension, and that in its most perfect form. In this view they are fully considered in the article MAN.

Each of the Lower Extremities is formed by a Femur, Tibia, Fibula, Patella, Tarsus, Metatarsus, and Toes.

*Fig.* 23.




The Femur, or Thigh-bone, A, is the largest of the Body. It articulates with the acetabulum of the Os innominatum by its head (1), which forms rather more than half a sphere, and is smooth, except at its summit, where there is a depression for an interarticular ligament. It rests upon a narrower part, the Neck (2), which descends obliquely to the summit of the shaft, and is at its base somewhat expanded. It is here set between two strong processes called Trochanters, by which the shaft is surmounted, and its base is bordered by two oblique lines, named Intertrochanteric, which pass on either surface of the bone, from one to the other Trochanter. The Greater Trochanter (3) is the uppermost, and lies at the outer part of the bone; it is thick, rough, and strong, and gives attachment to the great muscles of the buttock. Behind it is a deep depression, the Digital Fossa, in which the obturator and other muscles to rotate the thigh outwards are attached. The Lesser Trochanter (4) is on the inner aspect of the femur, and also gives a point of insertion for muscles. At the level of the Trochanters the shaft is flattened both behind and before, but below them it is round and nearly cylindrical, till, within one-fourth of its length from the lower end, it expands, and again becomes flattened. The shaft (5, 5) of each femur is directed rather inwards, and is slightly arched forwards; its axis makes, with that of the neck and head, an angle of about 120°; its surface is everywhere smooth, except behind, where there is a prominent line, the Linea aspera, running along the middle, and at either end dividing into two, which above go each to one of the trochanters, and below each to one of the condyles. These condyles are the processes in which the lower expanded part of the femur terminates. The inner condyle (6) is the narrower, and descends lower than the outer (7), which is the broader and stronger. Their articular surfaces are united in front at a concave pulley-like surface (8), over which the patella lies; below it they diverge, and at the back of the femur are separated widely on two very convex prominences, between which there is a deep and rough fossa, in which the Crucial ligaments of the knee-joint are fixed. On the sides of the femur, just above the lower border of the condyle, are eminences, the Tuberosities (9, 9), to which the external and internal lateral ligaments respectively are attached.

The Tibia, or Shin-bone (*Fig*. 23, B), is placed on the front and inner part of the Leg. Its upper part or Head (1) is far larger than any other. Its upper surface is nearly oval, its greatest diameter being transverse; and it presents two slightly concave oval smooth surfaces (2, 2), on which the condyles of the femur rest. Between them is an eminence, named the Spine, which fits in between the condyles, and to which, as well as to rough surfaces before and behind it, the crucial ligaments and semilunar cartilages are fixed. Below and on the sides of the head are Tuberosities on which the lateral ligaments are inserted, and behind the external tuberosity is a smooth surface which articulates with the head of the fibula. In front, and a little below them, is the Tubercle (4), to which the ligamentum patellæ is attached. Below this the body (5, 5) is triangular, and as it descends, becomes smaller: its outer surface is hollowed; its inner, which forms the skin, slightly convex; its posterior rounded. The outer border gives attachment to an interosseous ligament, which fills up the space between it and the opposed part of the fibula: the anterior is sharp and prominent, and is named the Crest. The lower or tarsal extremity is a little expanded, and has a somewhat quadrilateral form. Its outer aspect has a slightly concave surface, which is articulated immoveably with the fibula; the inner is prolonged into a bluntly pointed process, the internal malleolus (6), which has the internal lateral ligament of the ancle fixed to its extremity, and a smooth surface on its outer side, which articulates with the astragalus. The anterior surface of this extremity is smooth where tendons pass over it; the posterior is flat; the lower or terminal surface (7) is quadrilateral and slightly hollowed; it rests on and is articulated with the astragalus.

The Fibula (*Fig*. 23, B) is situated at the outer part of the leg, and is fixed immoveably by the side of the Tibia. It is long, very slender, for the most part three-sided, and enlarged at either extremity. The upper extremity or head (1) is the smaller; it is rounded, and on its upper and inner part has an oval smooth surface, with which it articulates with the outer tubercle of the Tibia; the rest of its surface is uneven, for the attachment of ligaments and a tendon. The lower extremity (2) is longer and more pointed than the upper; it forms the external malleolus, or outer ancle, to whose extremity the external lateral ligament of the joint is attached, and whose inner surface is articulated with the astragalus; behind it is a deep groove, over which the tendons of some muscles of the leg pass to the sole of the foot. Above the malleolus, and on the inner aspect of the fibula, is a smooth surface, where it is united with the tibia.

The Patella, or Knee-pan, has a somewhat triangular outline. Its narrowest part is below, and is fixed by the ligamentum patellæ to the tubercle of the tibia. Its anterior surface is slightly convex, and looks fibrous, being marked by the insertions of the tendons of the extensor muscles of the leg; the posterior is smooth, and divided by a ridge into two parts, of which the outer is the larger, and which are adapted to the pulley-like surface between the condyles of the femur.

The Tarsus is composed of seven bones, namely, the Astragalus (1), Os Calcis (2), Navicular (3), Cuboid (4), Internal (5), Middle (6), and External (7) Cuneiform Bones. These are set together so that they cannot be moved by any slight force, and yet are possessed of considerable elasticity. The Astragalus is that on which, through the Tibia, which rests upon its upper quadrilateral surface, the weight of the body first falls. With the Tibia above, and the two malleoli on either side of it, it forms the ancle-joint, a hinge with a limited lateral motion. Its lower part rests, with two surfaces of contact, on the os calcis, whose hinder prominent part (8) forms the heel; and its anterior portion or head is received in a cavity, formed by the navicular bone in front, part of the os calcis behind, and a very strong ligament below and between them. This cavity is at the summit of an arch which the tarsus and metatarsus together contribute to form, and of which the supports are the os calcis behind and the ends of the metatarsal bones before. It is indeed a double arch, for it has at the sole a concavity, both from before backwards and from side to side; and the strength with which its several parts are joined is so great, that few accidents are rarer than a fracture or dislocation of any of the bones of the tarsus.

The rest of the bones of the Foot, including those of the Metatarsus (9, 9) and the Toes, are in number, arrangement and form very similar to the Metacarpus and the Phalanges of the Fingers. The metatarsal bones however are longer, more slender, and set more closely side by side than the metacarpal; and the Phalanges are all much shorter, and (except the two of the great Toe) smaller. Their movements are in general the same as those of the fingers, but less extensive; neither is there any adaptation for so free a movement of the first toe as of the thumb.

For the remainder of the mechanism of the bones of the leg the article MAN may be again referred to.

There are some supplemental bones of the skeleton, which need but just be mentioned. These are the Sesamoid and the Hyoid bones. The former occur within the substance or in the course of tendons which are much exerted; the patella is the largest of them; the number and existence of the others are not certain, but there are almost always two at the first joints of each of the thumbs and great toes; they are small, oval, or round, and rough on all their surfaces, except that by which they articulate with the bone on which they lie. The Hyoid bone is that on which the larynx is suspended, and the base of the tongue fixed; it is not articulated, except by long ligaments, with any other of the bones, and is described in the articles LARYNX and TONGUE. In relation to many points in this article, those on ARTICULATIONS and BONE may be consulted, as well as those to which distinct references are given.

SKELLEFTEA-ELF. [BOTHNIA.]

SKELTON, JOHN, an English poet of an antient Cumberland family, was born some time in the latter part of the fifteenth century. Very few particulars of his life are known. The first mention of him is in the preface to Caxton's translation of the 'Æneid,' printed in 1490, where he is said to have been lately created poet-laureate in the 'Unyversite of Oxenforde.' This honour was a degree in grammar conferred by universities, and not, as is now the case, an office in the gift of the crown. (Warton, *Hist. Eng. Poetry*, in the account of Skelton; and Malone, *Life of Dryden*, i. 83.) Skelton was ordained deacon in 1498, by the bishop of London, and priest the following year. (*Regism. Savage. Episi. London.*, quoted by Bishop Kennet in his collections; Lansdowne MSS.) He was afterwards admitted to an ad eundem degree at Cambridge and allowed to wear the dress (*habitus*) given him by the king. This we must suppose to have been some badge of royal favour bestowed on him by Henry VII., to whose son Henry VIII. he was tutor, being esteemed so great a classical scholar as to obtain from Erasmus the praise of being 'Britannicarum Literarum Decus et Lumen.' (*Epistle to Henry VIII.*, prefixed to his *Epigrams*, 294, 4to., Basil., 1518.) In 1507 we find from his own statement in his poems that he was rector of Diss in Norfolk and curate of Trompington in Cambridgeshire.

In the reign of Henry VIII., if not during the lifetime of his predecessor, he was appointed orator regius, as he styles himself in the title to several of his poems, being, according to Warton, a graduated rhetorician employed in the service of the king, though whether with any salary does not appear; in one place he is called Reginæ Orator ('Poems'), in a passage referring probably to the battle of Guinegate, 1513.

Skelton became notorious from his coarse and bold invective against Cardinal Wolsey and the clergy in general, but according to tradition his own conduct as a priest was far from being creditable. He was esteemed, observes Wood (*Athenæ Oxon.*), in his parish and the diocese more fit for the stage than the pew or pulpit; he is said to have been suspended by the bishop of Norwich, having been guilty of 'certain crimes, as most poets are. (Wood, *Ibid.*) The crimes alluded to in this passage were probably something more than the mere extravagances of buffoonery; he is accused by Fuller of having kept a concubine, or a wife (according to Delafield, 'Anecdotes of celebrated Jesters, &c., MS. Bodl., quoted by Bliss, *Ath. Oxon.*), a graver offence at that time. The severe attack upon Wolsey in the poem, 'Why come ye not to Court?' drew down upon him the resentment of that great ecclesiastic, who ordered him to be arrested. Skelton took sanctuary at Westminster, under the protection of Abbot Islip, to whom, in 1512, he dedicated the 'Præconium Henrici Septimi.'

He died in this retreat, June 21, 1529, and was interred in the churchyard, with the inscription, 'J. Skeltonus Vates Pierius hic situs est. Animam egit 21 Junii, An. Dom. MDXXIX.'

Skelton was much thought of in his day. We have already quoted the praise bestowed on him, and 'of the like opinion,' says Wood, 'were many of his time. Yet the generality saw that his witty discourses were biting, his laughter opprobrious and scornful, and his jokes commonly sharp and reflecting.' Among the nobility his patron was Algernon Percy, fifth earl of Northumberland, and he has written a long elegy on the death of that nobleman's father.

The chief of his poems are the 'Crowne of Lawrell' and the 'Bouge of Courte,' two cold and tedious allegories; 'Why come ye not to Court?' a satire against Wolsey, and the 'Boke of Colin Clout,' 'Ware the Hawk,' &c., attacks upon the whole body of the church. In other poems Henry VIII.'s foreign enemies, particularly the Scotch, are the victims of his scurrility, or else some private grudge is gratified, as in his abuse of William Lilye the grammarian. Most of his productions are enumerated in Wood's 'Athenæ' (Bliss), who says he wrote '50 several things.' According to Caxton, in the passage quoted above, he translated the Epistles of Cicero, Diodorus Siculus, and various Latin writers.

Skelton has been called original and inventive. He is rather unique; in style there is no known writer throughout our literature to whom he can be compared. His poems, if they deserve the name, present a strange mixture of ribaldry, learning, malice, and buffoonery, unrelieved by any traces of the higher qualities of satire. The structure of his verse is irregular and tuneless; the language, a motley jargon, at once pedantic and barbarous; in the 'Boke of Philip Sparow,' he complains of the rude and unpolished state of his native tongue, to the improvement of which his studied obscurity has certainly not contributed. His Latin compositions are written with comparative elegance.

He appears to have been one of the earliest authors in this country who addressed themselves to the nation at large, rather than to the nobility or to any particular class. Hence perhaps the grotesque combination in his works of classical allusions and phraseology, and of doggrel for the unlettered multitude. That he should have been admired in an imperfectly civilized age and in the dearth of better literature is not surprising, when we consider that in a crisis of great political excitement, such as the Reformation, any metrical compositions are eagerly circulated which embody, however rudely, the feelings and opinions generally prevalent among the people.

In this point of view, regarding them as eminently typical of the bold and unlicensed spirit of his time, we may still be interested by the poems of Skelton. They present moreover a curiously minute picture of the corruptions of the Romish church, to the infamy and downfall of which they probably much contributed, and contain several allusions to passing events which are not without historical value. In the 'British Bibliographer' (iv. 389) there is a full length portrait of Skelton in the dress of his time, copied from the wood-cut in a work of Skelton's in the British Museum entitled 'A Ryght Delectable Tratyse upon a goodly Garlande or Chapelet of Laurell, by Mayster Skelton, Poete laureat, studyously devysed at Sheryfhotton Castell, &c. Inprynted by me Rycharde faukes,' &c., 1523, 4to. A new edition of the Works of Skelton, with an introductory Life by the Reverend A. Dyce, is announced for publication.

**SKEW-BACK**, in civil engineering, the course of masonry forming the abutment for the voussoirs of a segmental arch, or, in iron bridges, for the ribs. In the latter case a plate of cast-iron is usually laid upon the stone skew-backs, extending the whole width of the bridge, and forming a tie to the masonry. On account of the expansion and contraction of iron under changes of temperature, the ribs should not, especially in large arches, be fixed to their abutments. The ribs of Southwark Bridge, over the Thames, were originally bolted to the masonry of the piers; but it was found necessary, on this account, to detach them, during the progress of the works.

**SKEW-BRIDGE**, a bridge in which the passages over and under the arch intersect each other obliquely. In conducting a road or railway through a district in which there are many natural or artificial watercourses, or in making a canal through a country in which roads are frequent, such intersections very often occur. As however the construction of an oblique or skew arch is more difficult than that of one built at right angles, skew-bridges were seldom erected before the general introduction of railways; it being more usual to build the bridge at right angles, and to divert the course of the road or of the stream to accommodate it, as represented in *Fig.* 1, in which *a b* is a stream crossed by the road, the general direction of which is indicated by the dotted line *c d*. In a railway, and sometimes in a common

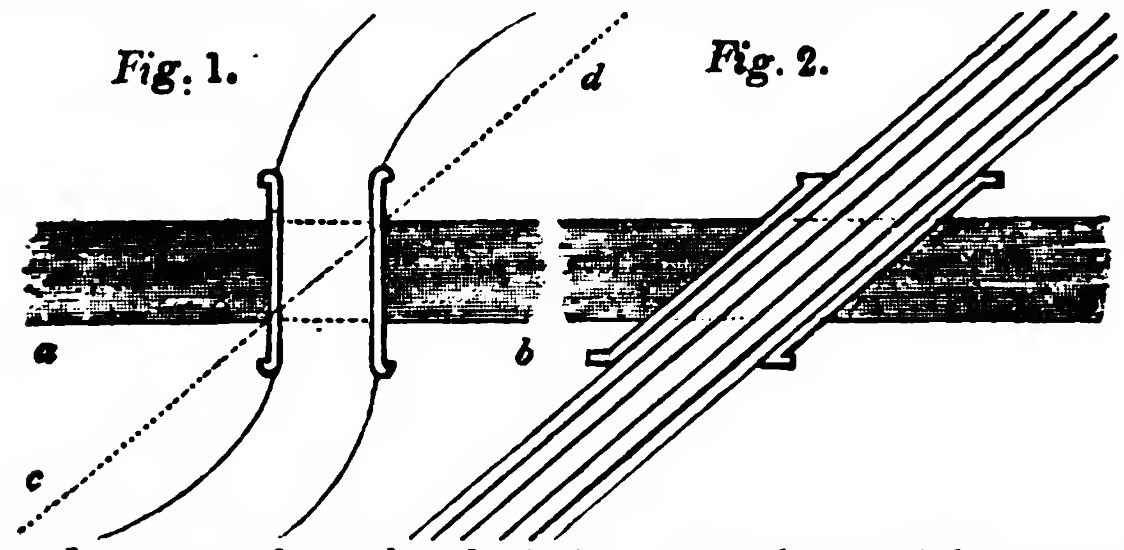


*Fig.* 1. *Fig.* 2.

road or a canal, such a deviation from the straight line of direction is inadmissible, and it therefore becomes necessary to build the bridge obliquely, as represented in the plan, *Fig.* 2. Where space and neatness do not require to be considered, an oblique arch may be avoided, either by building the bridge square with the upper passage, and making the span so wide as to allow the stream to pass under it without being diverted; or by building the arch square with the stream, and of sufficient length to allow the upper passage to take an oblique course over it; but either of these is a clumsy expedient, although well adapted for some situations. The arches or tunnels by which the Birmingham railway is conducted under the Hampstead-road and Park-street, near the London terminus, are instances of the latter kind of construction; the length of the arches being such that they present faces square with the line of railway, notwithstanding the oblique direction of the roads over them. A similar case occurs at Denbigh Hall, on the same line, where the railway crosses over the London and Holyhead road at such an angle that the difference of direction is only 25°. In this case a long gallery is constructed under the railway, consisting of iron ribs or girders, resting upon walls built parallel with the turnpike road; the ribs, and consequently the faces of the bridge, being at right angles with it. This gallery is about two hundred feet long and thirty-four feet wide; and by its adoption, the necessity of building an oblique arch of eighty feet span was avoided. The necessity of increasing the span of an arch according to its degree of obliquity, by which the expense and difficulty are materially increased, is illustrated by *Fig.* 3, the ground-plan of an oblique arch across a stream *a b*. Here it is evident that *c g* is the actual span of the arch; although *c d*, the breadth of the stream, would be the span of a straight arch, leaving the same width of passage underneath.

Very little is known respecting the origin of skew-bridges. It has been repeatedly asserted that those built by George Stephenson on the Liverpool and Manchester railway were the first erections of the kind; but this is certainly incorrect, there being some of earlier date even in Lancashire. A paper in the 'Transactions of the Institution of Civil Engineers,' vol. i., p. 185, alludes to an oblique arch erected about the year 1530 by Nicolò, called 'Il Tribolo,' over the river Mugnone, near Porta Sangallo, at Florence. It appears however that the principle upon which such bridges should be constructed was too little understood to render an attempt at constructing them on a large scale advisable. The next information the writer has met with on the subject is contained in the article 'Oblique Arches,' in Rees's 'Cyclopædia;' an article which appears to have escaped the notice of modern writers on this branch of engineering science. It is written by an engineer named Chapman, who mentions oblique bridges as being in use prior to 1787, when he introduced a great improvement in their construction. Down to that time, as far as he was informed, such bridges had always been built in the same way as common square arches, the voussoirs being laid in courses parallel with the abutments. How very defective such an arch would be may be seen by reference to *Fig.* 3, in which lines are drawn to indicate the direction of the courses. It is evident that here the portion *c d f e* is the only part of the arch supported by the abutments; the triangular portions *c d g* and *e f h* being sustained merely by the mortar, aided by being bonded with the rest of the masonry. This plan could therefore only be adopted for bridges of very slight obliquity, and even then with considerable risk. About the time mentioned above, Mr. Chapman was employed as engineer to the Kildare canal, a branch from the Grand Canal of Ireland to the town of Naas, on which it was desired to avoid diverting certain roads which had to be crossed. He was therefore led to think for some method of constructing oblique arches upon a sound principle, of which he considered that the leading feature must be that the joints of the voussoirs, whether of brick or stone, should be rectangular with the face of the arch, instead of being parallel with the abutment. Thus the courses, instead of taking the direction shown in *Fig.* 3, were laid in the manner indicated in *Fig.* 4. One of the first bridges built on this plan, the Finlay bridge, near Naas, crossed the canal at an angle of only 39°; the oblique span being 25 feet, and the height of the arch 5 feet 6 inches. Mr. Chapman observes that the lines on which the beds of the voussoirs lie are obviously spiral lines, and to this circumstance may be attributed much of the singular appearance of oblique arches. The Finlay bridge stood well, but the ingenious designer did not think it prudent in any other case to attempt so great a degree of obliquity, although he built several other bridges on the same principle, over the Grand Canal in Ireland, and over some wide drains in the East Riding of Yorkshire. He recommends carrying up the masonry as equally as possible from each abutment, in order to avoid unequal strains on the centering.

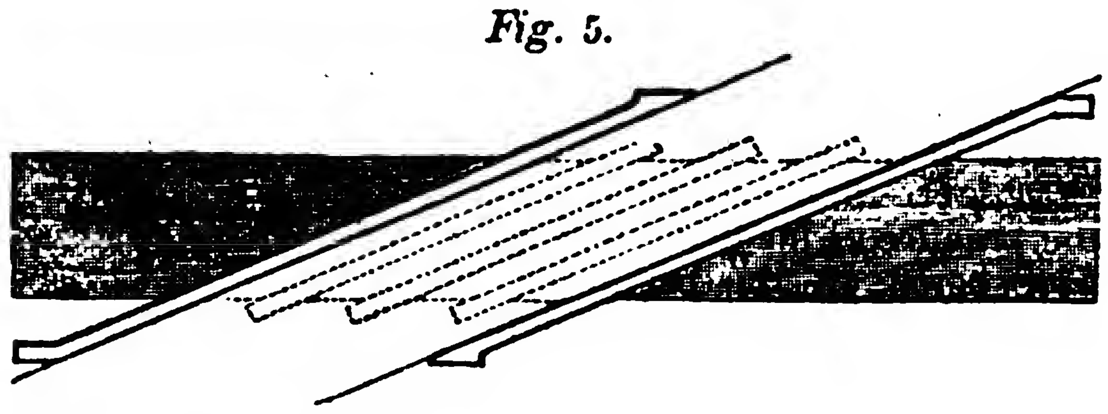
On the Liverpool and Manchester railway, out of rather more than sixty bridges, about one-fourth were built on the skew; one, built of stone, conducting the turnpike-road across the line at Rainhill, being at an angle of only 34°, by which the width of span is increased from 30 feet, the width of the railway from wall to wall, to 54 feet, the width on the oblique face of the arch. Skew-bridges have since become very common, and some have been erected of even greater obliquity. That at Box-moor, on the Birmingham railway, is stated, in Roscoe and Lecount's history of the undertaking, to be unrivalled for obliquity by any other brick arch. Its angle is 32°, the square span 21 feet, and the oblique span 39 feet. There are also brick arches of great obliquity on the Greenwich and Blackwall railways, but with their precise angles we are unacquainted.

The extended use of such structures has led to the promulgation of several methods for forming the voussoirs with accuracy, and disposing them in the most advantageous manner. The common theory, the credit of which is claimed, we believe, both by Mr. Nicholson and Mr. Fox, is that the courses of the stones should form portions of the thread of a square-threaded screw, or rather, of a thread somewhat of the dovetail form; the highest point of each thread, or that in the crown of the arch, being at right angles to the direction of the road. This theory, it is contended by the author of the article 'Skew-Bridge,' in the recent edition of the *Encyclopædia Britannica*, is imperfect; and he intimates that, in the present state of this branch of science, the most perfect way of constructing a skew-arch would be to cut the stones as they are wanted, forming each of them in such a manner 'that two of its opposite sides, or at least the middle parts of these sides, should be as nearly as possible at right angles both to the soffit and also to the direction of the passage over the bridge.' Those who wish for further information on this subject are referred to Nicholson's paper on the *Principles of Oblique Bridges*, presented to the British Association in 1838; the treatises of Messrs. Fox, Hart, and Buck on oblique bridges; and the article just quoted.

From Mr. Buck's treatise it appears that the difficulty of building skew-bridges increases with the obliquity of the angle from 90° to 45°, which is supposed to be the most hazardous angle for a semicircular arch; but that beyond that point, instead of increasing, it rather diminishes, to about 25°, which appears to be about the natural limit for a semi-cylindrical arch. Mr. Buck, whose experience renders his opinion highly valuable, considers that oblique arches of the elliptical form should not be attempted, as they are deficient in stability, more difficult to execute, and more expensive than semicircular or segmental arches.

The construction of skew-bridges of iron or timber is comparatively simple, the ribs or girders of which such bridges are composed being of the usual construction, laid parallel with each other, but the end of each being in advance of that next preceding it. *Fig.* 5 represents the ground-plan of such a bridge, the dotted lines indicating the situation of the ribs upon which the platform is sup-

*Fig.* 5.



ported. The extraordinary iron bridge by which the Manchester and Birmingham railway is conducted over Fairfield-street, Manchester, at an angle of only 24½°, is a fine example of this kind of skew-bridge. It consists of six ribs, of rather more than 128 feet span, although the width of the street is only 48 feet, resting upon very massive abutments of masonry. The total weight of iron in this bridge, which is considered to be one of the finest iron arches ever built, is 540 tons. It was erected from the design of Mr. Buck, who has constructed several other oblique bridges of great size and very acute angles. Timber bridges, formed of trussed ribs or girders, are built on the same principle. One of very great obliquity, on the Sechill railway, is represented in the second series of Brees's *Railway Practice*. A somewhat similar mode of constructing skew-bridges in brickwork has been introduced by Mr. Gibbs on the Croydon railway. The Jolly Sailor bridge, which crosses over this line near Norwood, consists of four separate ribs of brickwork, each forming an elliptical arch of 50 feet span, with a versed sine of 12 feet 6 inches, supporting a flat viaduct of Yorkshire flagstones. Each of these ribs, which are three feet wide on the transverse face, is built square, so that the brickwork is of the simplest kind; but by making the respective abutments project beyond each other according to the oblique direction of the railway, the ribs, taken collectively, form a skew-arch. In a bridge erected by Mr. Woodhouse on the line of the Midland Counties railway, the same principle is adopted, but the ribs are placed close together, so that no platform of flagstones is required.

SKIDDAW. [CUMBERLAND.]

SKIMMER. [RYNCHOPS.]

SKIN. The skin, or derma, is the outer covering of the body; and having to serve at once as a defence for the more deeply seated structures, as an organ of touch, and as an apparatus for secretion, it is one of the most compound of all the tissues.

It is composed of two chief parts:—a vascular basis named Cutis, and a superficial layer named Epidermis or Cuticle, which is not vascular. The cutis is made up for the most part of fibres and laminæ, like those of common cellular tissue. They are much more densely woven near the surface than in the deeper part of the skin: in the former they constitute a very tough and elastic compact membrane; in the latter they are arranged in irregular large cells, which in moderately stout persons are filled with fat, but in the emaciated are collapsed, and form a loose flocculent white tissue. This general form of structure prevails through the whole skin; but in different parts of the body, and still more in different persons, the density and thickness of its layers, the size of the cells, the quantity of fat which they contain in the deeper parts, and the fineness or coarseness of the tissue composing them, vary considerably.

The external surface of the skin presents a variety of wrinkles. The larger of these are produced by the action of muscles, which in many parts throw the skin into folds; others result from its loss of elasticity in old age, and the removal of the fat beneath it; and again others, which are seen most plainly on the palms and the balls of the fingers, and on the corresponding parts of the foot, run in very close parallel arches, and indicate the arrangement of subjacent rows of sensitive papillæ, with which the whole surface of the skin is beset, and which in the parts just named, and in some others, are arranged in regular double lines. In their most developed state, on the balls of the fingers for example, the papillæ are very fine conical processes, standing somewhat obliquely, and so densely set, that their summits form a seemingly smooth surface. On these parts each elevated line which one sees on the surface has beneath it two rows of papillæ; for when looked at closely, each such ridge shows on its summit a little furrow dotted with minute apertures, and which fits into the space between the rows of papillæ. Over the rest of the body the papillæ are much smaller, and are irregularly arranged. Everywhere however they are the most vascular part of the skin, each papilla receiving a distinct loop from the subjacent network of blood-vessels. It is in them also that the greater part of the very numerous nerves of the skin terminate; for though every part of the skin be sensitive, yet the papillæ are so in the highest degree, and are the chief instruments by which the sense of touch is exercised. [SENSES; NERVE.] It is through their being so much developed, that the tips of the fingers are adapted for the perception of the finest impressions of the sense; though even they have less delicate perception than the tip of the tongue, on which similar but larger and more pointed papillæ are set.

The chief secretory apparatus of the skin consists of the perspiratory glands, which are disposed over its whole extent, but, like the papillæ, are largest and most numerous in the palms and soles. By looking on the surface of the cuticle covering these parts, one may see, especially on a warm day, or when perspiring freely, a number of minute orifices between and upon the tops of the arched ridges already described. These are the orifices of the glands by which the perspiration is secreted, and sometimes one may squeeze through them a drop of the clear crystal fluid which the glands produce. Each orifice leads to a fine tube of somewhat less diameter than itself, which passes down through the epidermis, and into the deeper parts of the skin, making on its way several spiral turns, and ending in a slightly enlarged closed sac. In the sole each such tube makes from 15 to 20 spiral turns; in the palm, from 6 to 10; in other parts, fewer: in the right hand the spiral turns are made from left to right; in the left, from right to left. There are about 25 of these orifices in a square line of the surface of the tip of the fore-finger; and about 75 in the same space between the bases of the fingers: taking therefore the whole superficies of the body at 14 square feet, it is probable that, as Eichhorn calculated, there are not less than ten millions of these glands scattered through the skin.

It is in them that the perspiration is being constantly formed, though it most generally passes away as fast as it is produced in an invisible vapour, and during health collects in the form of sweat only when it is very rapidly formed, as during active exercise, or when the surrounding atmosphere is already saturated with moisture. The fluid of the perspiration is composed of water, with very small quantities of animal and saline manner, some free lactic acid, nitrogen, and carbonic acid. By thus removing carbonic acid from the blood, the skin is, next to the lungs, the most important and essential excretory organ of the body; some recent experiments have proved that animals prevented from perspiring die of suffocation as certainly, though not so rapidly, as when their respiration is obstructed. The quantity of perspiration secreted amounts to about two pounds in 24 hours; but it is liable to considerable variations, according to the habits of the individual, the state of the atmosphere, the activity of other glands, such as the lungs and kidneys, and other circumstances.

Another secretion from the skin is that of the oily sebaceous matter by which its surface is always kept in a slight degree greasy, so that water adheres to it only in drops, and does not easily soak into the substance of the epidermis. The sebaceous glands by which this secretion is produced, as well as the hair-follicles on which they are almost always attendant, are already described. [Hair.]

The loss of fluid by these secretions from the skin is in some measure compensated by the absorption which it also exercises. It is uncertain how much, if any, of the vapour of the atmosphere around us is thus imbibed; but it is certain that the skin absorbs fluids placed for a short time in contact with it, and this so rapidly, that (especially after long fasting) a perceptible increase of weight is observed after a person has been immersed in a bath. The obstacle to a more constant and considerable absorption of fluid is the nearly impenetrable layer of epidermis; and hence the substances most rapidly absorbed are those which most easily pass through it, such as water, after having been imbibed into its deepest layers, vapours of sulphuretted hydrogen, hydrocyanic acid, &c., oils rubbed upon it, or corrosives which destroy its texture.

Besides its secretions, there are produced from the vessels of the skin materials of which are formed certain appendages for its protection and other purposes, such as the cuticle, the hair, and the nails.

The cuticle, or epidermis, is an insensible and non-vascular membrane, which is laid over the whole of the external surface of the body in a layer, the thickness of which is varied according to the protection required for the well-being of the subjacent cutis. The under surface, which lies next to the cutis, is accurately fitted into all its irregularities, and sends prolongations down into the interior of all its glands and follicles; the outer surface, which is exposed to friction, is comparatively smooth. The epidermis is composed of several layers of cells: of the two layers into which it may commonly in an ordinary dissection be split, the lower is called rete mucosum, or rete Malpighii; the upper and outer, more particularly, epidermis. In the deeper layers the epidermis is composed entirely of minute polygonal cells, adhering by their edges, and containing nuclei and a thin fluid; in the layers nearer the surface are cells of the same kind, but larger and flatter; and those on the very outer surface are dry and scale-like; they have lost almost all trace of form, and becoming loose, are removed by friction at exactly the same rate as, under ordinary circumstances, new cells are produced at the surface next the cutis. Thus the epidermis is subject to constant and rapid change: its cells, as fast as they dry and are removed in the form of scurf [Scurf] from its exterior, being replaced by new ones at its interior; and thus, whatever waste (within certain limits) it is subject to, its thickness is not diminished, but rather, as the waste is increased, so is its thickness, till it attains that degree which is competent to the protection of the subjacent cutis; as any one may see in the palms of his hands, soon after he has begun to occupy himself in a more than usually laborious handicraft.

The epidermis is the seat of the characteristic national colours of the skin, as well as of the colours of freckles and other superficial marks. In dark-complexioned races, especially in negroes, it is very thick, and its cells are filled with minute black or otherwise coloured pigment-granules, many of which also lie loose among them. The thickness of the epidermis in these tribes renders it less penetrable by the rays of heat; and it is hence (and not on account of its colour, which would have an opposite effect) that a negro can bear the exposure of his skin to a degree of solar heat which blisters that of a European.

The hairs are already described in a separate article. The nails are thin laminæ of horny tissue, produced by the cutis on the back of the ends of the fingers and toes. Under each of the more perfect of the nails, such as those of the fingers and the great toe, the cutis has a peculiar structure, called the matrix of the nail, composed of large sharply pointed and very vascular papillæ, which at the root are arranged irregularly, but at the body of the nail are placed in close-set rows or longitudinal ridges. By all this vascular surface the substance of the nail is produced in minute cells, which subsequently coalesce and form the dense, obscurely fibrous, and transparent mass of the body of the nail. The crescentic opaque part at the root of the nail owes its whiteness in part to its own substance, which in the deeper layers is softer and more opaque than in those of the body, and in part to the surface beneath it being less vascular than the rest.

The under surface of the nail is grooved or otherwise marked in correspondence with the matrix, to which it closely fits; the outer surface, exposed to friction, is comparatively smooth, though still it presents traces of the ridges in which, when it was at the under surface, it was formed; for the nails are produced in the same method as the cuticle; as fast as their exposed surfaces or their ends are worn away, they are replaced by layers growing from the matrix; and the whole mass of the nail, growing at once from below its body and from its root, is constantly pushed forwards and thickened, at the very same rate as its free extremity is cut or worn down, and its body thinned by friction.

**SKINNER, STEPHEN, M.D.**, born 1623, died 1667, a skilful physician and a very learned philologist. He was born in London or the neighbourhood; studied in the University of Oxford, where he was a commoner of Christ Church; but the civil war coming on, he left Oxford without taking a degree, and travelled abroad, occasionally remaining some time at the foreign universities. In 1646 he returned to Oxford, and took the usual academical degrees; after which he again went abroad, living in France, Italy, Germany, and the Netherlands; frequenting the courts of princes and the halls of the universities, being highly esteemed both for his learning and his general deportment. He took the degree of M.D. at Heidelberg, and afterwards at Oxford, in 1656. He then settled at Lincoln, where he engaged in the practice of medicine with great success; but his career was short. In the beginning of autumn in 1667 febrile complaints were very prevalent in Lincolnshire, and he, among others, was fatally attacked. He died on the 5th of September in that year, at the age of forty-four, to the great regret of his friends, to whom the innocence of his life and the cheerfulness of his disposition had endeared him.

His early decease was a great loss also to the world, for he was applying his vast stores of philological knowledge to the illustration of his native language; and had made no inconsiderable progress in a work which was designed to serve as an etymological dictionary of the language. This manuscript came after his death into the hands of Thomas Henshaw, Esq., of Kensington, who had a disposition to the same kind of studies, and who made additions to it. He also superintended the publication of it, which was effected in 1671, in a folio volume, under the title of 'Etymologicon Linguae Anglicanae.' Dr. Skinner's work has the great disadvantage of having been left unfinished by the author, who, it may be presumed, would have struck out, as well as added, as his knowledge advanced and the general principles of philology became more distinctly perceived by him, which would probably have been the case had he proceeded in his work. As it is, it is to be regarded rather as containing anecdotes of the language than as a systematic body of English etymologies; but it contains numerous valuable suggestions, and many later English etymologists have made use of his labours. The etymological part of Dr. Johnson's Dictionary is almost wholly derived from Skinner and Junius.

SKIPTON. [YORKSHIRE.]

SKIRRET. [SIUM.]

SKODRE'. [SCUTARI.]

SKORODITE. *Cupreous Arseniate of Iron.* Occurs crystallized and massive. Primary form a right rhombic prism. Cleavage parallel to the primary planes, indistinct. Fracture uneven. Hardness, scratches carbonate of lime, and is scratched by fluor-spar. Rather brittle. Colour bluish-green of different degrees of intensity, also blackish-green, brown, and black. Streak white. Lustre vitreous. Transparent; translucent; opaque. Specific gravity 3·162 to 3·2.

*Massive varieties*, globular, fibrous, radiating.

By the blow-pipe gives arsenical vapours, and fuses into a globule attracted by the magnet. Found in Cornwall, Saxony, near Huttenburg in Carinthia, Brazil, &c.

Analysis by—

| Chenevix. | | Ficinus. | |
|---|---|---|---|
| Arsenic Acid | 33·5 | Arsenious Acid | 31·40 |
| Oxide of Iron | 27·5 | Protoxide of Iron | 36·35 |
| Oxide of Copper | 22·5 | Protoxide of Manganese | 4·00 |
| Water | 12 | Sulphuric Acid | 1·54 |
| Silex (matrix) | 3 | Lime | 2·00 |
| | | Magnesia | 2·00 |
| | 98·5 | Water | 18·00 |
| | | Gangue | 1·40 |
| | | | 96·59 |

It would appear that different substances have in this, as in other cases, been called by the same name. In one analysis we have arsenic and in the other arsenious acid; one contains no oxide of copper, and the other no oxide of manganese. A specimen examined by R. Phillips contained no copper.

SKOVORODÂ (known in the Ukraine under the name of Gregory Sawicz, or Gregory the son of Sava) was born about 1730, of poor parents, in a village near Kiew, where his father was subdeacon or parish clerk. He was admitted at the age of twelve years into the ecclesiastical academy of Kiew, in the capacity of a servant, but was soon allowed to attend the lectures there, in consideration of the talent which he showed. After obtaining the reputation of being the best classical scholar of the place, and in vain soliciting permission to go abroad, he set out on foot, without the knowledge of his superiors, for Pesth, where he commenced the study of the German language, and in six months was able to profit by the lectures. His account of these lectures however shows them to have been very inefficient, and moreover the fame of Wolf was then at its height and attracting students from every part of Germany to Halle. Skovorodâ went to Halle, where he devoted three years to metaphysical and theological studies; and that his country might profit by the advantages which he derived from foreign learning, he made at this time translations from the Homilies of St. Chrysostom, and composed moral fables which have been handed down orally by the inhabitants of the Ukraine, the surest possible test of their popularity. After four years he returned to Kiew, but was not re-admitted into the academy, nor appointed to any post in which his energies might find exercise. Upon this he applied himself to mitigate the persecutions of the United Greeks, concerning whom a few details are necessary.

This sect had arisen in Russia from a kind of politico-religious compact between the Holy See and the sovereign of Russia about the year 1610, for the purpose of reducing Russia under the papal dominion. In order to effect this, the two powers established a medium sect, partly Romanist, partly Greek: the pope sent Jesuits to teach the necessary doctrine; and the emperor Wladislaw, by a power over the consciences of his people which we can scarcely understand, imposed this body of doctrine as the creed of the provinces on the border of Russia and Poland, whose situation had already exposed them to the influences of both parties. The Unites (as the members of the Greek Church who acknowledge the supremacy of the pope are called in Russia) had already appeared in the north of Italy, in Illyria, and Croatia; but nowhere under similar circumstances. In Russia this sect became a sort of rallying-point for the members of both churches, teaching the Russians gradually to confound distinctions of doctrine, and so to think little of the purer faith and system handed down to them by their ancestors. It has existed to the present day, and so late as 1840 the emperor of Russia, by a dispensing power as strange as that which he exercised originally, decreed that the United Greeks should exist no more. But in the reign of Catherine II., under which Skovorodâ lived, the oppression of the inhabitants of the Ukraine (who had lost the privileges guaranteed to them by Peter the Great after the battle of Poltava) had so far spoiled their disposition, as to render them willing in their turn to oppress any one who was weak enough to fear them. The United Greeks, who had from the commencement of the sect lived under the protection of the throne, were selected as the objects of their persecution. The most rational way of checking these persecutions was to destroy the spirit which gave them birth. To this task Skovorodâ applied himself: in the mixed character of priest and minstrel, he proceeded from village to village through his native Ukraine, preaching the words of peace, singing the religious songs which he had composed for them, and inculcating the same truths under the attractive form of fables. Still he constantly refused to head the sect of the Unites, as his object was not to create or foster schism, but merely to give both parties the benefit of his lessons. By this time the influence which he had justly acquired had pleaded strongly in his favour, and the academy conferred on him the vicarage of his native village. In this station he prohibited all rigour against the persecuted Unites, and endeavoured to gain them over by his doctrines, which were enforced by an eloquence unequalled in the pulpit of South Russia. This at the same time gave an impulse to the clergy of the province, which however unhappily ceased with his death. Even when ordered by the synod, he refused to use the means of persecution, and his refusal led to his ejection from the cure which his exertions had so greatly benefited. His occupation being gone, he resolved to indulge a long-felt desire to visit Rome, the nurse of doctors and confessors, and to view her who, in his eyes, had been glorious as the queen of nations. But almost immediately on his arrival in that city he was recalled by the news of fresh persecutions at home; his works however show what an impression Christian rather than Pagan Rome had left on his mind. His return again checked the fury of the opposite parties; but his exertions, though successful, were only working out his own ruin. The jealousy of the court at St. Petersburg could not allow a single individual, in a cause however humane, to stand in the way of its views. He was considered as a rebel, and orders for his apprehension were issued, which he evaded by taking refuge at the country residence of a noble who had often pressed him to become tutor to his son. This sanctuary of feudal power could not be invaded even by the imperial authority, and he might still have lived in a diminished sphere of usefulness, but he died at the early age of forty-eight, and traditions say that he foretold his own death the day before it occurred, and dug his grave in the garden, unwilling to give this last trouble to the friends to whom he thought he had long enough been a burden.

He was the only author in Little Russia who has yet written in prose: his work called 'Symphonon' is a solitary instance of that kind of composition, and it has the advantage over the works written in Great Russia in being formed rather on the antient Greek model than on that of the Latin or German languages, a style of which Lomonossof was the founder. His translations have been already noticed. Some original essays in the Latin and Russian languages, which remain, show much good taste and elegance, with a great extent of reading, qualifications which were little known in his age or country. With the exception of the common songs of war and love, all traditional songs of the present day are attributed by the bandurists (the troubadours of the Ukraine) to Skovorodâ.

The object of this notice is to rescue from utter neglect the name of one who in his exertions resembled Felix Neff (whose name and character have become generally known through the memoir of the Rev. W. S. Gilly), but has still further claims on our notice as the founder of a national literature.

Further details, garnished with all the romantic circumstances with which tradition loves to invest its heroes, may be found in the 'Moskowski Telegraph.'

SKULL. [SKELETON.]

SKUNK. [WEASELS.]

SKYE. [HEBRIDES.]

SKYLIGHT. Including under this term every mode of admitting light into an apartment through its roof or ceiling, we may here briefly notice that particular fashion of skylight distinguished in Gothic architecture by the name of Lantern, though lanterns in Gothic buildings were not so much intended to admit light, as to supply ventilation and the means of escape to smoke. Accordingly their sides were generally left unglazed or open, whence such lanterns were distinguished by the name of *Louvre* (*l'ouvert*); and though no longer required for its original purpose, after fireplaces were introduced, the lantern was still retained as a characteristic feature of the hall, not only in monastic and collegiate, but also in domestic architecture, when that apartment showed itself externally as a distinct portion of the building, being carried up as a small turret rising out of the ridge of the roof. The lantern over the hall of the Middle Temple, London, is an example. Lanterns of this kind appear to have been invariably polygonal in plan, octagonal or hexagonal, and had apertures or windows on all sides. But the term lantern is occasionally used in two other significations: it is applied to the lower part of a tower placed at the intersection of the transepts with the body of a church, which, being open below, forms a loftier portion of the interior, lighted by windows on each side; and again to an upper open story, that is, one entirely filled with windows, on the summit of a tower, and frequently forming a superstructure different in plan from the rest, as at Fotheringay Church, and that at Boston, Lincolnshire, in both which examples the lantern forms an octagon placed upon a square. The upper portion of the tower of St. Dunstan's, Fleet Street, London, may also be described as a lantern.

Of skylights however, properly so called (that is, which are nearly in the same plane as the general surface of the ceiling), or of lanterns intended to light the whole of an interior, without other windows in its side walls, no examples are to be met with in our antient architecture; not but that skylights might be, and probably in some cases have been, introduced into buildings in the Pointed style, without doing violence to its character, by merely perforating some of the compartments and tracery in a groined ceiling. As one instance at least of the kind, we may mention the conservatory that was at Carlton House, which had a roof of fan-tracery, designed after that of Henry VII.'s Chapel, the whole of which was perforated and filled in with glass; but as the ceiling itself was low, and three sides of the building consisted entirely of windows, it conveyed only an imperfect idea of the effect that might be produced in an interior of the kind, if lighted from above only, particularly if the perforated parts of the ceiling were filled in with stained glass.

Notwithstanding both the variety as to design and decoration of which skylights are susceptible, and the picturesque effect produced in an interior where the light falls in from above, so far from having been turned to account for architectural purposes, and studied as ornamental features, skylights have generally been considered and treated as mere shifts and expedients in building, excusable only when resorted to from necessity, and for inferior rooms situated where it was impossible to obtain side-windows. Hence scarcely anything on the subject, hardly the bare mention of skylights, is to be met with in architectural works. In Italian buildings such mode of lighting rooms is almost unknown, even where it recommends itself as being greatly preferable to that by side-windows, and in fact scarcely less than indispensable, as is the case with sculpture and picture galleries, staircases, and libraries; and though, as regards these last, it is not very material whether the light is admitted from the side of the room or from above, the second method is attended with this advantage, that it allows the bookcases to be continued on all sides of the room.

For rooms in general, the plan of lighting them from the ceiling would not be practicable; yet, where suitable opportunity offers, it should be adopted, not only for the sake of variety of effect, but also as affording great scope for ornamental design.

Scarcely anything of the kind occurs in Italian architecture, except it be in the form of a cupola over a central saloon. [SALOON.] Neither is the very best effect usually studied in Italian cupolas and domes, the light being generally admitted partly through small apertures in the concave of the dome itself, or through a mere lantern on its summit, and partly through upright windows in the tambour or cylindrical wall immediately beneath it; instead of being concentrated and diffused through a single large opening, as in the Pantheon at Rome, which, though professedly so much admired, has very rarely indeed been followed as a model by the architects of Italy. The same remark applies to their followers in other countries: so far from studiously availing themselves of opportunities of lighting interiors from above, and varying the means of accomplishing it according to the particular occasion or design, they have rather avoided everything of the kind. Even where it would seem the most direct mode of obtaining light, as in the case where a dome is introduced, the effect that might be so produced is more frequently than not quite neutralised, if not destroyed, by the chief light being derived from lateral windows. Of this we have an instance in St. Stephen's, Walbrook, which, whatever merit it may possess in regard to proportions, most assuredly does not exhibit the most refined taste, the small oval holes in the walls, serving as windows, being in fact so many blemishes in the design. In that and most other examples of the same kind the lantern is so narrow or small in diameter compared with the dome, that it seems as much intended to obstruct as to admit light, and applied rather with a view to external than to internal effect and utility,—as an architectural finish to the outside of the dome, than in order to light the inside of the building.

It seems indeed a strange kind of perverseness, that while lighting interiors entirely from above has been employed not only for picture and sculpture galleries, but also for concert-rooms, lecture-rooms, and other places intended to accommodate an auditory or congregation, it should hardly in any instance have been applied to churches, though by getting rid of apertures in the walls, noises and sounds from the street would be excluded. If the style of the building be Gothic, such mode of course becomes out of the question; for windows in the walls themselves are then essential, being not only characteristic features, but one chief source of decoration, while owing to their being divided by mullions into compartments, and more or less filled up with tracery, the glare of light is properly attempered. With regard to other styles, Grecian or Italian, the case is widely different: in them the windows are internally no better than so many gaps—mere glazed apertures, which, so far from contributing to decoration, have not even any kind of finishing bestowed upon them, neither architrave, mouldings, nor cornices.

The only instance that we are acquainted with of a church lighted entirely from above, without lateral windows, is that of St. Peter-le-Poor, Broad Street, London, which is a rotunda, covered by a cove, and a large circular lantern, whose tambour forms a sort of clerestory, consisting of a continuous series of arched windows, while the ceiling makes a very flat or slightly concave dome. In point of design this example is not particularly tasteful, but the principle deserves attention. Other ideas of a similar nature have occasionally been thrown out, though not carried to the same extent: the centre of the interior of St. Mary Woolnoth's is covered by a square clerestory lantern, having a large semicircular window on each of its sides,—a peculiarity probably forced upon the architect (Hawksmoor) on account of its being desirable to have no windows on the side towards Lombard Street, and it is only to be regretted that any were allowed on the opposite one, as the whole interior would have been materially improved by the omission of them. A more recent instance is that of Hanover Chapel, Regent Street, London, which has what may be conveniently distinguished by the term *lantern-dome*, viz. a dome where the light is admitted neither through a smaller lantern, or other aperture at its apex, nor through windows in a tambour beneath it, but by a series of windows or glazed panels in the lower part of the concave of the dome itself, similarly curved, and therefore narrower at top than below. Taken by itself, this is a very pleasing feature of the interior, but its effect is counteracted by the numerous windows on the sides, which, in addition to being mere plain openings in the walls, destroy all architectural repose, by the spotty cross-lights which they occasion. Under such circumstances, it is to be wished that the architect could not possibly obtain light except from above. Fortunately this is sometimes the case, if not in regard to churches, in other spacious apartments, where it has been turned to more or less account in the design, and the necessity of lighting them, if not immediately from the ceiling, at least through the upper part of the walls, has given rise to new ideas and novel architec- | looked for, and because the enrichments bestowed upon it

The Waterloo gallery or saloon at Windsor Castle has a lantern ceiling of unusual design, not so much on account of the style of decoration, as of its arrangement and the mode in which the light is admitted. The only other instance we shall add, and it deserves to be noticed for the novelty of the idea, is that of a skylight in a shop at Southampton, forming a dome raised upon four columns, square in its plan, and semicircular in section, and entirely filled in with stained glass of various colours, forming a mosaic pattern in the Alhambra style, executed, we believe, from designs by Mr. Owen Jones.

**SKYROS** (Σκύρος), an island in the Ægean, lying to the east of Phalasia in Negroponte, and to the west of Psara, but nearer to the former, in 39° 10′ N. lat. and 25° 12′ E. long. The earliest inhabitants were Pelasgians and Carians, according to Nicolaus, quoted by Stephanus Byzantinus (Σκύρος), and Dolopes (Thucyd., i. 98). Homer records the capture of it by Achilles (*Il.*, x. 664), who is said to have been discovered there disguised in female attire before the Trojan war. Theseus was sent into exile to this island, and was murdered by Lycomedes, its king, who became jealous of his popularity. (Pausan., iii. 6.) In 476 B.C. it was taken by Cimon, when the inhabitants were enslaved, and a colony was sent thither from Athens (Thucyd., i. 98), but not in consequence of the oracle which directed the removal of the bones of Theseus, as Pausanias asserts, for the delivery of the oracle and the disinterment did not take place till six or seven years after the capture. It afterwards passed out of the hands of the Athenians, but was restored to them by the peace of Antalcidas, B.C. 386. It was taken by Demetrius Poliorcetes, and again given to Athens, B.C. 196, in the treaty between Rome and Philip of Macedon. (Livy, xxxiii. 30.)

In the division of the Greek empire by Constantine Porphyrogennetus, Scyrus was placed in the Thema Ægæum Pelagus, and in the Synecdemus of Hierocles, in the Provincia Helladis Achaiæ. After the taking of Constantinople by the Latins, it was seized by Andrew and Jerome Gizi. It afterwards formed part of the duchy of Naxos, and finally of the Turkish empire. In 1823 the Skyriotes were among the islanders who renounced their allegiance to the Porte, and repulsed the troops sent against them with great slaughter. This island was however restored at the close of the Greek war to the Turks, by the protocol of 1829.

According to Dapper the bearings of Skyros are as follows:—Ten or eleven leagues to the north of Cap Mantelo, the south-east cape of Eubœa; on the east it is sixteen or eighteen leagues from Lesbos, and the same on the north-east from Lemnos; and on the north-west six or seven leagues from the island of Skopelo. Tournefort states the circumference at sixty miles. On the west side is a large bay, with several islands at the mouth. The harbour here is called Kalamitza by the Greeks, and by the Italians Gran Spiaggia. Opposite to this, on the other side of the island, is Port Akhili. The isthmus between these two points divides the island into two parts; the southern portion is uncultivated, full of high mountains, intersected by deep gullies, and rugged and bare, except at their summits, where they are covered with oak, fir, and beech.

Mount Cocyla, on the east coast, a little to the south of Port Akhili, is 2588 feet high, according to some authorities. At the southern extremity of the island is a port called Trimpouchais, a corruption of Tre Boche, or the three mouths. It is surrounded by wooded hills, and has three entrances, the one on each side being about one-third of a mile in width, and the middle one rather narrower. They are all safe and deep. There is about twenty fathoms water in the centre of the harbour.

The northern division of the island is less mountainous. The town of St. George, on the east coast, covers the north and west sides of a high rocky peak, which terminates abruptly on the sea. On the table summit of this hill are the ruins of a castle built during the middle ages, and many houses, all abandoned, which are used by the inhabitants to keep stores in. The houses of Skyros are flat-roofed, of two stories, the lower of stone, the upper of wood, surmounted by terraces covered with earth. This hill was the site of the antient Acropolis. The remains of Hellenic walls may be traced round the edge of the precipices, particularly at the north end of the castle, and others halfway down the peak, or among the modern houses. The greater part of the antient city lay to the east, near the sea. In this direction there is a large semicircular bastion almost entire. Thence the wall is continued along the slope above the sea as far as a round tower, half of which is still standing. Beyond this are the remains of another tower, and a wall from each connects the city with the sea, like the long walls of Athens and other antient cities. Tournefort (*Voyage du Levant*) makes mention of the ruins of a temple of Pallas near the town. This goddess was worshipped here, as appears from Statius (*Achill*, i. 285).

In the neighbourhood of St. George is a plain four square miles in extent, which bears corn, grapes, and figs. There is another at Kalamitza, which is also fertile. On the steep ground in the north part of the island madder is grown. The wheat of Skyros equals in quality that of any island in the Ægean. Its productions are, 10,000 barrels of wine in a good vintage, three-fourths of which are exported; 15,000 kila of corn, 2000 of which are exported; 500 kanthars of fasulia; 2000 okes of wax; 8000 okes of honey; 100,000 oranges and lemons; and 400 kanthars of madder. There are a few oxen, and about 15,000 head of sheep and goats, of which 2000 are annually exported. The taxes are 20 purses, paid by 500 families living in St. George. There are three kaiks belonging to the island, and many feluccas built with the fir of the mountains. The oak timber is only used for firewood. (Leake's *Travels in Northern Greece.*) In 1813 Scyros had 12 ships, with an average tonnage of 100; average number of crews 12; of cannon 4. (Pouqueville, *Voyage dans la Grèce.*) The inhabitants are good seamen, and fond of the chase. They retain more antient customs than most of the islanders in the Archipelago, and are attached to the early Greek traditions. The memory of Achilles is still preserved in the name Akhili (Ἀχίλλειον). Skyros was much celebrated among the antients for its red and white marble, which, as Strabo informs us, was used at Rome in preference to white marble. (Strabo, 437, Casaub.) There is a bishop, who resides in the deserted part of St. George. His see is dependent on that of Rhodes. Tournefort mentions two monasteries—St. George and St. Dimitri.

**SLANDER** consists in the malicious speaking of such words as render the party who speaks them in the hearing of others liable to an action at the suit of the party to whom they apply.

Slander is of two kinds: one, which is actionable, as necessarily importing some general damage to the party who is slandered; the other, which is only actionable where it has actually caused some special damage. The first kind includes all such words as impute to a party the commission of some crime or misdemeanour for which he might legally be convicted and suffer punishment, either by the general law, or by the custom of a particular place, as where one asserts that another has committed treason, or felony, or perjury, &c. It also includes such words spoken of a party, with reference to his office, profession, or trade, as impute to him malpractice, incompetence, or bankruptcy; as of a magistrate, that he is partial or corrupt; of a clergyman, that 'he preaches lies in the pulpit;' of a barrister, that 'he is a dunce, and will get nothing by the law;' of a physician, that 'he is an empiric, a mountebank;' of an attorney, that 'he hath no more law than a goose, bull,' &c., or that 'he is no more lawyer than the devil;' of a trader, that he has failed, or uses deceit in his trade, &c.; or that charge a party with having, at the time being, an infectious disease which prevents his having intercourse with others; or that tend to the disherison of a party, as where it is said of one who holds lands by descent, that he is illegitimate. Where a party is in possession of lands which he desires to sell, he may maintain an action against any one who slanders his title to the lands; as by stating that he is not the owner, or that another has a lease of the lands or is in possession of a mortgage or other incumbrance upon them. With respect to the second class of slander, the law will not allow damage to be inferred from words which are not in themselves actionable, even although the words are untrue and spoken maliciously. But if, in consequence of such words being so spoken, a party has actually sustained some injury, he may maintain an action of slander against the person who has uttered them. In such case the injury must be some certain actual loss, and it must also arise as a natural and lawful consequence of speaking the words. No unlawful act done by a third person, although he really was moved to do it by the words spoken, is such an injury as a party can recover for in this action. Thus, the loss of the society and entertainment of friends, of an appointment to some office, the breach of a marriage engagement caused by the slanderer's statement, are injuries for which a party may recover damages. But he can have no action because in consequence of such statement certain persons, to use an illustration of Lord Ellenborough's, 'have thrown him into a horse-pond by way of punishment for his supposed transgression.'

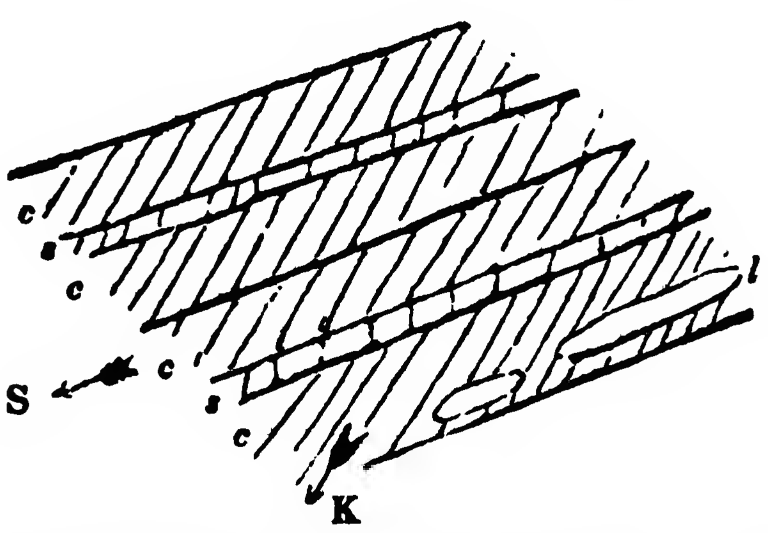
With respect to both kinds of slander, it is immaterial in what way the charge is conveyed, whether by direct statement, or obliquely, as by question, epithet, or exclamation. But the actual words used must be stated in the declaration, and upon the failure to prove them as stated, the plaintiff will be nonsuited at the trial: it is not sufficient to state the meaning and inference of the words. They will be interpreted in the sense in which they are commonly used, but where they are susceptible of two meanings, one innocent, the other defamatory, the innocent interpretation is to be preferred. Where words are equivocal either in their meaning or their application, a parenthetical explanation may be inserted in the declaration. This is called an innuendo. It may be employed to explain and define, but not to enlarge or alter, the meaning or application of the words spoken. The declaration must state the publication of the words, that is, that they were spoken in the hearing of others, and spoken maliciously. Two cannot join in bringing one action of slander, except in the case of husband and wife, or of partners for an injury done to their joint trade; nor can an action be brought against two, except a husband and wife, where slanderous words have been spoken by the wife. Where an action is brought for slanderous words spoken of a party relative to his office or profession, the declaration must state that he was at the time of speaking the words in possession of the office or engaged in the profession. And where the knowledge of extraneous facts is necessary to show the application of the slander, these should be stated in the introductory part of the declaration.

In answer to an action of slander the defendant may plead that the words spoken were true, or that they were spoken in the course of a trial in a court of justice, and were pertinent to the case; or formed the subject of a confidential communication, as where a party on application *bonâ fide* states what he believes to be true relative to the character of a servant, or makes known facts merely for the purpose of honestly warning another in whom he is interested. (Com., *Dig.*, 'Action on the case for Defamation,' D. 1, &c.)

SLANE. [MEATH.]

SLANEY, River. [WEXFORD.]

SLATE. By some geological writers the laminar structures which prevail in many stratified and in some metamorphic rocks are called slaty or schistose; but, in consequence of the progress of investigation, one of these structures, locally superinduced in deposited strata, which is characterized by planes of cleavage generally meeting those of deposition at considerable angles, is specially called the slaty structure. If, in the diagram below, *c*, *s*, *l*, represent in




section a series of deposited beds of clay (*c*), sandstone (*s*), and nodules of limestone (*l*), all dipping, as the arrow S (south) indicates, at 20°: the lines which cross these beds at oblique angles, and are more highly inclined, as in the arrow K = 60°, are the edges of innumerable parallel planes of cleavage, which are continuous through the finely argillaceous beds *c*; more or less twisted in and about the limestone nodules *l*; more or less interrupted by the arenaceous beds *s*, or represented therein by lines more nearly rectangled to the plane of deposition. The law here indicated of the want of coincidence in the planes of cleavage and deposition is almost universally observed in nature. Nearly horizontal strata are crossed by inclined cleavage; highly inclined strata are traversed by nearly vertical cleavage. In strata which dip different ways from an axis or to an axis, the cleavage planes are sometimes found to be parallel throughout the mass on both sides of the axis; and even where strata are variously contorted, they are frequently dissected through a great part or the whole of their mass by cleavage planes passing in one direction. Hence the conclusion is obvious that this slaty structure, this monohedral symmetry (if we may not call it crystallization), is the fruit of a general cause acting subsequently to the deposition and disturbance of the strata, capable of pervading and rearranging the particles so as to polarize and systematize their mutual attractions, but not to fuse them together, destroy their original distinctness, or obliterate the evidence of their original condition. This force was so general, that along many miles of country, as, for example, in the whole Snowdonian chain, one particular direction (north-north-east), in North Devon and Pembrokeshire another (nearly east and west), is found to prevail more or less distinctly in all the rocks; though, as before observed, arenaceous and pebbly beds are least influenced by it, and limestones are unequally and variously affected.

This dependence of the slaty structure on the nature of the rock is sometimes very positively pronounced, as in some classes of rock the cleavage does change and even reverse its inclination where contortions prevail. (This is very observable in some cases of cleavage in the old red sandstone of Pembrokeshire.) On a first view it appears to be equally dependent on geological time, since it is principally among the older strata that it is well exhibited on a large scale; but on this head doubt arises, when we find the Silurian rocks, which are not slaty at Ludlow, become so near Llandovery; the old red-sandstone slaty in Pembrokeshire and not so in Monmouthshire; the mountain limestone shales slaty near Tenby and not so in Yorkshire; the lias shales slaty on the northern slopes of the Alps, but not so in England.

There are then *local conditions* which influence the development of slaty cleavage, and it is essential to a general solution of the problem which this structure involves, that these conditions should be determined. Proximity to rocks of igneous origin has been freely appealed to for this purpose; but this appears an insufficient and not often applicable cause. The most general condition which has occurred to our observation is the fact of remarkable displacement of the strata on one or more anticlinal or synclinal axes; and it is of consequence to this inference to remark that very often, approximately or even exactly, the horizontal edge ('strike') of the inclined cleavage planes coincides with the axis of movement (and therefore with the strike) of the stratification. *Pressure* in some peculiar application appears to us to be indicated by all the phenomena as the grand agent in the production of slaty cleavage. Only one tolerably successful effort has been made experimentally to reproduce this structure by art. Mr. R. W. Fox has caused electrical currents to traverse a mass of moist clay, and has observed in consequence the formation of numerous fissures, more or less similar to slaty cleavage, in planes parallel to the vertical bounding surfaces of the mass, and at right angles to the electrical currents. The exact application of this experiment is not understood. Perhaps however, conjoined with the admission that the great movements of strata, by which apparently slaty cleavage was determined, depended on disturbed equilibrium of internal heat, which might, or rather must, have developed electrical currents, this solitary experiment may be the commencement of a right mode of more extensive inquiry embracing the many circumstances of chemical nature, stratified arrangement, disturbed position, and proximity of igneous rocks, which must all be included in a good theory of slaty cleavage.

For economical purposes there appears little chance of obtaining in the British Islands good *slate* (properly so called) from any but the antient argillaceous strata superposed on mica schist and gneiss, and covered by old red-sandstone or mountain limestone. From these strata in Scotland, Cumberland, Westmoreland, Yorkshire, Charnwood Forest, North Wales abundantly, South Wales, Devonshire, Cornwall, the north and south of Ireland, slates of various value are dug. The thin flagstone of the coal formation in many parts of England and Wales, the laminated sandy limestone of Stonesfield, Collywiston, &c., which are often called slates, and are extensively used in roofing, are all obtained by natural partings parallel to the stratification. True slate is split by wedges from the apparently solid rock along planes often no more discoverable than those of a real crystal. In colour it is purple, blue, green, yellowish, or almost white, or striped across the planes. In some slates (west of Scotland, Ingleton, &c.) crystals of cubical iron pyrites are scattered. Much of the Cumberland slate appears full of fragments (Borrodale), and some contains chiastolite (Skiddaw).

**SLAVE, SLAVERY.** The word slavery has various acceptations, but its proper meaning seems to be the condition of an individual who is not master of his own actions, and who is also the property of another or others. Such was the condition of the 'servi,' or slaves among the Romans and Greeks; such is still that of the slaves in Eastern countries, and that of the negro slaves in many parts of Africa and America. A mitigated form of this condition exists in the case of the serfs in Russia and Poland, and of a similar class in India and some other parts of Asia. The Russian and Polish serf is bound to the soil on which he is born; he may be sold or let with it, but cannot be sold away from it without his consent; he is obliged to work three or four days in the week for his master, who allows him a piece of land, which he cultivates. He can marry, and his wife and children are under his authority till they are of age. He can bequeath his chattels and savings at his death. His life is protected by the law. The real slave, in the Greek and Roman times, had none of these advantages and securities, any more than the negro slave of our own times; he was bought and sold in the market, and was transferred at his owner's pleasure; he could acquire no property; all that he had was his master's; all the produce of his labour belonged to his master, who could inflict corporeal punishment upon him; he had no right of marrying; and if he cohabited with a woman, he could be separated from her and his children at any time, and the woman and children sold; he was, in short, in the same condition as any domesticated animal. The distinction therefore between the slave and the serf is essential. The villeins of the middle ages were a kind of serfs, but their condition seems to have varied considerably according to times and localities, and in many cases it appears to have been more advantageous. The villani or coloni were in a less dependent condition than the adscriptitii, or than the actual Russian and Polish serfs. This subject however is treated under VILLEINAGE. Servitude of every kind is now abolished in the greater part of Europe. In the present article we treat only of the real slave of antient and modern times.

Slavery, properly so called, appears to have been, from the earliest ages, the condition of a large proportion of mankind in almost every country, until times comparatively recent, when it has been gradually abolished by all Christian states, at least in Europe. The prevalence of domestic slavery constitutes one great difference between antient and modern society. Slavery existed among the Jews: it existed before Moses, in the time of the Patriarchs; and it existed, and still continues to exist, all over the East. The 'servants' mentioned in Scripture history were mostly unconditional and perpetual slaves: they were strangers, either taken prisoners in war or purchased from the neighbouring nations. They and their offspring were the property of their masters, who could sell them, and inflict upon them corporeal punishment, and even in some cases could put them to death. The three hundred and eighteen servants born in Abraham's own house (*Genesis*, xiv. 14) were of this description. But the Hebrews had also slaves of their own nation. These were men who sold themselves through poverty, or they were insolvent debtors, or men who had committed a theft, and had not the means of making restitution as required by the laws, which was to double the amount, and in some cases much more. (*Exodus*, xxii.) Not only the person of the debtor was liable to the claims of the creditor, but his right extended also to the debtor's wife and children. Moses regulated the condition of slavery. He drew a wide distinction between the alien slave and the native servant. The latter could not be a perpetual bondman, but might be redeemed; and if not redeemed, he became free on the completion of the seventh year of his servitude. Again, every fifty years the jubilee caused a general emancipation of all native servants. During the time of their servitude they were to be treated with kindness; 'for the children of Israel are servants unto me,' saith the Lord. 'Both thy bondmen and thy bondmaids which thou shalt have shall be of the heathen that are round about you, of them shall you buy bondmen and bondmaids. Moreover, of the children of the strangers that do sojourn among you, of them shall ye buy, and of their families that are with you which they begat in your land; and they shall be your possession. And ye shall take them as an inheritance for your children after you, to inherit them for a possession, they shall be your bondmen for ever; but over your brethren the children of Israel ye shall not rule one over another with rigour. And if a sojourner or stranger wax rich by thee, and thy brother that dwelleth by him wax poor, and sell himself unto the stranger or sojourner by thee, or to the stock of the stranger's family, after that he is sold he may be redeemed again, one of his brethren may redeem him......And if he be not redeemed in three years, then he shall go out in the year of the jubilee, both he and his children with him.' (*Leviticus*, xxv. 44-54.)

The sources of the supply of slaves have been the same both in antient and modern times. In antient times all prisoners were reduced to slavery, being either distributed among the officers and men of the conquering army, or sold by auction for the benefit of the troops. In very remote times, when the early Æolian and Ionian colonies settled in the islands of the Ægean Sea, or on the coast of Asia Minor, it was a frequent practice with them to kill all the adult males of the aboriginal population, and to keep the wives and children. As however dealing in slaves became a profitable trade, the vanquished, instead of being killed, were sold, and this was so far an improvement. Another source of slavery was the practice of kidnapping men and women, especially young persons, who were seized on the coast, or enticed on board by the crews of pirate vessels; and most vessels were piratical in the earlier ages. The Phœnicians, and the Etruscans or Tyrrhenians, had the character of being men-stealers; and also the Cretans, Cilicians, Rhodians, and other maritime states. Another source was, sale of men, either by themselves through poverty and distress, or by their relatives and superiors, as is done now by the petty African chiefs, who sell not only their prisoners, but often their own subjects, and even their children, to the slave-dealers. The sale of Joseph by his brethren to the Midianite or Arabian merchants, who sold him again in Egypt, is a proof of the antiquity of the practice.

The sequel also shows, that in Egypt, unlike most other countries of antiquity, the life of a slave was protected by law; for Joseph's master, when he had reason to believe him guilty of a heinous offence, did not put him to death, but sent him to prison, there to await his trial, and this inference is confirmed by Diodorus, who, in speaking of the laws of the Egyptians, says, that whoever murdered a man, whether free or slave, was punished with death.

Among the Greeks slavery existed from the heroic times, and the purchase and use of slaves are repeatedly mentioned by Homer. The household of Ulysses was served by slaves, over whom their master had power of life and death. The use of such domestics however was confined, in those early ages, to the houses of the great, who alone could afford the purchase money. As war and piracy became frequent, slaves taken or bought became more plentiful and cheaper, and they were chiefly employed in handicraft and household labours. The labours of husbandry were performed in some instances by poor freemen for hire, but in most places, especially in the Doric states, by a class of bondmen, the descendants of the older inhabitants of the country, resembling the serfs of the middle ages, who lived upon and cultivated the lands which the dominant or conquering race had appropriated to themselves; they paid a rent to the respective proprietors, whom they also attended in war. They could not be put to death without trial, nor be sold out of the country, nor separated from their families; they could acquire property, and were often richer than their masters. Such were the Clarotæ of Crete, the Penestæ of Thessaly Proper, and the Helots of Sparta, who must not be confounded with the Periœci, or country inhabitants of Laconica in general, who were political subjects of the Doric community of Sparta, without however being bondmen. [SPARTA.] In the colonies of the Dorians beyond the limits of Greece, the condition of the conquered natives was often more degraded than that of the bondmen of the parent states, because the former were not Greeks, but barbarians, and they were reduced to the condition of slaves. Such was the case of the Kallirioi or Kallikurioi of Syracuse, and of the native Bithynians at Byzantium. At Heraclea in Pontus, the Mariandyni submitted to the Greeks on condition that they should not be sold beyond the borders, and that they should pay a fixed tribute to the ruling race.

The Doric states of Greece had few purchased slaves, but Athens, Corinth, and other commercial states had a large number, who were mostly natives of barbarous countries, according to the Greek phraseology. The slave population in Attica has been variously estimated as to numbers, and it varied of course considerably at different periods, but it appears that in Athens, at least in the time of its greatest power, they were much more numerous than the freemen. [ATHENS.] From a fragment of Hyperides preserved by Suidas (*v.* ἀπεψηφίσατο), the number of slaves appears to have been at one time 150,000, who were employed in the fields and mines of Attica alone. Even the poorer citizens had a slave for their household affairs. The wealthier citizens had as many as fifty slaves to each family, and some had more. We read of philosophers keeping ten slaves. There were private slaves belonging to families, and public slaves belonging to the community or state. The latter were employed on board the fleet, in the docks and arsenal, and in the construction of public buildings and roads. Pausanias says that slaves were introduced for the first time among the land forces at the battle of Marathon; but this was, it seems, in the ranks of the Platæans, for the Athenians did not introduce them into their armies till a later period. At the sea fight of Arginusæ there were many slaves serving in the Athenian fleet, and they were emancipated after the battle. Again at Cheronæa the Athenians granted liberty to their slaves who served in the army.

Slaves were dealt with like any other property: they could be given as pledges; they worked either on their master's account or on their own, in which latter case they paid a certain sum to their master; or they were let out on hire as servants or workmen, or sent to serve in the navy of the state, the master receiving payment for their services. Mines were worked by slaves, some of whom belonged to the lessees of the mine, and the rest were hired from the great slave proprietors, to whom the latter paid a rent of so much a head, besides providing for the maintenance of the slave, which was no great matter. They worked in chains, and many of them died from the effect of the unwholesome atmosphere. Nicias the elder had 1000 slaves in the mines of Laurium; others had several hundreds, whom they let to the contractors for an obolus a day each. At one time the mining slaves of Attica murdered their guards, took possession of the fortifications of Sunium, and ravaged the surrounding country. (Fragment of Posidonius's Continuation of Polybius; see Boeckh's *Public Economy of Athens*, b. i.) The thirty-two or thirty-three iron-workers or sword-cutlers of Demosthenes annually produced a net profit of thirty minæ, their purchase value being 190 minæ; whilst his twenty chair-makers, whose value was estimated at 40 minæ, brought in a net profit of 12 minæ. (Demosthenes *Against Aphobus*, i.) The leather-workers of Timarchus brought in to their master each two oboli a day, and their foreman three. The master furnished the raw materials. The price of slaves at Athens varied from half a mina to five and ten minæ a head: a common mining slave, in the age of Demosthenes, cost from 125 to 150 drachmæ. The profits derived from slave labour must have been very high, as the owner had to replace his capital and to obtain the usual rate of interest for his money, which was a high rate, and the slave was only valuable so long as he had health and was able to work. There was also the danger of his running away, especially in war time. Antigenes of Rhodes was the first to establish an insurance for slaves. For a yearly contribution for each slave serving in the army he undertook to make good his price to the owner, in case of his running away.

The antients were so habituated to the sight of slavery, that none of the antient philosophers make any objection to its existence. Plato, in his 'Perfect State,' desires only that no Greeks should be made slaves. The only states of Greece in which no slaves appear to have been introduced were Locris and Phocis, probably by reason of the poverty of the people and the simplicity of their manners.

The Etruscans and other antient Italian nations had slaves, as is proved by those of Vulsinii revolting against their masters, and by the tradition that the Bruttii were runaway slaves of the Lucanians. The Campanians had both slaves and gladiators previous to the Roman conquest. But the Romans by their system of continual war caused an enormous influx of slaves into Italy, where the slave population at last superseded almost entirely that of the free labourers.

The Roman system of slavery had peculiarities which distinguished it from that of Greece. One distinction existed in principle. The Greeks considered slavery to be derived from the law of nature and from permanent diversities in the races of men. (Aristotle, *Polit.*, i.) The Romans admitted in principle that all men were originally free (*Instit.*, i., tit. ii.) by the law of nature (jure naturali), and they ascribed the rights of masters over their slaves entirely to the will of society, to the 'jus gentium,' if the slaves were captives taken in war, whom the conquerors, instead of killing them, as they might have done, spared for the purpose of selling them, or to the 'jus civile,' when a man of full age sold himself. It was a rule of Roman law that the offspring of a slave woman followed the condition of the mother. (*Inst.*, i., tit. 3.) Emancipation was much more frequent at Rome than in Greece: the emancipated slave became a freedman (libertus), but whether he became a Roman citizen, a Latinus, or a Dediticius, depended on circumstances. If the manumitted slave was above thirty years of age, if he was the Quiritarian property of his manumittor, and if he was manumitted in due form, he became a Roman citizen. At Athens, on the contrary, emancipation from the dominion of the master was seldom followed by the privileges of citizenship even to a limited extent, and these privileges could only be conferred by public authority. It is true, that at Rome, under the empire, from the enactment of the Lex Aelia Sentia, passed in the time of Augustus, there were restrictions, in point of number, upon the master's power of freeing his bondmen and raising them to the rank of Roman citizens; still in every age there was a prospect to the slave of being able to obtain his freedom.

The slaves of the Romans were called by the names of servi, servitia, mancipia, famuli, and, as being members of a familia, also familiares. A slave was often called 'puer,' which was sometimes contracted into 'por,' and added to the master's name, as 'Marcipor,' the slave of Marcus. Slaves were not considered members of the community: they had no rights, and were not legally considered as persons, but as things or chattels. They could neither sue nor be sued, and they could not claim the protection of the tribunes. When an alleged slave claimed his freedom on the plea of unjust detention, he was obliged to have a free protector to sue for him, until Justinian (*Code*, vii., tit. 1. 7, 'De adsertione tollenda') dispensed with that formality. Slaves had no connubium, that is, they could not contract a Roman marriage; their union with a person of their own rank was styled contubernium, and cohabitation with another person was not adultery; and even the Christian church for several centuries did not declare the validity and indissolubility of slave marriages. At last the emperor Basilius allowed slaves to marry and receive the blessing of the priest, and Alexius Comnenus renewed the permission. As slaves had no connubium, they had not the parental power (patria potestas) over their offspring, no ties of blood were recognised among them, except with respect to incest and parricide, which were considered as crimes by the law of nature. Though slaves were incapable of holding property, they were not incapacitated from acquiring property, but what they did acquire belonged to their masters. They were often allowed to enjoy property as their own, 'peculium,' consisting sometimes of other slaves, but they held it only by permission, and any legal proceedings connected with it could only be conducted in the name of the master, who was the only legal proprietor. No slave could hold a public office, and if a slave unknown to be such had obtained a responsible office, it was a question among the jurists whether his acts would be valid or null. Until the latter period of the republic, slaves and even freedmen were not admitted into the ranks of the army. In cases of urgent public danger, such as after the defeat of Cannæ, slaves were purchased by the state and sent to the army, and if they behaved well, they were emancipated. (Livy, xxii. 57, and xxiv. 14-16.)

Male slaves were not permitted by law to wear the toga and bulla, nor females the stola, but otherwise there was no fixed distinctive costume for them, and they were mostly dressed like poor freeman, who could not afford to wear the toga. A distinct dress for slaves had been proposed in the decline of the republic, but the proposition was rejected upon some senator adverting to the danger of showing the slaves how much superior in numbers they were to the freemen. Slaves were forbidden the use of horses, carriages, or litters (lecticæ) within the walls of the city

They were not however denied the rights of burial, and numerous inscriptions attest that monuments were often erected to the memory of deceased slaves by their masters, their fellows, or friends, some of which bear the letters D. M 'Diis Manibus,' for according to the Roman principle that slavery was not by nature, but was the effect of law, death was considered as putting an end to the legal distinction between slaves and masters, and the manes of a departed slave might be an object of reverence even to a freeman. Slaves were often buried in the family burying-place of their masters. The 'sepulchretum' or burial-vaults of the slaves and freedmen of Augustus and his wife Livia, discovered in 1726 near the Via Appia, and which has been illustrated by Bianchini and Gori, and another in the same neighbourhood also belonging to the household of the early Cæsars, and containing at least 3000 urns with numerous inscriptions, which have been illustrated by Fabretti, throw much light upon the condition and domestic habits of Roman slaves in the service of great families. [Bianchini, Francesco.]

With regard to the classification and occupations of slaves, the first division was into public and private. Public slaves were those which belonged to the state or to public bodies, such as provinces, municipia, collegia, decuriæ, &c., or to the emperor in his sovereign capacity, and employed in public duties, and not attached to his household or private estate. Public slaves were either derived from the share of captives taken in war, which was reserved for the community or state, or were acquired by purchase and other civil process. Public slaves of an inferior description were engaged as rowers on board the fleet, or in the construction and repair of roads and national buildings. Those of a superior description were employed as keepers of public buildings, prisons, and other property of the state, or to attend magistrates, priests, and other public officers, as watchmen, lictors, executioners, watermen, scavengers, &c.

Private slaves were generally distributed into urban and rustic; the former served in the town houses, and the others in the country. Long lists of the different duties performed by slaves of each class are given by Pignorius, 'De Servis et eorum apud Veteres Ministeriis,' Amsterdam, 1674; Popma, 'De Operis Servorum,' ibid., 1672; and Blair, 'An Inquiry into the State of Slavery amongst the Romans,' Edinburgh, 1833, which is a very useful little book. It will be enough here to say, that for all the necessities of domestic life, agriculture, and handicraft, and for all the imaginable luxuries of a refined and licentious people, there was a corresponding denomination of slaves. Large sums were occasionally paid for slaves of certain peculiar kinds, some of which we should consider the least useful. Eunuchs were always very dear; the practice of emasculating boys was borrowed by the Romans from the Asiatics, among whom it was a trade as early as the time of Herodotus (viii. 105): it continued to the time of Domitian, who forbade it; but eunuchs continued to be imported from the East. A 'morio,' or fool, was sometimes sold for 20,000 nummi, or about 160 pounds. Dwarfs and giants were also in great request. Marc Antony paid for a pair of handsome youths 200 sestertia, or 1600 pounds. Martial (*Ep.*, iii. 62) mentions a single handsome youth who cost as much as those two. Actors and actresses and dancers sold very dear, as well as females of great personal attractions, who were likely to bring in great gains to their owners by prostitution. A good cook was valued at four talents, or 772 pounds. Medical men, grammarians, amanuenses, anagnostæ or readers, and shorthand-writers, were in considerable request. With regard to ordinary slaves, the price varied from fifty to twenty pounds, according to their abilities and other circumstances. The lowest legal valuation of a man slave in the time of Justinian was twenty solidi, or about sixteen pounds; and the value seems to have been about the same in the time of Horace (*Sat.*, ii. 7; v. 43). After a victorious campaign, when thousands of captives were sold at once on the spot for the purpose of prize-money, to the slave-dealers who followed the armies, the price sunk very low. Thus in the camp of Lucullus in Pontus slaves were sold for four drachmæ, or two shillings and sevenpence, a head; but the same slaves, if brought to the Roman market, fetched a much higher price. Home-born slaves, distinguished by the name of 'vernæ,' in contradistinction to 'servi empti,' or 'venales,' or imported slaves, were generally treated with greater indulgence by their masters in whose families they had been brought up; and for that very reason, when taken to market, bore an inferior value to the imported slaves, being considered as spoilt and troublesome. The number of slaves born in Roman families appears at all times to have been far inferior to that of the imported slaves. In general the propagation of slaves was not much encouraged by masters, many of whom considered slaves born at home to cost more than those who were imported. Ordinary female slaves were inferior in numbers to the males, and were generally cheaper in the market.

There was a brisk trade in slaves carried on from the coasts of Africa, the Euxine, Syria, and Asia Minor. The island of Delos was at one time a great mart for slaves, who were imported thither by the Cilician pirates. (Strabo, p. 668, Casaub.) The Illyrians procured numerous slaves for the Italian market, whom they bought or stole from the barbarous tribes in their neighbourhood. Thrace was the parent country of numerous slaves, and the selling of children by their parents was an antient practice among the Thracian tribes. (Herod., v. 6.) But the chief supply of slaves was derived from Asia and Africa. In most countries it was customary for indigent parents to sell their children to slave-dealers, and even Roman citizens at times sold themselves or their children through distress. Criminals were also in certain cases condemned to slavery, like the galley-slaves of our own times.

Both law and custom forbade prisoners taken in civil wars, especially in Italy, to be dealt with as slaves; and this was perhaps one reason of the wholesale massacres of captives by Sulla and the Triumviri. In the war between the party of Otho and Vitellius, Antonius, who commanded the army of the latter, having taken Cremona, ordered that none of the captives should be detained, upon which the soldiers began to kill those who were not privately ransomed by their friends.

In the latter period of the empire free-born persons of low condition were glad to secure a subsistence by labour on the estates of the great landowners, to which, after a continued residence for thirty years, they and their families became bound by a tacit agreement under the name of adscriptitii, or adscripti glebæ, and this was one of the sources of the servitude of the middle ages.

The customary allowance of food for a slave appears to have been four Roman bushels, 'modii,' of corn, mostly 'far,' per month for country slaves, and one Roman libra or pound daily for those in town. Salt and oil were occasionally allowed, as well as weak wine. Neither meat nor vegetables formed part of their regular allowance, but they got, according to seasons, fruit, such as figs, olives, apples, pears, &c. (Cato, Columella, and Varro.) Labourers and artizans in the country were shut up at night in a house ('ergastulum'), in which each slave appears to have had a separate cell. Males were kept apart from females, excepting those whom the master allowed to form 'contubernia' or temporary connections. Columella adverts to some distinction between the ergastulum for ordinary labourers and that for ill behaved slaves, which latter was in fact a prison, often under ground, but generally speaking the ergastula in the later times of the republic and under the empire appear to have been no better than prisons in which freemen were sometimes confined after being kidnapped. The men often worked in chains. The overseers of farms and herdsmen had separate cabins allotted to them. Slaves enjoyed relaxation from toil on certain festivities, such as the Saturnalia. [Saturnalia.]

Every individual master had the power of manumitting his slave, and this he could effect in several forms, by Vindicta, Census, or by Testamentum. All slaves manumitted by a Roman citizen (subject to the conditions above mentioned) became Roman citizens and members of his gens, of which they took the name. They laboured however under several disabilities. They were enrolled in the lowest of the city tribes; they were ineligible to the consulship and other high offices; and they were not generally admitted into the best society. [Libertinus.]

The number of slaves possessed by the wealthy Romans was enormous. Some individuals are said to have possessed 10,000 slaves. Scaurus possessed above 4000 domestic and as many rustic slaves. In the reign of Augustus, a freedman who had sustained great losses during the civil wars left 4116 slaves, besides other property

The Lex Aelia Sentia, as already mentioned, laid various restrictions on manumission. Among other things it prevented persons under twenty years of age from manumitting a slave except by the Vindicta, and with the approbation of the Consilium, which at Rome consisted of five senators and five Roman equites of legal age (puberes), and in the provinces consisted of twenty recuperatores, who were Roman citizens. (Gaius, i. 20, 38.) The Lex Aelia Sentia also made all manumissions void which were effected to cheat creditors or defraud patrons of their rights. The Lex Furia Caninia, which was passed about A.D. 7, limited the whole number of slaves who could be manumitted by testament to 100, and when a man had fewer than 500 slaves, it determined by a scale the number that he could manumit. This Lex only applied to manumission by testament. (Gaius, i. 42, &c.)

In the earlier ages of the Republic, slaves were not very numerous, and were chiefly employed in household offices or as operatives in the towns; and they were generally treated like members of the family, and joined their masters in offering prayers and sacrifices to the gods. (Horace, *Epist.*, ii. 1, 142.) But after the conquests of Rome spread beyond the limits of Italy, the influx of captives was so great, and their price fell so low, that they were looked upon as a cheap and easily renewed commodity, and treated as such. The condition of the Roman slave, generally speaking, became worse in the later ages of the republic than that of the slave at Athens. It is worthy of remark that many of the emperors, even some of the worst of them, interfered on behalf of the slave. Augustus established courts for the trial of slaves who were charged with serious offences, intending thus to supersede arbitrary punishment by the masters, but the law was not made obligatory upon the latter to bring their slaves before the courts, and was often evaded. The same emperor strongly reprobated Vedius Pollio, a Roman knight, for sentencing a slave to be thrown alive into a fish-pond to be devoured by lampreys, and he took the slave into his own household. By a law passed in the time of Claudius, a master who exposed his sick or infirm slaves forfeited all right over them in the event of their recovery. The Lex Petronia, probably passed in the time of Augustus, or in the reign of Nero, prohibited masters from compelling their slaves to fight with wild beasts, except with the consent of the judicial authorities, and on a sufficient case being made out against the slave. Domitian forbade the mutilation of slaves. Hadrian suppressed the ergastula, or private prisons for the confinement of slaves; he also restrained proprietors from selling their slaves to keepers of gladiators, or to brothel-keepers, except as a punishment, in which case the sanction of a judge (judex) was required. The same emperor banished a lady of rank for five years on account of her cruelty to her slaves. Antoninus Pius adopted an old law of the Athenians, by which the judge who should be satisfied of a slave being cruelly treated by his owner, had power to oblige the owner to sell him to some other person. The judge however was left entirely to his own discretion in determining what measure of harshness on the part of the owner should be a proper ground for judicial interposition. Septimius Severus forbade the forcible subjection of slaves to prostitution. The Christian emperors went further in protecting the persons of slaves. Constantine placed the wilful murder of a slave on a level with that of a freeman; and Justinian confirmed this law, including within its provisions cases of slaves who died under excessive punishment. Constantine made also two laws, both nearly in the same words, to prevent the forcible separation of the members of servile families by sale or partition of property. One of the laws, dated A.D. 334, was retained by Justinian in his code. The Church also powerfully interfered for the protection of slaves, by threatening excommunication against owners who put to death their slaves without the consent of the judge; and by affording asylum within sacred precincts to slaves from the anger of unmerciful masters. A law of Theodosius I. authorized a slave who had taken refuge in a church to call for the protection of the judge, that he might proceed unmolested to his tribunal in order that his case might be investigated. After Christianity became the predominant religion in the Roman world, it exercised in various ways a beneficial influence upon the condition of the slaves, without however interfering, at least for centuries, with the institution of slavery itself. Even the laws of the Christian emperors abolishing the master's power of life and death over his slave were long evaded. Salvianus (*De Gubernatione Dei*, iv.) informs us that in the provinces of Gaul, in the fifth century, masters still fancied that they had a right to put their slaves to death. Macrobius (*Saturn.*, i., 11) makes one of his interlocutors, though a heathen, expatiate with great eloquence on the cruel and unjust treatment of slaves. In Spain, in the early period of the Visigothic kings, the practice of putting slaves to death still existed, for in the 'Foro Judicum' (b. vi., tit. 5) it is said that as some cruel masters in the impetuosity of their pride put to death their slaves without reason, it is enacted that a public and regular trial shall take place previous to their condemnation. Several laws and ecclesiastical canons forbade the sale of Christians as slaves to Jews or Saracens and other unbelievers.

The northern tribes which invaded the Western empire had their own slaves, who were chiefly Slavonian captives, distinct from the slaves of the Romans or conquered inhabitants. In course of time however the various classes of slaves merged into one class, that of the 'adscripti glebæ,' or serfs of the middle ages, and the institution of Roman slavery in its unmitigated form became obliterated. The precise period of this change cannot be fixed; it took place at various times in different countries. Slaves were exported from Britain to the Continent in the Saxon period, and the young English slaves whom pope Gregory I. saw in the market at Rome were probably brought thither by slave-dealers. Giraldus Cambrensis, William of Malmsbury, and others accuse the Anglo-Saxons of selling their female servants and even their children to strangers, and especially to the Irish, and the practice continued even after the Norman conquest. In the canons of a council held at London, A.D. 1102, it is said, 'Let no one from henceforth presume to carry on that wicked traffic by which men in England have been hitherto sold like brute animals.' (Wilkin's *Concilia*, i., p. 383.)

But although the traffic in slaves ceased among the Christian nations of Europe, it continued to be carried on by the Venetians across the Mediterranean in the age of the Crusades. The Venetians supplied the markets of the Saracens with slaves purchased from the Slavonian tribes which bordered on the Adriatic. Besides, as personal slavery and the traffic in slaves continued in all Mohammedan countries, Christian captives taken by Mussulmans were sold in the markets of Asia and Northern Africa, and have continued to be sold till within our own times, when Christian slavery has been abolished in Barbary, Egypt, and the Ottoman empire, by the interference of the Christian powers, the emancipation of Greece, and the conquest of Algiers by the French.

With the discovery of America, a new description of slavery and slave-trade arose. Christian nations purchased heathen negroes for the purpose of employing them in the mines and plantations of the New World. It was found by experience that the natives of America were too weak and too indolent to undergo the hard work which their Spanish task-masters exacted of them, and that they died in great numbers. Las Casas, a Dominican, advocated with a persevering energy before the court of Spain the cause of the American aborigines, and reprobated the system of the 'repartimientos,' by which they were distributed in lots like cattle among their new masters. [CASAS, BARTHOLOMÉ DE LAS.] But it was necessary for the settlements to be made profitable in order to satisfy the conquerors, and it was suggested that negroes from Africa, a more robust and active race than the American Indians, might be substituted for them. It was stated than an able-bodied negro could do as much work as four Indians. The Portuguese were at that time possessed of a great part of the coast of Africa, where they easily obtained by force or barter a considerable number of slaves. The trade in slaves among the nations of Africa had existed from time immemorial. It had been carried on in antient times: the Garamantes used to supply the slave-dealers of Carthage, Cyrene, and Egypt with black slaves which they brought from the interior. The demand for slaves by the Portuguese in the Atlantic harbours gave the trade a fresh direction. The petty chiefs of the interior made predatory incursions into each other's territories, and sold their captives, and sometimes their own subjects, to the European traders. The first negroes were imported by the Portuguese from Africa to the West Indies in 1503, and in 1511 Ferdinand the Catholic allowed a larger importation. These however were private and partial speculations; it is said that Cardinal Ximenes was opposed to the trade because he considered it unjust. Charles V. however being pressed on one side by the demand for labour in the American settlements, and on the other by Las Casas and others who pleaded the cause of the Indian natives, granted to one of his Flemish courtiers the exclusive privilege of importing 4000 blacks to the West Indies.

The Fleming sold his privilege for 25,000 ducats to some Genoese merchants, who organised a regular slave-trade between Africa and America. As the European settlements in America increased and extended, the demand for slaves also increased; and all European nations who had colonies in America shared in the slave-trade. The details of that trade, the sufferings of the slaves in their journey from the interior to the coast, and afterwards in their passage across the Atlantic—their treatment in America, which varied not only according to the disposition of their individual masters, but also according to different colonies, are matters of notoriety which have been amply discussed in every country of Europe during the last and present centuries. It is generally understood that the slaves of the Spaniards, especially in Continental America, were the best treated of all. But the negro slaves in general were exactly in the same condition as the Roman slaves of old, being saleable, transferable, pawnable, and punishable at the will of their owners. Restrictions however were gradually introduced by the law of the respective states, in order to protect the life of the negro slave against the caprice or brutality of his owner. In the British colonies, especially in the latter part of the last century and the beginning of the present, much was done by the legislature; courts were established to hear the complaints of the slaves, flogging of females was forbidden, the punishment of males was also limited within certain bounds, and the condition of the slave population was greatly ameliorated. Still the advocates of emancipation objected to the principle of slavery as being unjust and unchristian; and they also appealed to experience to show that a human being cannot be safely trusted solely to the mercy of another.

But long before they attempted to emancipate the slaves, the efforts of philanthropists were directed to abolish the slave traffic, which desolated Africa, wholly prevented the advance in civilization, and encouraged the maltreatment of the negroes in the colonies, by affording an unlimited supply, and making it not the planter's interest to keep up his stock in the natural way. The attention of mankind was first effectually awakened to the horrors of this trade by Thomas Clarkson. His labours, with the aid of the zealous men, chiefly Quakers, who early joined him, prepared the way for Mr. Wilberforce, who brought the subject before parliament in 1788, and although, after his notice, the motion, owing to his accidental illness, was first brought forward by Mr. Pitt, Mr. Wilberforce was throughout the great parliamentary leader in the cause, powerfully supported in the country by Thomas Clarkson and others, as Richard Phillips, George Harrison, William Allen, all of the Society of Friends, Mr. Stephen, who had been in the West Indies as a barrister, and Mr. Z. Macaulay, who had been governor of Sierra Leone, and had also resided in Jamaica. A bill was first carried (brought in by Sir W. Dolben) to regulate the trade until it could be abolished, and this in some degree diminished the horrors of the middle passage. But the question of abolition was repeatedly defeated, until 1804, when Mr. Wilberforce first carried the bill through the Commons; it was thrown out in the Lords, and next year it was again lost even in the Commons. Meanwhile the capture of the foreign colonies, especially the Dutch, during the war, frightfully increased the amount of the trade, by opening these settlements to British capital; and at one time the whole importation of slaves by British vessels amounted to nearly 60,000 yearly, of which about a third was for the supply of our old colonies. At length, in 1805 an order in council prohibited the slave-trade in the conquered colonies. Next year the administration of Lord Grenville and Mr. Fox carried a bill through, prohibiting British subjects from engaging in the trade for supplying either foreign settlements or the conquered colonies. A resolution moved by Mr. Fox, the last time he took any part in public debate, was also carried in 1806, pledging the Commons to a total abolition of the trade early next session, and this was, on Lord Grenville's motion, adopted by the Lords. Accordingly next year the General Abolition Bill was brought in by Lord Howick (afterwards Earl Grey), and being passed by both houses, received the royal assent on the 25th of March, 1807. This act prohibited slave-trading from and after the 1st of January, 1808; but as it only subjected offenders to pecuniary penalties, it was found that something more was required to put down a traffic the gains of which were so great as to cover all losses by capture. In 1810 the House of Commons, on the motion of Mr. Brougham, passed unanimously a resolution, pledging itself early next session effectually to prevent 'such daring violations of the law;' and he next year carried a bill making slave-trading felony, punishable with fourteen years' transportation, or imprisonment with hard labour. In 1824 the laws relating to the slave-trade were consolidated, and it was further declared to be piracy, and punishable capitally, if committed within the Admiralty jurisdiction. In 1837 this was changed to transportation for life, by the acts diminishing the number of capital punishments. Since the Felony Act of 1811, the British colonies have entirely ceased to have any concern in this traffic. If any British subjects have engaged in it, or any British capital has been embarked in it, the offence has been committed in the foreign trade.

The influence of Great Britain was strenuously exerted at the peace in 1814 and 1815, and afterwards at the congress of Aix-la-Chapelle, to obtain the concurrence of foreign powers in the abolition; and with success thus far, that all of them have passed laws prohibiting the traffic, and all, except the United States of North America, have agreed to the exercise of a mutual right of search, the only effectual means of putting it down. As the United States were the first to abolish the foreign trade by law, having passed their abolition act before ours, and as early as the constitution gave congress the power to do so, it is the more to be lamented that they should still refuse a right of search, which France herself has given, and should thus enable slave-traders to use their flag to a dreadful extent. The Duke of Wellington, while ambassador at Paris in 1814, used every effort to obtain from the restored government a prohibition of the traffic; but the West Indian interest, and commercial jealousy of England, frustrated all his attempts, and Napoleon, during the hundred days, on his return from Elba, first abolished the trade by law. The right of search has been most honourably granted by the revolutionary government of 1830. The History of the Abolition is to be found in the work under that title, by T. Clarkson (edition 1834), and the state of the law, as well as the treatment of slaves practically in the colonies, is most fully treated of in a work on that subject by Mr. Stephen. T. Clarkson's other works on the nature of the traffic, which first exposed it to the people of this country, were published in 1787.

The slave-trade was suppressed, but slavery continued to exist in the colonies. In 1834 the British parliament passed an act by which slavery was abolished in all British colonies, and twenty millions sterling were voted as compensation money to the owners. This act stands prominent in the history of our age. No other nation has imitated the example. Slavery exists in the French, Dutch, Spanish, and Portuguese colonies, and in the southern states of the North American Union. The new republics of Spanish America, generally speaking, emancipated their slaves at the time of the revolution. As the slave population in general does not maintain its numbers by natural increase, and as plantations in America are extended, there is a demand for a fresh annual importation of slaves from Africa, which are taken to Brazil, Cuba, Puerto Rico, Monte Video, and, it is said, clandestinely and circuitously, also to Texas. In a recent work, 'The African Slave-Trade and its Remedy,' by Sir T. Fowell Buxton (who, after Mr. Wilberforce's retirement, took a most active part in parliament on the subject of slavery), it is calculated, apparently on sufficient data, that not less than 150,000 negro slaves are annually imported from Africa into the above-mentioned countries, in contravention to the laws and the treaties existing between Great Britain and Spain and Portugal, the local authorities either winking at the practice or being unable to prevent it. But another appalling fact is, that since the slave-trade has been declared to be illegal, the sufferings of the slaves on their passage across the Atlantic have been greatly increased, owing to its being necessary for masters of slave-traders to conceal their cargoes by cooping up the negroes in a small compass, and avoiding the British cruizers; they are often thrown overboard in a chase. There is a considerable loss of life incident to the seizing of slaves by force in the hunting excursions after negroes, and in the wars between the chieftains of the interior for the purpose of making captives. There is a loss on their march to the sea-coast: the loss in the middle passage is reckoned on an average at one-fourth of the cargo; and, besides this, there is a further loss, after landing, in what is called the 'seasoning' of the slaves. At present the Portuguese and Brazilian flags are openly used, with the connivance of the authorities, for carrying on the slave-trade. The Spanish flag is also used, though less openly, and with greater caution, owing to the treaty between England and Spain which formally abolishes the slave-trade on the part of Spain. A mixed commission court of Spaniards and British exists at Havana to try slavers; but pretexts are never wanting to elude the provisions of the treaty. There seems indeed to be a great difficulty in obtaining the sincere co-operation of all the Christian powers to put down the slave-trade effectually, although it is certain that in all but the Portuguese and Spanish settlements the traffic has now almost entirely ceased.

Besides the slave-trade on the Atlantic, there is another periodical exportation of slaves by caravans from Soudan to the Barbary states and Egypt, the annual number of which is variously estimated at between twenty and thirty thousand. There is also a trade carried on by the subjects of the Imam of Muscat, who export slaves in Arab vessels from Zanzebar and other ports of the eastern coast of Africa, to Arabia, Persia, India, Java, and other places. In a despatch, dated Zanzebar, May, 1839, Captain Cogan estimates the slaves annually sold in that market to be no less than 50,000. The Portuguese also export slaves from their settlement on the Mozambique coast, to Goa, Diu, and their other Indian possessions.

By a law of the Korán, which however is not always observed in all Mohammedan countries, no Mussulman is allowed to enslave one of his own faith. The Moslem negro kingdoms of Soudan supply the slave-trade at the expense of their pagan subjects or neighbours, whom they sell to the Moorish traders. There is no likelihood that Mohammedan powers will ever suppress this trade of their own accord.

There is also a considerable internal slave-trade in the United States of North America. Negroes are purchased in Maryland and Virginia, and some other of the slave-holding states, and carried to the more fertile lands of Alabama, Louisiana, and other southern states.

It is maintained by some that the African slave-trade cannot be effectually put down by force, and that the only chance of its ultimate suppression is by civilizing central Africa, by encouraging agricultural industry and legitimate branches of commerce, and at the same time spreading education and Christianity; and also by giving the protection of the British flag to those negroes who would avail themselves of it. It is certain that if other countries will not exert themselves to enforce these laws, the abolition must be postponed to this remote period. The Africans sell men because they have no other means of procuring European commodities, and there seems no doubt that one result of the slave-trade is to keep central Africa in a state of barbarism. We refer for evidence of this, and of the nature of the traffic generally, to the numerous authorities quoted in Sir T. Buxton's book, and to the works of T. Clarkson, and Messrs. Wilberforce, J. Stephen, Brougham, and Macaulay.

The amount of the slave population now existing in America is not easily ascertained. By the census of 1835 Brazil contained 2,100,000 slaves. The slaves in Cuba, in 1826, were, according to Humboldt, about 260,000. In the United States, in 1830, the number of slaves was a little more than two millions. For more precise details we refer to the separate heads of each state, CAROLINA, GEORGIA, VIRGINIA, &c.

Societies for the ultimate and universal abolition of slavery exist in England, France, and the United States, and they publish their Reports; and a congress was held in London, June, 1840, of delegates from many countries to confer upon the means of effecting it. The American Society has formed a colony called Liberia, near Cape Mesurado, on the west coast of Africa, where negroes who have obtained their freedom in the United States are sent, if they are willing to go. The English government has a colony for a similar purpose at Sierra Leone, where negroes who have been seized on board slavers by English cruizers are settled. [SIERRA LEONE.]

SLAVONIA is a province of the Austrian dominions, which, though incorporated with the kingdom of Hungary, is still styled in official documents the kingdom of Slavonia. It is situated between 44° 50′ and 46° 12′ N. lat., and between 17° and 20° 40′ E. long It is bounded on the west by Croatia, on the north and east by Hungary, and on the south by Turkey. It is separated from Hungary by the Drave and the Danube, from Turkey by the Save, and has the Ilowa on part of the western frontier. It consists of two parts, the province of Slavonia, and the Slavonian part of the Military Frontier. The area of the whole is 6600 sq. miles, and the population is 598,800. The province has an area of 3570 square miles, divided into the three counties of Posega, Veröez, and Sirmium, with 348,000 inhabitants. A chain of high mountains coming from Croatia traverses the province. Where this chain enters the province the valleys are narrow, but they gradually become more open towards the middle of the province, and form near Posega a wide plain bounded by lofty mountains, which is called the Posega Valley; but at the eastern frontier of this county, the branches of the mountains again join in one principal chain, which covers all the northern part of the county of Sirmium. This chain is covered with vast forests. The highest points are 2800 feet above the surface of the three principal rivers. The remaining part of Slavonia consists partly of fertile eminences planted with vines and fruit-trees, and partly of beautiful and extensive plains. But as many tracts of land on the Save and Drave are very low, they are subject to be frequently overflowed, and there are several large and small pieces of stagnant water, and extensive marshes. Many of these are presumed to have been formed through neglect, and some have already been drained and cultivated. The country produces corn of all kinds, hemp, flax, tobacco, and great quantities of liquorice. There are whole forests of plum-trees: chesnut, almond, and fig-trees are likewise found, and the white mulberry abounds. Slavonia is rich in useful domestic animals. The horses are of a small race, and sheep are not numerous. Of wild animals, the bear, wolf, fox, pole-cat, and vulture are common. Swarms of troublesome insects are bred in the marshes, and a long continuance of southerly winds sometimes brings locusts from Turkey. The only minerals of which there are considerable quantities are sulphur, limestone, coal, salt, and iron. It may be said that there are no manufactures in Slavonia. The peasant makes all his farming implements—his cart, his plough, &c., and his wife and daughters weave the cloth and knit the stockings for the family. The anonymous author of the 'Geographical and Statistical Description of Hungary, Croatia, and Slavonia,' says that wheat yields 20-fold and sometimes 30-fold, and that one grain of maize yields 2000. In so fertile a country agriculture and the breeding of cattle are the most profitable occupations of the inhabitants. The culture of silk is flourishing. The quantity of wine produced is very large, especially in the county of Sirmium, where the vine was planted in the third century by the soldiers of the emperor Probus: about 560,000 eimer (the eimer is 10 gallons) are produced in one year in that county. The wines, both red and white, are very fiery, but will not keep long, and are therefore not fit for exportation. The export trade is confined almost entirely to the natural productions of the soil, such as corn, swine, and oxen to Austria; tobacco to Italy, France, and Belgium; spirits, distilled from plums, to Hungary, Turkey, and Germany; silk to Ofen; honey, wax, liquorice, gall-nuts, and raw hides to Austria and Italy; pipe-staves and wooden hoops are sent to Hungary; some salt and oil are also exported; and Peterwardein has a considerable trade in fruit.

*Religion and Education.*—The inhabitants are Roman Catholics and Non-united Greeks; the latter are the most numerous, in the proportion of about five to three. Till 1827, the law excluded Protestants from Slavonia, though it made an exception in favour of those who were settled in the country in 1791. There are now two flourishing Protestant communities in Old and New Panza, consisting of about 3500 persons; and a few Jews, mostly in Peterwardein, and about 300 in Semlin. There are about 30 Roman Catholic schools in the province, and as many in the Military Frontier; and two Roman Catholic gymnasia at Essek and Posega. The Non-united Greeks have an archbishop at Carlowitz, where there is a flourishing lyceum. There is likewise a clerical school at Carlowitz, and another at Pakratz. In the archbishopric there are above 260 national schools.

The earliest known inhabitants of Slavonia were the Scordisci; it was afterwards inhabited by the Pannonians, who were subdued by Augustus. The country was afterwards part of Pannonia Inferior, and was called Pannonia Savia. The emperor Probus, who was a native of Sirmium, did much to improve the cultivation of the country, and caused the first vines to be planted in the year 270. Subsequently, several portions of Slavonia were detached from the Byzantine empire; but Sirmium continued to belong to it, even when the whole country was a prey to the Avari. When the Avari were overpowered, in 796, by Pepin, the father of Charlemagne, the greater part of Pannonia Savia was a desert, and Charlemagne afterwards allowed a Slavonian tribe living in Dalmatia to settle in it. The first settlers were soon followed by others, and the Slavi (or Slavonians) soon became a numerous people, who in the time of the emperor Louis the Pious had their own prince, named Lindewit, subject however to the Franks. In 827 the Bulgarians invaded the country, but were repulsed by the Franks. The Slavonians had indeed been partially converted to Christianity on their first settling, but as they fell into gross ignorance for want of instruction, two brothers, Cyrillus and Methodius, went in 864 to visit the Slavonian tribes in the west, and to instruct them. In the tenth century, the Magyars, having conquered all Pannonia, afterwards subdued Slavonia also; Sirmium however still remained subject to the Byzantine empire, but by degrees became independent, and had its own princes. In 1019 it was again, for a short time, subject to Byzantium, and continued for many years the theatre of war between the Byzantines and the Hungarians; the latter ultimately got possession of it, till it was finally ceded to the Hungarians in 1165. In 1471 the Turks invaded Slavonia for the first time. In 1524 the whole country was conquered by the Turks, to whom the counties of Valpo, Posega, Veröez, and Sirmium were ceded in 1562, and erected by them into a distinct pashalik. It was recovered by the emperor Leopold I., and after having been for a long time the theatre of war, was ceded to Austria by the treaty of Carlowitz in 1699. The country having become almost a desert while under the Turks, numbers of Illyrians were settled in it. In 1690 and the following years the country was placed under a military administration; the inhabitants were exempted from taxes, but were bound to arm themselves, and be always ready for the defence of the country. This military administration was abolished in 1745, but in later times it has been again introduced under a better form, which is chiefly confined to the tract along the Turkish frontier.

The Slavonian Military Frontier (including what is called the district of the Czaikist Battalion, between the Danube and the Theis) has an area of 3030 square miles and 250,000 inhabitants, and is divided into the three regimental districts of Peterwardein, Brod, and Gradiska, and the Czaikist district. [Essek; Military Frontier; Peterwardein; Semlin.]

(*Oesterreichische National Encyclopedie; Statistisch-Geographische Beschreibung des Königreichs Ungarn, Croatien, und Slavonien*; Stein; Hassel; Hörschelmann.)

SLAVONIANS. The Slavonian or Slavic race, which now extends from the Elbe to the Pacific, and from the northern ocean to the frontiers of China, Persia, and the Mediterranean, comprehends about 70,000,000 inhabitants, divided into several nations, who speak various cognate dialects, and live within the dominions of Russia, Austria, Turkey, Prussia, and Saxony. The name 'Slavonian' is deduced from the word *slava*, 'glory,' or *slovo*, 'word.' The advocates of the first etymology support it by referring to the usual termination of Slavonian names in *slav*, such as *Stanislav*, 'establisher of glory;' *Vladislav*, 'ruler of glory;' and *Yaroslav*, 'furious for glory.' Others maintain that the name of Slavonians, which is often written *Slovenie* instead of *Slavenie*, is derived from *slovo*, 'word,' and that the Slavonians being unable to understand the language of the nations with whom they came into contact, called them *Niemetz*, that is, 'mute,' an appellation which is given to the Germans in all the Slavonian dialects, whilst they called themselves Slovenie, that is, 'men endowed with the gift of the word.' The Byzantine writers changed the appellation of Slavonians into Sclaben or Sclav (Σκλαβηνοί, Procopius); and hence the appellation of Sclavonians, adopted by the western authors.

According to Jornandes, the first writer who mentions the Slavonians, they were formerly called Venedi; and Pliny (iv. 13) says that they lived about the banks of the Vistula. Ptolemy places them on the eastern shore of the Baltic, which he calls the Venedian Gulf. This is the oldest account that we have about the country inhabited by the Slavonians; but whence and when they came to these parts is unknown. Jornandes gives the following account of them:—'Dacia is secured by Alps (*i.e.* Carpathian), on whose left side, which from the source of the Vistula runs to the north through an immense extent, the nation of the Winidi have their settlements. Although their names vary in various tribes and places, they call themselves Slavonians and Antæ.' Jornandes also says that this nation was conquered, A.D. 376, by Hermanarik, king of the Goths; and he says in another place, 'These, as we have said, proceed from the same blood, and have three names, Venedi, Antæ, and Slavonians, who for our sins are now ravaging everywhere' (*i.e.* in the Roman empire).

The evidence of Jornandes proves that the Venedi, Antæ, and Sclavini or Slavonians were the same race, although they may have formed separate tribes or nations, as the Bohemians, Poles, and Russians of our days; and we may add that the Slavonians of Lusatia and Saxony are even now called Vendes by the Germans.

The Slavonians appeared on the borders of the empire about A.D. 527, and having invaded the Greek provinces committed terrible ravages. The Imperial legions were defeated by them, and the wall erected by the emperor Anastasius to arrest the savage tribes of the north was forced by the Slavonians, who devastated all the country from the Ionian Sea to the walls of Constantinople. They besieged the capital itself, and nobody dared to encounter them. Belisarius at last succeeded, more by presents than force, in removing this dangerous enemy from Constantinople. After that time they settled on the banks of the Danube, alternately ravaging the provinces of the empire or serving in its armies. The Slavonians were conquered in the sixth century by the Avari, with the exception of those who were settled on the Danube, and who, in the year 581, invaded the empire. The emperor Tiberius, who was occupied at that time with the Persian war, was unable to repel the Slavonians, and he induced the Khan of the Avari to attack them. The power of the Slavonians was destroyed, and they were obliged to submit to the Khan. After that time they served in the wars of their new master, and the Greeks experienced their desperate valour when the Avari besieged Constantinople in 629, on which occasion the Slavonians nearly carried the town.

The Slavonians who inhabited the vicinity of the Baltic remained free, while their brethren of the south were under the yoke of the Avari. This yoke was at last broken by the Slavonians of Bohemia, who rose against their oppressors, and defeated them under the command of a chieftain called Samo, who was chosen king by his grateful countrymen. The emancipation of the Slavonians from the dominion of the Avari was followed by an extension of their possessions. In the seventh century, having concluded an alliance with the emperors of Constantinople, they entered Illyria, and after having expelled the Avari, they founded new colonies under the name of Slavonia, Croatia, Servia, Bosnia, and Dalmatia. The Greek emperors favoured their settling in the Imperial provinces. In the seventh century there were Slavonian settlements on the river Strymon in Thrace, in the vicinity of Thessalonica, and in Moesia, or the modern Bulgaria. Many of them settled in the Peloponnesus, and a considerable number passed into Asia and settled in Bithynia and other provinces.*

From this time the Slavonians are no longer historically known under that general appellation, but they continued to take a prominent part in political affairs under the various denominations by which the nations belonging to that race are distinguished, as Poles, Russians, Bohemians, &c.

The customs, religion, and language of the Slavonian race are still characterised by a family likeness, which is preserved in the numerous nations which have sprung from the same stock, notwithstanding the modifications produced in the respective nations by local circumstances and historical events.

Procopius (*De Bello Goth.*, iii.) gives the following account of the Slavonians: 'The nations of the Slavonians and Antæ do not obey a single master, but live under a democratical government; therefore the gains and losses are common amongst them, and all other things go in the same

* At the same time Christianity began to spread among them. The sixth synod of Constantinople (A.D. 680) enumerates the Slavonians among the Christian nations.

way. They acknowledge as god and as the lord of all their nation the maker of the thunder, to whom they offer oxen and other sacrifices of every kind. They do not acknowledge fate, and do not even admit its influence on mortal men; and when they apprehend, in sickness or trouble, a speedy death, they vow to God some bloody sacrifice for their health or safety; and believe, when they come out of danger, that they did so in consequence of their vow. They worship also river-nymphs and some other divinities, to whom they offer sacrifices, making at the same time divinations. They live in miserable huts, standing isolated, and they change their settlements. In a battle many of them fight on foot, armed only with a small target and a lance. They do not wear any armour, and they have not even a shirt or a cloak; but they encounter the enemy only in breeches covering the secret parts. They all speak the same very barbarous language, and do not differ much in their exterior. Their complexion is not very white, and their hair is neither fair nor black, but dark. They lead, like the Massagetæ, a rude and wandering life, and they are always dirty. Their mind is neither malicious nor fraudulent, and they preserve, with the simplicity, the manners of the Huns in many things. Formerly the Slavonians and Antæ had the same name; both were called Spori, probably because they live in a scattered manner (sporaden) in isolated huts, and they occupy for that reason a large extent of country. They possess the greatest part of the farther banks of the Danube. According to some they feed their flocks wandering about.'

This description shows that the Slavonians then lived in a state of barbarism. They were inured to every kind of fatigue and privation, and accustomed to all the expedients of a savage warfare. These qualities made them formidable enemies and invaluable allies to the Greeks. They were rapacious, like all savage tribes, but the cruelty with which they were taxed may be partly ascribed to the provocation of the Greeks, who frequently treated their vanquished enemies with great barbarity. But the Slavonians exhibited, notwithstanding their state of barbarism, virtues of the noblest kind, and a mildness of character unparalleled even among the civilised nations of that time. According to the emperor Mauritius, they treated their prisoners with great humanity, and instead of keeping them in servitude like other nations, they always fixed a limit to it, and gave them the choice of paying a ransom and returning to their country, or remaining with them as freemen and friends. A stranger was welcome among them, and hospitably entertained. The houseowner was answerable to all his nation for the safety of the stranger whom he had received; and he who had not preserved his guest from injury drew upon himself the vengeance of his neighbours.

The matrimonial fidelity of the Slavonian wives and husbands is extolled by foreign authors. The wives were complete slaves, as is generally the case amongst uncivilised nations: the widow was burnt on the same pile with her deceased husband, as it was disgraceful to survive him. It is also said that a Slavonian father might destroy a female child, when he was already overcharged with a large family, but he might not put a male child to death; and that the children might put their parents to death, when from old age and infirmity they were a burthen to them. Their chief occupation was agriculture. They seem to have possessed some knowledge of the arts, and they were exceedingly fond of music. The most antient musical instrument of the Slavonians is a kind of lyre called *gusla*, which is still preserved among some nations of their race.

Although the Slavonians who appeared on the borders of the Greek empire were rude and uncivilised, those who lived on the southern shores of the Baltic had towns and enjoyed the advantages of a considerable commerce. Their chief cities were Arcona, on the island of Rügen, which contained the most celebrated fane of their worship, and Vineta, at the mouth of the river Oder. Adam of Bremen, who wrote in 1067, and Helmold, state that all the Slavonians were idolaters, but that no nation was more hospitable and honest than they; that the original form of government was democratical, that the fathers of families had great authority over their wives and children, and that they met together occasionally to consult on the affairs of their community. With the progress of time, and probably also from the necessities created by their coming into contact with more civilised nations, the Slavonians introduced permanent authorities and chiefs. Aristocracies were formed, either by military leaders, or by the more wealthy and cunning persons, who succeeded in establishing an hereditary influence. Many Slavonian communities came under the rule of hereditary chiefs or sovereigns; others elected their chiefs for life; whilst many retained their primitive democratic form, somewhat modified by circumstances. The Slavonian chiefs were called Kral or Krol, which signifies king. Kniaz or Knez, is now employed for prince; Boyar, a warrior, from Boy, fight; Lekh, or noble; Voyevoda, *i.e.* leader of war, perhaps a more modern translation from the Saxon heretog, or German herzog; Pan, in Polish, lord; Zupan, the chief of a district, Zupa. All these dignities, whether hereditary or elective, by no means implied absolute authority, and the persons holding them were always subject to the popular will, which decided on public affairs in the assemblies, which were held in the open air, and called *Viecha* or *Vieche*, probably from the Slavonian word *vieshchat*, 'to proclaim.'

The religion of the antient Slavonians seems to have been different from that of the Teutonic nations. The latest account of the Slavonian idols and pagan rites is given by the German missionaries, who had an opportunity of observing the Slavonians of the Baltic coast, or at least derived information on that subject from eye-witnesses, as well as by some Scandinavian authors.

According to the above-mentioned authors, the Slavonians of the Baltic acknowledged two principles, one of good, and the other of evil. They called the former Biel Bog, or the 'white god,' from whom all that was good proceeded; and the second Cherni Bog, or 'black god,' who was the cause of all evil. This latter was represented in the form of a lion. The most celebrated Slavonian idol, whose temple was at Arcona, was Sviatovid, that is, 'holy sight.' He was held in great veneration by the Slavonians, and even the kings of Denmark, who then professed Christianity, frequently sent him offerings. This idol represented a man larger than life, dressed in a short garment made of many-coloured wood. He had two chests and four heads. He stood with his feet on the ground, held in one hand a bow, and in the other a horn, which was filled once every year on a solemn occasion with mead. Near the idol were placed, as belonging to him, a bridle and saddle, and a sword richly ornamented with silver. His festival was celebrated on a certain day after harvest, when the priest brought out to the assembled multitude the horn which the idol held in his hand, and from the decrease of the liquid poured into it the year before the result of the next harvest was prognosticated. The mead of the last year was poured at the idol's feet, and his horn was replenished, with appropriate ceremonies and prayers. The remainder of the day was spent in feasting; abstemiousness on that day was considered sinful, and the greatest excess in drinking and eating was accounted an act of devotion.

The Slavonians paid a tax to the temple of the idol, and gave him the third part of their booty. There were also three hundred horsemen belonging to the idol, who deposited in his temple all the spoils that they made. These different donations were employed to ornament the temple, or deposited in the treasury, which contained a great number of chests filled with coin, rich stuffs, and other precious things. There was a white horse consecrated to the same idol, which was led and mounted only by the priest. The Slavonians believed that Sviatovid occasionally rode upon this horse, in order to combat the enemies of their faith; and its moving with the right or left foot over lances placed on the ground, decided the most important undertakings. The temple of Sviatovid was destroyed in the twelfth century by Waldemar, king of Denmark. Some German chroniclers believe that Sviatovid was the same as St. Vitus, whom the Slavonians had adopted after having heard of his great miracles; but this is evidently an error founded on the similarity of names.*

There were also several other divinities worshipped by the Slavonian idolaters, such as Porenut, whose idol had four faces, and a fifth on his breast, supposed to have been the god of seasons, from the word *pora*, 'season;' Porevit, represented with five hands; Rughevit, supposed to be the god of war, whose idol had seven faces, seven swords suspended at his side, and an eighth in his hand. All these three were in the island of Rügen, the last asylum of Slavonian idolatry.

This account of the Slavonian deities is founded, as already observed, on the report of writers who had either seen the

* The most detailed account of Sviatovid and his worship is given by Saxo Grammaticus.

idols or derived their information from hearsay. The only genuine monuments of Slavonian idolatry which have reached our times are the idols dug up about the end of the seventeenth century in the village of Prillwitz, on the banks of the lake Tollenz, in the territory of Mecklenburg. This village is supposed to occupy the site of the Slavonian town of Retra, which was destroyed by the Saxons in the middle of the twelfth century, and was celebrated in its time for its temples and idols. These archæological treasures remained unknown to the learned world till 1771, when Mr. Masch, chaplain of the duke of Mecklenburg, published a description of them with engravings. These antiquities were found in two metal vessels, supposed to have served for sacrifices, and which were so placed that one formed a cover to the other: they had engraved on them several inscriptions, but unfortunately they were both melted for the casting of a bell before they were examined by any person competent to judge of the inscriptions. The contents of these vessels were not only idols, but also several objects employed in the performance of sacrifices. They are all of brass, with more or less admixture of silver. The greatest part of them have inscriptions in Runic characters: one of them however, exhibiting the attributes of autumn, has the Greek inscription ΟΠΩΡΑ. The greater part of these idols have Slavonian names, such as Radegast, Cherni Bog, Zibag, &c. (Bog in Slavonian signifies God); several of them however have Lithuanian names, and must belong to the Lithuanian and Prussian idolaters, who probably sought refuge among the Slavonians from their common enemies the Christians. Both Slavonian and Lithuanian idols correspond to the descriptions given of them by the old chroniclers. The Slavonian divinities usually have more than one head: many of them have on some part of their body either a human face, signifying the good principle, or a lion's head, denoting the evil principle. Many have also the figure of a beetle on them, which might denote an Egyptian origin. They are in general only a few inches long.

The chief Slavonian divinities represented by these idols are Radegast, having the head of a lion, surmounted by a bird; Woda, represented as a warrior, perhaps the Scandinavian Odin, &c.

These monuments of Slavonian idolatry present a wide field for investigation, and they prove that the nation with whose religious worship they are connected was not a stranger to the arts. It is difficult to ascertain whether the divinities of Lithuanian and Scandinavian origin, which were foreign to the Slavonians, were adopted by them, or only found an asylum with their worshippers when expelled from their countries by the progress of Christianity.

The eastern Slavonians worshipped Perun, or the god of thunder; Volos, the god of the flocks; Koleda, the god of festivals, whose festival was celebrated on the 24th of December, and it is remarkable that the common people in many parts of Poland and Russia on that account even now call Christmas, Koleda; Kupala, the god of the fruits of the earth, received sacrifices on the 23rd of June, and in many parts of Russia and Poland, St. John, whose festival falls on the same day, is called John Kupala. Dittmar, a German writer, pretends that the pagan Slavonians did not believe in the immortality of the soul; but this statement is sufficiently refuted by several customs and ceremonies which they observed for the repose of the dead.

In the ninth century the Slavonians occupied a large part of Eastern Europe. They extended from the Black Sea along the Danube and to the westward of that river on the shore of the Adriatic, occupying the antient Roman provinces of Pannonia, Dacia, Illyricum, and Dalmatia. The Slavonian settlements reached from the northern part of the Adriatic bordering on the Tyrol and Bavaria to the upper part of the Elbe, and they occupied the country between that river and the Saal, as well as all the right bank of the Elbe, extending over the southern shore of the Baltic from Jutland to the mouths of the Vistula. From the Vistula (with the exception of the coast of the Baltic inhabited by another race) the Slavonians spread over all the country between that river and the Danube. Thus they possessed the countries which now constitute the greater part of the Austrian dominions, Hungary, the provinces bordering on Italy and the Tyrol, Bohemia and Moravia, a great part of Saxony, the March of Brandenburg, Silesia, Pomerania, and the island of Rügen, to which must be added the territory which constituted antient Poland, and a great part of the present Russian empire.

The Slavonian population of Pomerania, Mecklenburg, the island of Rügen, the March of Brandenburg, and of Saxony, on the left bank of the Elbe, was either exterminated or so completely Germanised, that the language of their country is completely superseded by the German; but there are traces of this language being used in official documents in the country about Leipzig as late as the beginning of the fourteenth century. The names of many towns and villages situated in those parts of Germany are evidently of Slavonian origin.

The following are the Slavonian nations now in existence:—

1. The Bohemians and Moravians, who inhabit Bohemia and Moravia, and are scattered in some parts of Hungary and Silesia.

2. The Poles, who inhabit the territory of antient Poland, Silesia, and Prussia.

3. The Muscovites or Great Russians, who have a considerable admixture of Finnish blood, and have become somewhat orientalised by the dominion of the Tartars in Russia. They inhabit the north-eastern provinces of Russia in Europe.

4. The Russians, who are quite distinct from the Great Russians or Muscovites, are divided into Little Russians, who inhabit the antient Polish provinces of the Ukraine, Podolia, and Volhynia, now incorporated with Russia, a part of the kingdom of Poland, Gallicia or Austrian Poland, and some parts of Northern Hungary; and White Russians, who inhabit a part of Lithuania, and chiefly the provinces of Mohilof and Witepsk, which were acquired by Russia at the first dismemberment of Poland, in 1772, as well as a part of the government of Smolensk.

5. The Slovacks, who inhabit the north of Hungary.

6. The Croats, who inhabit the south-west of Hungary.

7. The Illyrians, who inhabit the Austrian provinces of Carinthia, Carniola, and Dalmatia.

8. The Servians, who inhabit Servia, to whom may be added the Montenegrins.

9. The Bulgarians and Bosnians in Turkey, of whom a part have embraced Mohammedanism, while others profess the Christian religion according to the Eastern church.

10. The Syrbes or Wends, who inhabit Lusatia, and whose settlements are about 25 miles from Dresden.

*Slavonian Tongue.*—It has been observed that Procopius, who described the Slavonians in the fifth century, says that they and the Antæ used the same language, and a similar opinion is expressed about the Slavonians of the eighth century, by Eginhard, the historian of Charlemagne. It is however impossible to admit the perfect universality of the same language among a race composed of so many tribes, and occupying such a vast extent of country. The evidence of the writers above mentioned, who have not transmitted to us any monument of the Slavonian language, and probably did not understand it, cannot be admitted as conclusive, except to prove that all the Slavonians, who were divided into various tribes or nations, could easily understand each other. The truth of this fact cannot be doubted; for notwithstanding the lapse of ages, during which many Slavonian nations have remained completely isolated from several of their kindred populations, and have lived in constant intercourse with nations of an entirely foreign race, their respective dialects preserve a strong similarity, so that a Slavonian inhabiting the shores of the Frozen Sea may frequently understand the language of those who live on the coasts of the Adriatic. This fact is moreover corroborated by the circumstance that the monuments of the different Slavonian languages, though written several centuries ago, exhibit a much greater similarity among themselves than is the case with those languages in our time. We may therefore conclude that at some unrecorded period all the Slavonian race had the same tongue, which began to split into different dialects at the same time when the race, increasing in numbers, began to divide into various tribes; and that the differences among those dialects grew in the same proportion as the surrounding tribes who spoke them became more estranged from each other by physical, political, and religious causes. The Slavonian tongue is generally considered to have an Indian origin, and this supposition is founded on the great number of Sanscrit roots which it contains, as well as on some traces of a similar origin exhibited in the religion of the antient Slavonians, of which the most striking circumstances are the burning of widows on the funeral pile of their deceased husbands, the idol of Sviatovid, represented with four heads, and other resemblances of a like kind. The most antient written Slavonian language is that into which Cyrillus and Methodius translated the Scriptures in the ninth century, and which must have been the dialect of the Slavonians who inhabited the banks of the Danube, for whom this translation was made from the Septuagint, and for which an alphabet, formed on the model of the Greek one, was introduced by the translators.

Although the above-mentioned alphabet was adopted for the translation of the Scriptures, it is impossible to admit that the Slavonians were, previously to their conversion to Christianity, totally unacquainted with the use of letters, and indeed the Bohemian chronicles speak of legislative tables (deski pravodatne) in the seventh century. (Palatzky, *Geschichte von Böhmen*, vol. i., p. 182.) The antient Slavonian name for a wizard (*czarnoknijnik*), signifying one occupied with black books, leads to the supposition that the antient Slavonian conjurors made use of certain writings in performing their incantations. Martinus Gallus speaks of Polish chronicles previous to the introduction of Christianity, which were destroyed by Christian missionaries. Dithmar of Merseburg, who wrote in the eleventh century, positively states that the Slavonian idols had inscriptions on them, a statement fully confirmed by the discovery of the monuments of the antient Slavonian worship found at Prillwitz. It is true that the above-mentioned inscriptions were Runes borrowed from the Scandinavians, and one of them was Greek, which may lead to the conclusion that the Slavonians employed foreign characters, but they tend to show that they were not strangers to the art of writing.

The conversion of the south-eastern Slavonians by Greek missionaries was a circumstance highly favourable to their national language, as the Eastern church left to the newly converted nations the use of the vernacular tongue in the performance of divine service, instead of introducing the Latin, as was the case with the Western church. The conversion of the majority of the Slavonians was effected principally by the exertions of Cyrillus and Methodius. As early as the seventh century a great number of Slavonians has been converted to Christianity, and were followers of the Eastern church. This seems to have been particularly the case with those who had settled within the confines of the Greek empire, whilst those who lived beyond its borders remained either in a complete state of idolatry or exhibited only some individual conversions. Among the Slavonian states of that time, the most important was that of Grand Moravia, which must however not be confounded with the province that now bears this name: it extended over part of Hungary and some adjacent countries, and it was converted, though it appears rather nominally than really, about the beginning of the ninth century, by the missionaries of the West; for the Papal records prove that Moravia about 820-830 was under the spiritual authority of the archbishop of Passau. Nestor, a monk of Kief, one of the oldest Slavonian chroniclers, says that the princes of Moravia sent, about 863, a message to the Greek emperor Michael, stating that their country was baptised, but that they had no teachers to instruct the people and to translate for them the sacred books, and accordingly they requested him to send them men capable of performing such a task. The emperor complied with their request, and sent them the two brothers named Cyrillus and Methodius, natives of Thessalonica, who were distinguished by their learning as well as piety, and possessed a thorough knowledge of the Slavonian tongue.

The missionaries, having arrived in Moravia, translated the Scriptures, or at least a part of them, into the Slavonian tongue of the country; they also invented the letters, which, being called the Cyrillic alphabet, are still used, with some few variations, by the Slavonians who follow the tenets of the Eastern church, who also employ in the performance of divine service the same Slavonian idiom into which the Scriptures were translated, and which is now become the sacred tongue of those nations. Cyrillus and Methodius, having completed the translation, established the worship in the vernacular language, founded schools, and organised everything necessary for the promotion of the Christian religion. They extended their labours beyond the frontiers of Moravia, and converted Bohemia, A.D. 873. It is even supposed that they visited Poland, and there can scarcely be a doubt that their disciples were active in that country.

The apostolical labours of Cyrillus and Methodius took place during the time of those disputes between the patriarch of Constantinople and the pope of Rome which led to the final separation of the Eastern from the Western church. Among many causes of dispute, the dominion over the newly converted Slavonian nations formed an important subject of contention between Rome and Constantinople. Cyrillus and Methodius, although they introduced among their new converts the rites of the Eastern church, and the worship in the vernacular tongue, acknowledged the supremacy of the pope, and not that of the Greek patriarch, as is evident from the approbation of their proceedings, which they sought and obtained from pope John VIII., before whom they were accused of deviating from the line of conduct followed by Roman missionaries in the conversion of pagan nations.

The confirmation granted by pope John VIII. to the national mode of worship introduced by Cyrillus and Methodius, was rather a concession extorted by circumstances, and particularly by apprehension lest the missionaries, in case of refusal, should transfer their obedience from Rome to Constantinople, than a real approbation of the use of the vernacular language in the divine service, a principle considered by the Western church as prejudicial to its polity, the object of which is not only unity of dogma, but also uniformity of ritual; and indeed although some successors of John VIII. assented to the Slavonian mode of worship, they constantly endeavoured to abolish it, or at least to limit its use. This tendency became much stronger when the final separation between the Eastern and the Western churches removed the reasons which the latter had for conciliating the nations that were wavering between the two churches. Rome declared an unrelenting hostility against every ritual which deviated from that which it had established, and the council of Salona, held in 1060, proclaimed Cyrillus a heretic, and his alphabet a diabolical invention. The kingdom of Grand Moravia was destroyed by the pagan Hungarians about the middle of the tenth century, and the Slavonian population either fled to other countries inhabited by their own race, or remained under the yoke of their conquerors, who, having embraced Christianity from the Western church, promoted the papal views as to the Slavonian worship. In Bohemia the same worship struggled for some time against the Roman ritual, till its last stronghold, the convent of Sazava, was abolished in 1094, and the Slavonian books were destroyed by the zealous promoters of the Roman ritual. In Poland, where Christianity was established in 966 by Bohemian priests, when the national mode of worship was still prevailing in that country, and where Christianity had partly penetrated, even before its final triumph, from Moravia and Greece, the same mode of worship struggled for some time against the Roman ritual, and seems to have been continued in some parts as late as the fourteenth century.

The Slavonian service and the use of the Cyrillic letters, which were completely superseded by the Latin worship and letters among the Slavonians who followed the Western church, remained in full vigour among those who belonged to the Eastern church. This was the case with the Servians and other Slavonians of the Danube, the population of Muscovy, and of many provinces of Lithuania and Poland. And it is moreover used by the Wallachians, who inhabit Moldavia, Wallachia, and several parts of Hungary, although their language is derived from the Latin and has only a slight admixture of the Slavonic. Several Slavonian nations, which had originally followed the Eastern church, but submitted to the supremacy of Rome after the union of Florence, were allowed to retain the Slavonian liturgy and the use of the Cyrillic letters. The most antient manuscripts written in the Cyrillic alphabet are the gospel of Ostromir, written in 1056, which is preserved at St. Petersburg, and a Sbornik, or collection of religious tracts, of the year 1073, now at Moscow. An inscription in the same letters, preserved in a church at Kief, is supposed to date from the reign of Vladimir the Great. The first printed works with the same characters are a book of prayers, entitled 'Oktoikh,' &c., printed at Cracow in 1491, and another work of a similar description, at Venice in 1493.

Besides the Cyrillic letters, there is another alphabet used by some Slavonian populations of Dalmatia and Illyria, which is called the Glagolite character, and the use of which, as well as of the liturgy in the Slavonian language, has been allowed by the Roman see to these nations. The invention of that alphabet has been ascribed to St. Hieronymus, a native of Dalmatia, but this origin of the Glagolite letters, probably invented by their advocates in order to gain the approbation of Rome, cannot stand the test of historical criticism, as St. Hieronymus lived in the fourth century, being born A.D. 331, in Dalmatia, while the Slavonians settled in that province only in the seventh century. Many Slavonian scholars supposed that the Glagolite alphabet was comparatively a modern invention, and that it was nothing more than the Cyrillic, disguised by some alterations and the addition of superfluous ornaments. This opinion was supported by the circumstance that the oldest monument of the above-mentioned characters was a Psalter written in the thirteenth century, and their invention was considered on that account to be of no earlier date. The same opinion seemed to be corroborated by the fact that it was only in 1248 that Pope Innocent IV. permitted the use of the Slavonian liturgy, and of those letters which they had from St. Hieronymus, to those nations that had still retained them. This theory about the Glagolite alphabet, which was combated by many Slavonian scholars, has been recently overturned by the learned Kopitar, librarian of the Imperial Library at Vienna, one of the first Slavonian scholars of our time. He has proved, from a manuscript written in the Glagolite characters, that the Glagolite character was coeval with the Cyrillic, if it was not more antient. This manuscript, which was long considered to be an autograph of St. Hieronymus, is of a very antient date, and belongs to Count Cloz, in the vicinity of Trento. The lovers of Slavonian antiquity may consult Kopitar, *Glagolita Clotzianus, &c.*, Vienna, 1836.

It has been said that the liturgy in Slavonian with the use of the Glagolite letters was approved by Pope Innocent IV. in 1248. A Slavonian missal was printed in these characters, at Venice, in 1483. In the tenth century, when a revision of the Roman missal and breviary was made by the order of the popes, the same measure was extended to the Slavonian missal, and the congregation *De Propaganda Fide* intrusted that task to a Franciscan monk, Raphael Levakovich, a native of Croatia; but as he was not completely master of the sacred Slavonian tongue, he called to his assistance Terletzki, a Greek bishop of Lutzkn in Poland, who, having subscribed the union with Rome at Brest in Lithuania, in 1576, came to Rome. Terletzki replaced many words which he could not understand, by others employed in the Slavonian liturgy of the Greek churches in Poland and Russia, by which the original text was spoiled. The Slavonian missal thus revised was printed at Rome, 1631-1648. Another revision was made by Rastricius, a Dalmatian clergyman, who spoiled it still more by substituting modern words for those which he could not understand. It was printed in 1688-1706. The third and last revision of the Slavonian missal, published in 1741-1748, was made by Mathias Caruman, a clergyman of Dalmatia, who, having remained for some time at St. Petersburg, and acquired a thorough knowledge of the Russian language, disfigured the missal still more by introducing into it many Russian idioms, so that the missal became less intelligible to the inhabitants of Illyria and Dalmatia, for whom it was designed, than it had been before.

Except the populations of Dalmatia and Illyria, who, as we have just said, have retained the Slavonian liturgy and the use of the Glagolite characters, all the other Slavonian nations which were converted by the Western church adopted the Latin alphabet.

The sacred Slavonian tongue, having been originally the dialect of the Slavonians who inhabited the banks of the Danube, cannot be justly regarded as the mother tongue of all the Slavonian dialects now extant; we shall therefore give its characteristics in speaking of the Slavonian languages in general. It continued to be employed for some time in the composition of sacred books, as well as chronicles among the Slavonian nations who adhered to the Greek church, and particularly the Russians, but we shall have an opportunity of mentioning it hereafter in speaking of the literature of those nations.

*General Characteristics of the Slavonian Languages.*—The Slavonian languages are distinguished by the richness of their vocabulary, which consists not only in the great number of words, that is, a great quantity of synonymes, but also in the number of inflexions, both at the beginning and the end of words, which gives a facility of creating from one radical word an extraordinary number of derivatives. By the simple prefixing of the letters s, z, v, w, the verb acquires a different signification. The great facility with which the Slavonian languages receive new forms and additions is chiefly owing to their manifold declensions and their numerous tenses and participles, and they excel in that respect all the modern languages of Europe. The declensions, of which there is a great variety, are formed by the inflexion of the termination, and without any articles. The participles possess a great pliability by uniting in themselves the advantage of verbs and adjectives, and denoting as verbal adjectives at once the quality of the thing and the determination of the time, thus saving the use of relatives, as who, which, and prepositions, as after, since. This circumstance gives them a great conciseness, which is increased by the absence of auxiliary verbs. Another advantage of the Slavonian languages is their great facility of compounding words: it is possible to form from native roots all the scientific words which the languages of Western Europe have derived from the Greek and Latin. These languages contain not only diminutives to express small objects, and which are also used as terms of endearment, but likewise augmentatives, to express a thing of a larger size than usual. They have the patronymic which is formed by the addition of *wich*, answering to the Greek *ides*. There are also frequentative and inceptive verbs. The verbs are conjugated without the use of pronouns, which adds considerably to the conciseness of these languages, and the preterits of the third person singular and plural designate the sex by a variation in the last syllable. Many prepositions and much circumlocution of different kinds are saved by the use of the instrumental case corresponding to the ablative. The Slavonian languages have the dual number. They have several preterit tenses and many future ones, &c. It may be easily concluded from what we have said of the Slavonian languages that they must possess great expressiveness and energy, and that they are able to represent every object of imagination and of passion, as well as all the higher emotions of the poet and the orator, in a manner not inferior to any modern language, and superior to many; and that they are eminently fit for the translation of the classics. We must also add, that the Slavonian languages possess every sound contained in other languages, except the English *th*.

*Russian Language and Literature.*—The Russian language may be divided into three dialects. 1. The dialect of Great Russia, or Muscovy, which, since the time of Peter the Great, has been formed into the present literary language of Russia, and is subdivided into the minor dialects of Novgorod, Suzdal, and Rezan. The dialect of Great Russia is distinguished from other Slavonian languages by the admixture of some words and sounds of a Finnish origin, as the population which speak this dialect partly came from some Finnish tribes that were absorbed by the Slavonians. It also contains many Oriental words, which were introduced under the Tartar dominion, but these words have generally their Slavonian synonymes. 2. The dialect of Little or Southern Russia is spoken by the population of the Ukraine, the antient Polish provinces of Volhynia and Podolia, as well as that of Gallicia, or Austrian Poland. It differs from the dialect of Great Russia not only in many expressions, but also in many turns and grammatical forms, which often rather resemble those of the Polish language than the above-mentioned dialect. It is perhaps the softest of all the Slavonian dialects; it is full of picturesque expressions, and its diminutives, used as terms of endearment, have a peculiar sweetness. The national songs and ballads of the population who speak this dialect, are distinguished by great depth of feeling, and their music, although composed by simple peasants, is generally very beautiful. It was cultivated under the dominion of Poland, which continued for many centuries, and it may be regarded as a provincial dialect of that country. 3. The dialect of White Russia is now spoken by the population of the governments of Mohileff, Witepsk, and Smolensk, as well as some adjacent districts. It is less harmonious than the dialect of Little Russia. It is considered by philologists as being of high antiquity, and it was the official language of Lithuania till the latter part of the seventeenth century; the code of that country was originally composed in it.

The present literary language of Russia participates in all the merits of the other Slavonian languages; and it has been enriched by its authors, who have introduced many new words, either from the Slavonian sacred tongue or formed from its own roots. It is more harmonious than many other Slavonian languages, being richer in vowels, a peculiarity which is ascribed to the influence of the Finnish language, which is characterised by an extraordinary softness.

The history of the Russian language and literature may be divided into two great periods, one comprising the time before the reign of Peter the Great, and the other the period since his reign. The first period may be subdivided into three: the time from the introduction of the Christian religion in the tenth century, to the establishment of the dominion of the Tartars in the thirteenth; 2, the time from the dominion of the Tartars, or from the middle of the thirteenth to the middle of the fifteenth century; and the 3rd, from that time to the reign of Peter the Great, or the end of the seventeenth century. The written language of the first period is the Slavonian sacred tongue, into which the Scriptures were translated by Cyrillus and Methodius. The most remarkable author of that period is Nestor, a monk of the cavern convent at Kieff,* who was born in 1056, and who is the first chronicler of Russia and the father of Russian history. He was evidently a learned man. He knew Greek, and was acquainted with the Byzantine writers, from whom he translated and inserted into his chronicles several passages. He collected his information from tradition, and possibly from some now unknown records. He was much indebted to the narrative of his fellow monk Ian, who died in 1106, at the age of ninety-one, and was consequently born one year after the death of Vladimir the Great, who died in 1015, and must have known many persons who were witnesses of the great event of the establishment of the Christian religion in Russia by Vladimir in 988-9. Nestor also described many events which happened in his own time. His style is an imitation of that of the Bible, and he often makes the individuals who are the subjects of his history speak in the first person, as is the case in the historical books of the Old Testament. His Chronicle was continued after his death in 1116, by Abbot Sylvester, till 1123. Two other monks continued it till 1203. It has gone through many editions, and it has been often translated. The best translation is the German, with a valuable Commentary, by the learned historian Schlözer, Göttingen, 1802-4, in five volumes. After Nestor's Chronicle, the most remarkable literary monument of that period is the last will, or instructions to his children, of the grand-duke Vladimir, who was surnamed Monomachos, after his maternal grandfather the emperor Constantine Monomachos, and died in 1125. It contains precepts of Christian morality and of government; and it gives us an insight into the state of learning of that period, which seems to have been more advanced among the higher classes in Russia than in Western Europe. He says, when recommending his children to seek for information, 'My father remaining at home, that is, not having travelled, spoke four languages, for which we are praised by foreigners.' These last words imply that the knowledge of foreign languages was common at that time in Russia, but it is impossible to know what those languages were. We may however suppose that Greek was studied by the clergy, who were continually coming from Constantinople to Russia, and that the Scandinavian was cultivated by the higher classes, as the Russian princes, being sprung from a Norman stock, had at that time considerable intercourse with Sweden and Norway. Vladimir married, about 1070, Gida, daughter of Harold, the last Saxon king of England, who had retired to Sweden after the death of her father.

Several theological works of this period still exist. The most remarkable are two Epistles of Nicephorus, metropolitan of Kieff. There is also a description of a Journey to Jerusalem a few years after its conquest by the first crusaders, by a Russian abbot named Daniel. The only extant poetical production of that period is the poem of the 'Expedition of Igor.' It is written in poetical prose, and describes an unfortunate expedition against the nomadic nation of the Polovtzi, or Comanes, by Igor, a petty prince of Novgorod Severrski, in 1182. It contains much fine poetical imagery, and though written at a time when Christianity was completely established, the author introduces into his poem the gods of the Slavonian mythology, which leads to the supposition that the traditions of that mythology still lived in the national poetry. It appears, from the apostrophe to the different princes of Russia, to have been written immediately after the event had taken place which forms the subject of the poem. This precious monument of antient Russian literature was discovered, in 1796, by Count Moossin Pushkin. There have been several translations of it into the present Russian, as well as into Bohemian, Polish, and German. The code of laws given by the grand-duke Yaroslaf to Novgorod belongs to the same period, during which Russia enjoyed comparatively a high degree of civilization, owing to the influence of Byzantine literature, science, and art. Besides Vladimir Monomachos, many other princes and princesses are mentioned as having cultivated and encouraged learning, and libraries are spoken of as containing Greek and Latin manuscripts.

The progress of this civilization was stopped by the invasion of the Tartars, who established a reign of ignorant barbarism in the north-eastern principalities of Russia, and separated them completely from the rest of Europe. The clergy still continued to maintain some intercourse with Constantinople, but the Greek empire was rapidly declining, and the few learned men whom it produced were averse to visit a country which was under the yoke of barbarians. The customs of the country were orientalized, as the inhabitants adopted many things from their Tartar masters. The clergy, who were much favoured by the Tartars, did not take advantage of their position in order to cultivate learning or establish schools. They composed however several spiritual works, and some chronicles in the sacred Slavonian tongue. There are also extant some stories translated from the Greek during that period; as, for instance, of Alexander the Great from Arrian, on the heroes of antiquity, the rich Indies, &c. The popular songs on historical subjects, particularly on the times of Vladimir the Great, are supposed to have been composed during the same period by the people, who solaced themselves during their oppression by the traditions of better times. There were however several authors in this period. Cyprian, metropolitan of Russia, who died in 1406, was a native of Servia, and brought with him to Moscow a great number of Slavonian manuscripts. He composed and translated several spiritual works, and made a collection of Russian laws. Demetrius, probably a monk, translated, towards the end of the fourteenth century, from the Greek, the poem of George Pisides, metropolitan of Nicomedia (who lived in the seventh century), entitled the 'Creation of the World.' This translation was such an uncommon event, that the chronicles of the time mention it as such. The Diaconus Ignatius, who accompanied the metropolitan Pimen on his journey to Constantinople in 1389, left a detailed description of that journey. Sophronius, a clergyman of Rezan, towards the end of the fourteenth century, wrote a poetical description of the invasion and defeat of the Tartars, under Mamay, in 1380. A merchant of Tver, called Nikitin, went, about 1470, to the East Indies, and left a diary of his travels. It neither displays particular talent for observation, nor does it contain much information, but it is interesting, as it shows the route which was then followed by the commerce from Europe to India.

*Third Period · from the Termination of the Tartar domination to Peter the Great.*—Soon after Muscovy had been liberated from the yoke of the Khans, it begun to have some intercourse with the west of Europe. The marriage of the grand-duke Ivan III. with the Greek princess Sophia Palæologus, who had resided at Rome, contributed greatly to the increase of that intercourse and the progress of civilization in Muscovy. Many Greeks who accompanied the princess Sophia brought valuable Greek manuscripts. The Venetian architect Fioravanti Aristoteles built several churches, the Kremlin, and some other palaces at Moscow. Foreign artists cast cannon and bells, and coined money. Under Ivan's son Vassili the intercourse with Europe increased, and embassies were sent and received from several states. Under Ivan Vassilevich the Terrible (1534-84) a civil and an ecclesiastical code were composed, commercial intercourse was opened with England, and a printing-press was established at Moscow. Boris Godoonoff [GODOONOFF] was a great promoter of learning: he designed to establish at Moscow a university with foreign professors, but this project was defeated by the opposition of the patriarch, who feared that such an institution might be dangerous to the orthodoxy of his church. Boris patronised learned foreigners, and paid an immense sum to the tutor of his son.

* There are at Kieff extensive caves filled with bodies of saints, and known under the name of 'pechers,' or caverns, to which a convent is attached, called after the name of the cavern.

to whom he was giving a European education. A general map of the Muscovite dominions was also made by his orders. The events which agitated Muscovy after the death of Godoonoff, put a stop for some time to all improvement, but when tranquillity was restored, after the accession of Michael Federovich (1613-45), the course of improvement was resumed. Many foreigners were taken into the service of the Czar, and Greek and Latin schools were established in the house of the Patriarch in 1643. Under Alexey Michaelovich several manufactures were introduced, and a regular communication with western Europe was opened by the establishment of the German post, which carried letters twice a week from Moscow to Riga and Vilna, but there was no such accommodation for the interior. Several foreign books were translated; of which the most remarkable is one on military science, printed at Moscow, in 1644. A German newspaper was regularly translated for the Czar, but his foreign office seems not to have profited much by the information, for the credentials of the embassy which was sent by the Czar, in 1662, to Madrid, were directed to Philip IV., who had died two years before. The number of foreign officers was increased, and some regular troops were formed after the European fashion; but the most remarkable event of that reign is the *Ulojenie*, or code of laws, which was formed by order of the Czar, and printed at Moscow in 1649. The acquisition of Kieff, which possessed an ecclesiastical academy, founded under the Polish dominion [Russian Church], favoured the progress of learning among the Russian clergy. Under Fedor Alexeyvich (1676-88) a Græco-Latino Slavonian academy was founded at Moscow on the model of that of Kieff. The great map of Russia made under Godoonoff was revised and improved. During the regency of the princess Sophia (1682-89), Prince Galitzin, who was her principal minister, introduced many European refinements and luxuries into his house, and his example was imitated by other grandees.

The Slavonian language continued to be used in all ecclesiastical compositions, as well as by the chroniclers, but the common dialect of Moscow began to be adopted in all official acts of the government. At the same time the dialect of White Russia, which was the official language of Lithuania, was penetrating to Moscow, and there are several diplomatic notes addressed by the grand-dukes to foreign princes, which contain an admixture of that dialect, and even many Polish words. In the sixteenth century, and at the beginning of the seventeenth, the works of St. Ambrosius, Augustinus, Hieronymus, and Gregory, as well as the 'History of the Twelve Cæsars,' by Suetonius, were translated into Slavonian. Some tales written in a mixture of the Slavonian and the common dialect of Moscow belong to that period. Joseph, Hegumenos or abbot of a convent at Volokolamsk (died in 1516), became celebrated by his writings and personal exertions against the Jewish sect of Raskolnichi. [Russian Dissenters.] Part of his works were printed in the collection of materials for Russian history, entitled 'Antient Russian Bibliotheca.' His contemporary Gennadius, archbishop of Novgorod, an equally zealous persecutor of the above-mentioned sect, wrote several pastoral exhortations on the same subject. Macarius, metropolitan of Moscow (died in 1564), is the author of the lives of several saints. The annals known under the name of 'Stepennaya Kniha,' that is, the graduated book, were composed under his superintendence, and indeed the authorship has been ascribed to him. They are so called because they are divided into chapters, each of which contains the reign of one sovereign, and is called a grade. Maxim, a Greek monk of the convent of Mount Athos, and a man of great learning, who had studied at Paris, Florence, and other places in Western Europe, came to Moscow by the desire of the Czar Vassili Ivanovich, in order to revise the corrupted text of the sacred books used in Muscovy [Russian Church], and to arrange the Greek manuscripts which were in the possession of the Czar. It is said that he was astonished at the value and rarity of some of those manuscripts. He made a complete catalogue of them, and presented to the Czar a list of those sacred works which had not yet been translated into the Slavonian tongue. The Czar commissioned him to translate the commentaries on the Psalter, and gave him two translators and two copyists to assist him. After a labour of seventeen months, Maxim presented to the Czar his translation, which was received with much approbation by the metropolitan and all the clergy. He wished to return to his convent on Mount Athos, but he was persuaded to remain at Moscow, in order to revise the text of the sacred books, which had been corrupted by ignorant copyists. He devoted nine years to that important labour, but the favour of the Czar and the reputation which he had acquired excited great jealousy, and created enemies, who accused him of falsely expounding the Scriptures. He was confined in a convent in 1525, where he died in 1536, and his pupils shared his fate. He was engaged till his death in the composition of theological, philosophical, and ethical works; among others, he wrote in Slavonian a dissertation on the utility of grammar, rhetoric, and philosophy, which was an extraordinary performance at that time.

A monk called George composed a Russian chronicle, which reaches to the year 1533. Two merchants, called Korobeinikoff and Grekoff, were sent in 1583 by the Czar Ivan Vassilevich to distribute alms in different holy places of the East for the soul of his son, whom the Czar had murdered in a fit of passion. They visited Constantinople, Antioch, Jerusalem, Alexandria, Mount Sinai, and some other places, and kept a diary of their journey, which has been printed. Prince Kurbski, descended from a branch of the Ruric, or reigning house of Muscovy, and related to the Czar Ivan Vassilevich the Terrible, was born in 1529, and was one of his boyars and principal generals. He distinguished himself at the capture of Kasan in 1553, and in several other campaigns; but in 1564 he was obliged to seek refuge from the tyranny of his monarch in Poland, where he was kindly received by king Sigismund Augustus, who granted him estates. In his exile he devoted himself to literature and learnt Latin. He wrote the reign of the Czar Ivan Vassilevich, and the campaigns in which he himself had taken a part. This work is one of the most valuable contributions to the history of that period. He also wrote several letters to the Muscovite prince, upbraiding him for his tyranny, and proving by the Scriptures and the works of the antients that his conduct was very bad. Ivan Vassilevich answered all these letters, endeavouring to convince Kurbski, particularly by passages of Scripture, that it was he who was in the wrong, and that he had no right in any case to rebel against his sovereign.

In the seventeenth century the following authors deserve notice: Abraham Palitzin, abbot of the celebrated convent of Troytza or Trinity, distinguished himself by his patriotism in the year 1612, and left a description of the siege which the convent sustained against the Poles. Kubassov wrote a chronological universal history, beginning with the creation of the world. Epiphanius Slavinetski, a native of Poland, after having studied at Kieff and other academies, adopted the monastic life in Kieff. He was called to Moscow in 1649, by a boyar of the name of Rtishchef, in order to translate theological works from Greek into Slavonian, and he translated several of the works of St. John Chrysostomus, Gregory of Nazianzus, Basilius the Great, and other fathers of the church, which were printed at Moscow in 1664-65. He also made a complete Greek-Slavono-Latin Dictionary in two volumes, and a Philological Lexicon, or a comparison of passages of the Greek fathers. He was commissioned in 1664 by the Patriarch and the Czar to make a new version of the Scriptures from the Greek into Slavonian, but he was prevented by death from accomplishing that important work. Simeon of Polotsk, a native of that city in Poland, studied in his native country and in some foreign universities, and having become a monk, he went to Moscow in 1667, where he was appointed by the Czar Alexey Michaelovich tutor to his son Fedor. He wrote many poems, which were much praised at the time, although they are no longer readable. He was also the first who introduced the practice of writing sermons for his congregation, which was already usual with the Greek clergy of Poland. It had hitherto been the custom in Muscovy only to read sermons selected from ecclesiastical authors and approved by the patriarch. Sylvester Medveyeff, a pupil of Simeon of Polotsk, and abbot of a convent at Moscow, wrote many polemical works; but being suspected of a tendency to Romish doctrines, he was deprived of his clerical dignity, and confined in a convent; in 1691, being accused of participation in the revolt of the Strelitz, he was executed. He left several poems. Prince Shakhovski lived in the first part of the seventeenth century. Having fallen into disgrace with the Czar Michael Fedorovich, he was confined in a convent, where he composed epistles on religious subjects, of which the most remarkable is an Epistle on the orthodox faith to the highest Shah Abbas, king of Persia and Media, addressed in the name of the

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high archbishop and servant of God, the most holy Patriarch Philaret Nikitch. In this epistle he expresses his thanks for a relic, a supposed fragment of the garment of Jesus Christ, sent by the Shah to the Czar, and exhorts him to embrace the Christian religion.

The conquest of Siberia brought the court of Moscow in contact with China and some states of central Asia. An ambassador named Baykoff was sent to Pekin in 1654, and returned in 1658; he left a very curious description of his embassy, which has been translated into several foreign languages. A Cossack of Siberia named Petlin explored in 1620 the course of the river Oby, and wrote a description of his journey.

The first attempts at dramatic representations appeared in Russia about the middle of the seventeenth century. They were introduced from Poland by the students of the ecclesiastical academy of Kieff, who were used to perform plays on Scriptural subjects in Polish, Slavonian, and the dialect of Little Russia. They performed these plays during the vacation time in several towns of Russia, and they were finally introduced at Moscow by Simeon of Polotsk, whom we have mentioned. In 1676 German actors performed before the Czar Alexey plays taken from Scriptural history accompanied with ballets. The Princess Sophia, the eldest sister of Peter the Great, was very fond of theatrical amusements, and wrote several dramas, which she performed with her court.

*The Second Period of Russian Literature: from Peter the Great to the present time.*—It is unnecessary to expatiate on the civilization which Peter the Great introduced into Russia. He established many primary schools in different parts of his dominions, and a military and naval school at St. Petersburg. He sent young Russians abroad to study the various sciences and arts; he took into his service many foreigners of talent, collected books, cabinets of natural history, and got together philosophical instruments. A new alphabet, simplified from the old Slavonian, formed, as it is said, by himself, was introduced; but the language made no great progress from the state in which it had been during the preceding reign, and it was inundated with many foreign words introduced under Peter's reign, who showed perhaps too much predilection to everything foreign. Among the most remarkable authors of his time is Theophan Prokopovich, archbishop of Novgorod, a native of Kieff, but educated in Poland. He wrote many works on divinity, politics, and history, as well as sermons, orations, and some poetry. His works display considerable talent, notwithstanding their barbarous style. He also wrote in Latin, and his style in that language is much better than his Russian. Stephen Javorski, metropolitan of Rezan, a native of Leopol in Poland, and Demetrius, metropolitan of Rostov, a native of the environs of Kieff, who was canonized after his death, wrote many works on theological subjects. Gabriel Bushinski, bishop of Rezan, translated some of the works of Puffendorf and other authors, relating to history and politics. Kopievich, a native of Lithuania, studied in Holland, and passed from the Greek persuasion to Protestantism. He became pastor at Amsterdam. Peter the Great, during his visit to that city having been acquainted with Kopievich, gave him a commission to compose school books and other useful works in the Russian language. Accordingly he wrote and translated many books on several literary and scientific subjects, which were printed at Amsterdam. Prince Chilkoff (died in 1718) wrote an abridged history of Russia, which was used in schools, but has since been superseded by other works. Great service was rendered to primary instruction by Ernest Glück, a Lutheran clergyman of Livonia, who, being taken by the Russians, was employed by Peter the Great in establishing a school at Moscow for the children of burghers. He published many school-books, and among others, the 'Orbis Pictus' of Comenius.

Peter's successor, Catherine I., founded the Academy of Sciences at St. Petersburg, which was projected by her predecessor. Its object was to prepare teachers for public schools, to publish useful works, and to collect all kinds of information about Russia. The imperial physician Blumentrost was appointed president; and many learned foreigners, as De Lille de la Croyere, Bernoulli, Bayer, and others, were nominated members. The academy established a high school for the formation of teachers, caused many scientific treatises to be written, and promoted geographical discoveries. De Lille de la Croyere accompanied Behring on his expedition in the Pacific Ocean, and died from the hardships of the voyage. A great number of classical authors, Greek and Latin, were translated and published under the superintendence of the academy; but these translations, being made in a language which was not yet formed, and published at a time when they could scarcely find any readers, did not contribute to the progress of literature, and they found few purchasers. The reign of the empress Anna was not favourable to the national literature. The court, which was governed by Biren, imitated everthing that was foreign, and showed the greatest contempt for all that was national. These circumstances had a very unfavourable effect on the national language and literature, although Lomonossoff was preparing a salutary revolution towards the end of that reign. A favourable change took place under the empress Elizabeth, who was a great patroness of science and literature. The Academy of Sciences was enlarged by the addition of a section of arts, and its income increased in 1747, and in 1752 the University of Moscow was established on the proposition of Count Shoovaloff,* a distinguished patron of learning; and it was by the exertions of the same nobleman that the Academy of Arts for painting, sculpture, and architecture was founded. Geographical knowledge was also advanced by the discoveries which some Russian adventurers made in the Pacific.

Among the principal authors of this period was Prince Antiochus Kantemir, son of the hospodar, or reigning prince of Moldavia, who removed to Russia with all his family during the expedition of Peter the Great into that principality. He was born at Constantinople in 1708, and was educated at Kharkoff and Moscow, under the superintendence of a Greek clergyman, and also of his father, who was himself a learned man. Antiochus made such progress, that when he was only ten years old he wrote a Greek panegyric on St. Demetrius, which was read in a church. Owing to his extraordinary talents and high rank he obtained rapid preferment. In 1731 he was nominated Russian minister at London, where he remained till 1738, in which year he was transferred in the same capacity to Paris, where he remained till his death in 1744. He wrote eight satires, which were published at St. Petersburg in 1762; but translated into French during the author's lifetime. His language and versification belong to the old school; but in his satires he displays great power of observation, and such genuine wit, that they are still read with pleasure. He also left a translation of Horace's 'Epistles,' Fontenelle's dialogues on the 'Plurality of Worlds,' and a great many other translations from the classics, as well as from French and Italian writers. Living in constant intercourse from 1731 to 1744 with the first wits of London and Paris, Prince Kantemir's works contain ideas and opinions which belong more to those seats of European refinement than to Russia, and consequently he cannot be considered as truly national. Lomonossoff Trediakowski (Basil), born at Astrakhan in 1703, studied at the university of Paris under Rollin, and travelled in many parts of Europe. In 1733 he was nominated secretary of the academy of St. Petersburg; and in 1745 appointed by a ukase professor of eloquence: he died in 1769. Trediakowski possessed considerable learning, but more industry than talent. He wrote several works on the principles of literary composition, and a great many poems; but his versification is cumbrous, and his language so little pleasing, that the empress Catherine II. enacted, in the humorous code which she made for her own immediate society, that the transgressors of certain regulations should be condemned to read several pages of Trediakowski's poem 'Telemachida,' which was a versified translation of Fenelon's 'Telemachus.' He translated many foreign works, chiefly on history: as an instance of his indefatigable industry we may mention, that after having completed the translation of Rollin's 'Antient History' in 26 volumes, the manuscript was destroyed by fire, upon which he again translated the 26 volumes, which were published at St. Petersburg (1744-67). Tatishcheff (Basil), born of an antient family in 1686, was one of those young men who were sent in 1709 for their education by Peter the Great to different parts of Europe. He acquired a good deal of scientific information, and became thoroughly conversant with the German and Polish languages. On his return home he was employed in many offices of great importance. In 1724 he was sent on a secret mission to Sweden; in 1734 he was in-

* Count Shoovaloff is known in French literature by his 'Epître à Ninon,' which was ascribed to Voltaire before the real author was known.

vested with the supreme direction of the mines of Siberia; and in 1740 he was appointed governor of Astrakhan. It was there that our countryman Jonas Hanway, who speaks much of him, made his acquaintance. He died in 1750, holding the rank of a privy councillor. During his travels in Russia he diligently collected all kinds of information relating to that country, and acquired a rich store of materials for its history and geography. His principal work is a history of Russia, from the most antient times to the year 1462. He spent thirty years on this work, which was written amidst his multifarious official avocations: it is, in fact, a comparative chronicle; the author having procured several copies of different chronicles, compared them, and made a comment on them by extracts from various foreign authors which related to the same subject. The manuscript of this work was kept for some time in the archives. The empress Catherine II. ordered its publication, which was done under the care of Gerhard Müller, in 1764-74. It is much to be regretted that the chronicles and other materials on which Tatishcheff founded his work were destroyed by fire. He occupied himself with the composition of a complete geography of Russia, and a map of Siberia was made by his exertions, and published by the Academy of Sciences, in 1745, in 20 sheets. He also wrote an 'Historical and Political Lexicon of Russia,' which he completed to the letter L, and which was published in 1793.

Stephen Krashennikoff, professor of botany to the Academy of Sciences (1713-1755), became known all through Europe by his 'Description of Kamtchatka,' which was published at St. Petersburg in 1755. He was sent by the academy, with Steller, to examine this country, where he remained for many years, collecting the information which enabled him to produce a work of considerable merit, and which was translated into several languages.

The creation of a national drama in Russia dates from this reign. This honour belongs to Alexander Soomarokoff (1718-1777). He was educated partly in the house of his father, who was a general officer, and partly in the military school of St. Petersburg. The study of Corneille, Racine, and other French dramatic writers, awakened his talents, and he began to write tragedies about the year 1740, which were performed by the pupils of the military school, in the presence of the empress Elizabeth, who in 1756 nominated the author director of the court theatre. Soomarokoff wrote many tragedies, the best of which is 'The False Demetrius,' which has been translated into French and English, and also several comedies and operas. He was also the author of various minor poems, and numerous essays and dissertations in prose, on various subjects. Soomarokoff enjoyed during his lifetime, and some time afterwards, a great reputation, which has however declined, and his works are now little read. His dramatic productions are all imitations of the French school, and notwithstanding they display considerable talent, they are characterised by great affectation, and his heroes and heroines are never true to nature. His language also is now become obsolete.

Dramatic art in Russia begins with Volkoff, the son of a merchant of Kostroma, who learned German, painting, and music at Moscow. He established, with some other young men, a little theatre at Yaroslav, where they performed the dramas of Demetrius, bishop of Rostov. At St. Petersburg he saw the performances at the Italian court theatre, and he diligently studied its organization. Having thus improved his knowledge of the dramatic art, he returned to Yaroslav, where, with the assistance of some friends, he established a theatre, which contained a thousand spectators, and of which he was not only director and first performer, but also machinist and painter. Several young men of talent, as Popoff Dmitresski and others, joined Volkoff, whose reputation reached the court at St. Petersburg, where the plays of Soomarokoff were performed by the pupils of the military school. He was invited to court in 1752, and in 1756 an imperial ukase established a Russian theatre, of which Soomarokoff was appointed director, and Volkoff the first actor. He died in the prime of life, in 1763, but the pupils whom he had formed greatly contributed to the improvement of the national drama. Periodical literature also originated under the same reign. The first literary journal, which was entitled 'The Monthly Magazine for Utility and Amusement,' was edited by Gerhard Müller, and all the Russian authors of that time were contributors. In 1759 appeared the 'Industrious Bee,' edited by Soomarokoff.

The reign of Catherine II. was favourable to the civilization of Russia in many respects. Ambitious of every kind of distinction, she courted the applause of Voltaire and other French philosophers of that school, and these dispensers of reputation extolled the liberal and enlightened sentiments of that princess, notwithstanding her share in the destruction of Poland, and her continual invasions of the Turkish dominions, which were hailed by the same adulatory philosophers as so many steps towards the progress of the civilization of mankind; yet although the execution of Catherine's political schemes of aggrandizement was often stained by great atrocities, Russia is much indebted to her for encouraging literature and learning. The military and naval schools were enlarged and improved. A mining school was established in 1772, and it is still one of the best educational institutions in Russia. The University of Moscow and the Academy of Arts were enriched and enlarged. Several of the most distinguished members of the Academy of Sciences, as Pallas, Georgi, Richkoff, and others, were commissioned to undertake scientific travels in various parts of the Russian empire, and their researches contributed not only to extend the knowledge of that country, but also to the progress of science in general. A Russian Academy which had for its object the improvement of the Russian language was established on the plan of the French Academy, and it published a dictionary of the Russian language, a grammar, and other useful works of a similar description. The Society of the Friends of National Literature and History, established in connection with the university of Moscow, did great service. A commission for the organization of public schools was appointed, and it founded a seminary for teachers at St. Petersburg, one high school and twelve preparatory schools, and published under its superintendence many school-books. New schools, high as well as primary, were opened in several towns of the empire. Institutions for the education of the females of noble and burgher families were founded at St. Petersburg, where a number of pupils are maintained and educated free of expense, while others are admitted on the payment of a moderate sum. There were also established an agricultural society, a surgical school, and other useful institutions.

The Russian language, which is chiefly indebted to Soomarokoff for its improvement, was greatly enriched in this reign by the creation of new words from Slavonian roots, which were substituted for other words of a foreign origin: many new scientific terms also were introduced. Its grammatical construction was better developed, the versification was rendered more harmonious, and the style in general greatly improved by being purified from foreign expressions and idioms, which abound in the works of the authors belonging to the preceding period. Many literary periodicals were started, and some of them were continued with considerable success. The censorship of the press was remarkably liberal, and it seems indeed that Catherine, intoxicated with the flatteries of the French philosophers, entirely overlooked the tendency of their works, which were dangerous to such a government as hers. Many political works, such as those of Montesquieu, Delolme, Hume, Robertson, and Rousseau's 'Contrat Social,' were translated into Russian, and printed. This liberality was also extended to many productions of an immoral and irreligious tendency, and several works of this description, by Voltaire, Diderot, Rousseau, and others, were published in Russia. The effect of such works, in such a state of society as that of Russia, could not be very salutary.

Michael Kheraskoff (1733-1807), curator or supreme director of the university of Moscow, wrote the 'Rossiad,' an epic poem in twelve cantos, which describes the conquest of Kazan; and 'Vladimir, or the establishment of the Christian religion,' also an epic poem, in eighteen cantos. These two productions are considered his best, although they are far from having any real claim to the name of epic. His other poems are, 'The Pilgrims,' in six cantos, a production which displays much entertaining variety, and is written in various metres; 'The Fruits of Science,' a didactic poem; 'The Universe;' and 'The Battle of Chesme,' &c. Kheraskoff also wrote several novels, the subjects of which were taken from Greek and Roman history, and some dramas. The number of his productions, which is more than twenty, attests his great industry, and they show that he had considerable information; but the same praise cannot be extended to his poetical and creative talents. Basilius Petroff (1736-1799) was the son of a clergyman, and was educated in the ecclesiastical academy of

Moscow. He attracted the notice of Catherine II. by an ode on her coronation in 1763, and was appointed a translator of the imperial cabinet, and reader to the empress. He afterwards visited England, where he resided for some time, and after having travelled in other countries, he returned to St. Petersburg, where he was appointed librarian to the empress. The delicate state of his health compelled him, however, to abandon a career in which he might have expected rapid preferment, and he retired in 1780 into the country, where he devoted himself to literary pursuits and agriculture, visiting Moscow every winter, for the sake of the library. As one instance of his industry, we may mention that he learned modern Greek at the age of sixty. A complete edition of his works, in three volumes, was published at St. Petersburg in 1811: they consist of odes written on several solemn occasions, and epistles addressed to different persons. He also made a metrical version of the 'Æneid,' which was published in 1781-86. Petroff's poems are characterised by genuine animation and energy of thought, expressed in a concise and powerful manner, and he would have equalled Lomonossoff if his style had not been so rough; though some of his odes are free from that reproach, and are written in flowing and harmonious verses.

Hippolyte Bogdanovich (1743-1803) was born in the Ukraine, and educated in a school at St. Petersburg. In his fifteenth year, by frequenting the theatre and reading plays, he became so enamoured of the dramatic art, that he addressed himself to Kherashoff, who at that time superintended the theatre of Moscow, and requested to be received as an actor. Kherashoff, who was struck with the talents of the boy, dissuaded him from this design, and taking him into his house, made him continue his studies at the university of Moscow, where he made rapid progress. He was afterwards employed in the foreign department, and was secretary of the Russian embassy at Dresden (1766-68). After his return to St. Petersburg, he continued in the civil service till 1795, when he settled in the country. Bogdanovich began to write poetry when he was seventeen, and when he was twenty he edited a literary periodical called the 'Innocent Amusement:' he displayed considerable talent in several minor poems, particularly by a very successful translation of Voltaire's 'Ode on the Destruction of Lisbon.' His poetical fame was established by his 'Dooshinka,' or 'Little Soul,' an exceedingly successful translation of La Fontaine's 'Psyche.' This poem, which not only equals, but in some respects surpasses the original, is still one of the most popular productions of Russian literature.

Gabriel Derjavin (1745-1816) was born at Kazan, and belonged to a family of Tartar origin, as appears from his frequent allusions to such a descent. He was educated in the military school of the engineers, and served in the army till 1779, when he passed into the civil service. He was governor of Olonetz and then of Tambov (1784-1791), and afterwards successively secretary of state, president of the college of commerce, treasurer of the empire, and finally minister of justice. In 1803 he left the public service, and lived till his death chiefly on his estate of Zvanka, in the government of Novgorod. Derjavin is undoubtedly the first Russian lyric poet, a distinction which he has earned by the boldness of his imagery, the harmonious flow of his versification, and the happy turns of his expressions. He created many new words, and restored several that were either obsolete or considered as unsuitable to a higher style; but although these innovations proved very successful with Derjavin, they produced a contrary effect with his imitators. The faults of his style are frequent inequalities: a sublime passage is followed by lines of a very inferior description, and his imagination hurried him away to the neglect of the rules of art and good taste. Although he flattered the monarch in his poems, many of them contain very bold truths. The most remarkable productions of Derjavin are his 'Ode to God,' which was translated into several languages; 'To Felitza,' a name under which he addressed Catherine; 'On the Death of Prince Meshcherski;' 'The Cataract;' 'The Autumn,' &c.; and a great number of Anacreontics. He wrote also several prose works, but none of them equal his poetical productions. Several of his poems have been translated into English by Dr. Bowring, in his 'Russian Anthology.'

Basilius Kapnist was born in the Ukraine, of a distinguished family of that province, where he possessed large estates. He received an excellent education, and wrote several compositions of considerable merit when he was very young. The Ukraine, which after its separation from Poland had submitted to Russia, on condition that she should preserve all her privileges, which constituted a kind of self-government under the protection of Russia, gradually lost those rights, and was finally converted by Catherine into a Russian province. On that occasion Kapnist wrote an elegy, entitled 'Slavery,' in which he paints in animated colours the calamities resulting from the loss of liberty. He wrote a great number of poems, but his reputation was established by his comedy entitled 'Yabedniki,' that is, the Chicaneries of Law. In 1823 Kapnist died, at a very advanced age, on his estate in the government of Pultava. Kostroff (died in 1796) translated the 'Iliad,' from the original Greek; the 'Golden Ass' of Apuleius; and the Poems of Ossian. He also made some other translations from the French. Bobroff (died in 1810) became chiefly known by his 'Khersonide, or a Summer Day in the Crimea,' which has been translated into English by Dr. Bowring. His poetic style, formed chiefly from a deep study of the best English authors, has much feeling and animation, but he is frequently obscure, and sometimes degenerates into bombast. Neledinski Meletzki is the author of songs and romances, which are characterised by much tenderness and feeling; they are set to music, and are very popular among the ladies of Russia. Barkoff (died in 1768) translated the 'Epistles' of Horace, the 'Fables' of Phædrus, and many other works. He became universally known by his witty poems, which however are disfigured by extreme licentiousness. Prince Dolgoruki wrote epistles and other poems, in a popular style, on philosophical and moral subjects. His works have gone through several editions, the last of which is that of 1819. Chemnitzer was born at Moscow, of German parents, in 1744. He died in 1784, as Russian consul at Smyrna. He wrote fables, which, owing to their great simplicity and natural ease, have acquired a merited popularity, and continue to be read. Dramatic literature was cultivated chiefly by James Kniajnin (1742-91). His talents were formed under the direction and patronage of Soomarokoff, whose daughter he had married. Kniajnin wrote tragedies, comedies, and operas, besides odes, fables, and other minor poems. His principal productions are—'The Clemency of Titus,' 'Dido,' 'Sophonisba,' 'Roslaf,' 'Vladimirk,' and 'Yaropolt,' &c. Some of them are original; others translations or imitations from foreign authors, particularly from Metastasio. His comedies are—'The Boaster,' 'The Odd Fellows,' &c.; his operas, 'Misfortune from a Coach,' 'The Vender of Sbiten' (a national beverage), 'The Miser,' &c. His style is purer and more elevated than that of Soomarokoff, but it is often constrained, and he offends by a continual attempt to be sublime, which frequently degenerates into bombast. Like Soomarokoff, he is also a servile imitator of the French dramatic school. Some of his comedies, and particularly 'The Boaster,' and 'The Odd Fellows,' are clever. They were however surpassed by those of Von Visin, who was born at Moscow in 1745. He studied at the university of his native town, and travelled in several parts of Europe. His comedy of 'Niedorosl,' that is, the Minor, or the Spoiled Child, is an admirable picture of Russian manners in the eighteenth century, and although those manners are fast disappearing, it is still a very popular play. His other comedy of the same kind, entitled 'The Brigadier,' is also a clever performance. Von Visin translated into verse Voltaire's 'Alzire' and Bitaube's poem of 'Joseph.' He also wrote a poetical epistle, addressed to his servants, of a satirical description, which is very popular: it contains some ideas evidently borrowed from the French philosophy of his time, which the author is said to have afterwards much regretted, on account of the mischief which they might produce by their irreligious tendency. He also published many translations and original compositions, which are now forgotten. He died in 1792.

The study of national history was much advanced during this period by the learned researches of foreigners as well as natives. The learned Schlözer, who came to Russia in 1761, was nominated (1765) professor of history at the Academy of St. Petersburg. He remained there till 1769, when he was appointed professor at Göttingen. During his residence in Russia he learned the Russian language, and published some works relating to the history of that country. He continued his researches on that subject at Göttingen. John Stritter, born in 1740, at Stettin in Pomerania, died in 1801, at Moscow. By order of the Academy of Sciences, he collected according to the plan of Schlözer, from the Byzantine authors, the accounts of the different nations which are connected with the history of Russia: they were published in Latin, under the title of 'Memoriæ Populorum olim ad Danubium, Pontum Euxinum, Paludem Maeotidem, Caucasum, Mare Caspium, et inde magis ad Septentrionem Incolentium, à Scriptoribus Historiæ Byzantinæ erutae et digestæ,' 4 vols. large 4to., St. Petersburg, 1771-80, at the expense of the Academy of Sciences. This valuable collection of historical materials was well received by the learned in Europe, and was made use of by Gibbon in his great work. An abridgement of it, made by the author himself, in Latin, was translated into Russian by Svietoff, and published at St. Petersburg (1770-75) in 4 vols. 8vo. Stritter also wrote in Russian a 'History of Russia,' which reached only to the year 1464, and was printed in 3 vols. at St. Petersburg (1800-3), and some historical dissertations also in Russian. Prince Michael Shcherbatoff (born in 1733, died in 1790) from his youth evinced great zeal for the study of national history, and diligently collected materials relating to that subject. The empress Catherine commissioned him to arrange the archives of the cabinet of Peter the Great, and granted him free access to all the libraries and records of the state. He was thus enabled to prosecute his researches for a history of Russia, which appeared in 13 vols. (1770-92), but which reaches only to the reign of the Czar Michael Federovich. It is written in a heavy style, without criticism, and is full of blunders. Many of his errors were pointed out in Boltin's remarks on Lubec's 'History of Russia,' which led to a very angry literary quarrel between Shcherbatoff and Boltin. He was also the author of the following works: 'On the Antient Gradation of Ranks in Russia,' Moscow, 1784; and an 'Historical Account of the Origin of the Russian Princes who are descended from Ruric.' He also edited many important historical documents, such as the 'Diary of Peter the Great.' Boltin (1735-91) contributed by his critical writings to the elucidation of many obscure parts of antient Russian history, although his own writings were not free from error, as was proved by Shcherbatoff. He left in manuscript several historical and philological works, and a translation of the French Encyclopædia to the letter K. Golikoff (1735-1801) was a merchant, but occupied himself in his leisure hours with literature and history, and particularly with the history of Peter the Great. Being engaged with a cousin in the farming of the government revenue from the sale of ardent spirits, he was guilty of some irregularities, for which he was condemned to be imprisoned for life. He was however pardoned in consequence of an amnesty granted in 1782, on the occasion of the installation of the monument of Peter the Great. Golikoff went from his prison straight to the church to thank God for his deliverance, and then to the monument, before which he made a solemn vow to devote the remainder of his life to the glory of the monarch to whom it was erected. He kept his vow, and diligently collected all that was written about Peter the Great in every language, and as he did not understand any foreign tongue, he got translations made at his own expense. He also visited all the towns where Peter had resided, and collected all the traditions relating to him. Catherine, being informed of his exertions, gave him free access to all the public records. The result of his labours was a work entitled 'Deeds of Peter the Great,' in 12 vols., Moscow, 1788-90; and a continuation of that work in 18 vols., completed in 1798, under the title of 'Supplement to the Deeds of Peter the Great.' He also wrote anecdotes of Peter the Great and the Lives of Lefort and Gordon. These works, although written without any criticism, contain very valuable materials for the history of Peter the Great. Nicholas Novikoff (1744-1818) has done perhaps more than any other individual in Russia for the diffusion of literature. He edited several periodicals devoted to literature and education, and he collected numerous historical documents, such as relations of Russian ambassadors sent abroad, official instructions given to government agents, reports of governors of provinces, diaries of private persons, &c., which he published under the title of the 'Antient Russian Bibliotheca,' St. Petersburg, 10 vols., 1770-75; and its continuation in 9 vols., 1786-93. Novikoff established a society for publishing useful books at a cheap rate: he hired the printing-office of the university of Moscow, and introduced into it many improvements. He had foreign works translated into Russian, established booksellers' shops in provincial towns, and the first circulating library in Russia. These efforts to enlighten his countrymen awakened the suspicion of the government, which, being afraid of the French revolution, became much less liberal in its views than it had been before that event, and Novikoff, being accused of promoting the principles of that revolution, was subjected to a severe persecution. His innocence was however recognised under the emperor Paul, who generously rewarded Novikoff for his sufferings. Sergius Pleshcheyeff (1752-1802) was educated in England, and served in the Russian fleet during the campaign against the Turks in 1770 and the following years; passed into the civil service, and rose to the rank of a privy-councillor. Pleshcheyeff wrote the first statistical account of Russia, which was published in 1790, and translated into several languages; and the 'Diary of a Naval Expedition to Syria,' which was sent to assist, against the Turks, the celebrated Ali Bey, who had usurped the government of Egypt. Two French authors have written on the history of Russia, Levesque and Leclerc, both of whom resided in Russia and were conversant with the language, but their works belong rather to French than Russian literature.

The mathematical sciences and natural philosophy were cultivated with considerable success by several members of the Academy of Sciences. Roomovski, born in 1734, of poor parents, learnt mathematics under Euler. He was sent to Selenghinsk (on the frontiers of China) to observe the passage of Venus over the sun's disk, and afterwards made a journey for a similar purpose to Kola in Lapland. He was appointed professor of astronomy to the Academy of Sciences, and successively honoured with other duties connected with public education. Finally he was created in 1803 curator or supreme director of the university of Kazan. He died in 1812. Roomovski was the first who wrote a mathematical school-book in Russian, which appeared in 1760; and he also published translations of Euler's letters on different philosophical subjects, and of the 'Annals' of Tacitus. John Lepechin (1739-1802) studied at St. Petersburg and afterwards at Strasburg, where he took the degree of doctor of medicine. He undertook scientific journeys in several provinces of the Russian empire. His principal work is 'Diary of my Voyage in several Provinces of Russia,' St. Petersburg, 1771-80. He also wrote some minor works on subjects of medicine and rural economy. Nicholas Richkoff (died in 1780) published a 'Diary of Travels in different parts of Russia,' chiefly Asiatic, in the years 1768-71, 3 vols., St. Petersburg, 1772. Oseretzkovski published 'Travels on the Lakes of Ladoga and Onega,' and some other minor works. There were also many learned foreigners employed by the government in scientific travels in Russia.

The eloquence of the pulpit was chiefly cultivated during this reign by Platon Lefshin, metropolitan of Moscow (1737-1812). This learned prelate wrote many sermons, several theological works, and an abridged history of the Russian church. Athanasius, archbishop of Astrakhan, and John Levanda, Archiyerey of Kieff, were distinguished as writers of sermons. The national theatre received a new impulse. It was rendered a public amusement to which every one had admission by paying, whilst formerly it had been exclusively reserved for the court and the upper classes, who received free admission to places, distributed according to their respective ranks. A great number of periodicals appeared during the same period.

The reign of the emperor Paul was distinguished by the foundation of the university of Dorpat, and the agricultural school, the school for military orphans, the institute of the order of St. Catherine for the education of girls, and the placing of all the female educational institutions under the superintendence of the empress Maria, under whose care they remained till her death, and acquired a high degree of prosperity. The emperor Alexander gave a great impulse to the literature, learning, and public education of his country. By his order a new ministry of public education was established in 1802, and intrusted with the supreme direction of all the educational institutions in Russia, with the exception of the ecclesiastical, military, naval, and mining schools. Immediately after its establishment this ministry formed a general plan of public education for Russia, which was approved by the emperor. In consequence of that plan all the Russian dominions were divided into the six following educational districts, viz.: 1, Moscow; 2, St. Petersburg; 3, Vilna; 4, Dorpat; 5, Kazan; 6, Kharkoff· each of these districts had a university, and consequently two new ones, those of Kharkoff and Kazan, were established in 1804-5. The universities were intrusted with the organization and direction of all the schools in their respective districts. A gymnasium, or higher school preparatory for the university, was established in every government; and a school preparatory to the gymnasium, in every circle, besides many primary or parochial schools. The instruction in the university of Dorpat and its department is given in German, which is the official language of the Baltic provinces comprehended in that department. Polish was left to the university of Vilna and its department, which extended over all the provinces dismembered from Poland.

Besides the schools established in consequence of the general plan of public education, many other important institutions of that kind were founded in several parts of Russia; such as the Lyceum at Tzarskoye Selo, in 1811, which has produced several distinguished authors of the present day; the Lycée Richelieu, at Odessa, in 1817; the gymnasium of Yaroslaf, founded by Demidoff in 1805; the Lyceum of Krzemieniec in Volhynia; and some commercial schools, &c. A great number of learned and literary societies were also established in the capitals and other towns of Russia.

The Russian language, which had made great progress in the last ten years of the eighteenth century, attained under this reign a high degree of perfection. Its prose was chiefly formed by the writings of Karamsin, who began to replace the Latin and German construction into which the Russian authors had generally forced their national language, by periods approaching more to the French. But although his style is far more easy and agreeable than that of his predecessors, it often contains foreign turns, and the style of the school of imitators which he created was corrupted by so many Gallicisms, that it frequently appeared to be French written with Russian words. A reaction was produced, chiefly by the work of Admiral Shishkoff, on the antient and modern Russian style, in which he violently attacked those absurd innovations; but although there is much sound criticism in his observations, his zeal for the purity of the national language is sometimes extravagant. This work, which caused a great sensation, created two opposite parties in Russian literature—that of Moscow, which consisted of Karamsin's imitators, and that of St. Petersburg, which adhered to the ideas of Shishkoff, and the animated contest which has been carried on between them has greatly contributed to the improvement of the Russian style. The school of Karamsin became purified from its foreign idioms; and even the style of its founder, in his great work the 'History of Russia,' is far superior to his early productions. The labours of the Russian Academy, which was re-organized in 1816, have also tended to improve the language, the rules of which are determined by the grammar of that Academy, published for the last time in 1802. The imperial manifestoes and other public documents of importance issued since the accession of the emperor Alexander are written in a very good style.

John Dmitrieff (born in 1760) has done almost as much for Russian poetry as Karamsin did for prose. Dmitrieff began at an early age to write poems, several of which were printed in the 'Literary Journal of Moscow,' 1792 and 1793. His works, consisting of odes, epistles, satires, tales, epigrams, &c., have gone through several editions; they are written with great ease and elegance, are full of genuine wit, fine feeling, and good sense expressed in a very happy manner. His life was spent in public service, and he was minister of justice under the emperor Alexander.

Vladislaf Oseroff, a general officer (1770-1816), created by his tragedies a new æra in the dramatic literature of Russia, and threw into the shade all the dramatists who preceded him. Yet although his productions rise immeasurably above those of Soomarokoff and Kniajnin in artistic skill, animation and truth, and situations of high tragical interest, his versification is far from being perfect; it wants ease and harmony, and the structure is too artificial. Oseroff is still the first tragic writer in Russia, and a contemporary writer said that tragedy was born and died in Russia with Oseroff: his chief productions are—'Œdipus in Athens,' 'Demetrius Donskoy,' and 'Polyxena.'

John Kriloff (born in 1768), librarian of the Imperial library at St. Petersburg, is the author of several successful comedies, but his literary reputation rests on his fables, which rival those of La Fontaine, and display all the 'bonhommie' of the French fabulist. They have passed through several editions, and a splendid edition, with a French and Italian translation, was published by Count Orloff, at Paris, in 1825.

Nicholas Gnedich (born in 1784) is the author of a very successful translation, in hexameter verse, of the 'Iliad.' He also translated several tragedies from modern authors, of which Shakespere's 'King Lear' is the most remarkable.

Prince Peter Viazemski (born in 1792) occupies a distinguished place among Russian authors by his epistles and satirical poems, which are written in elegant verse, and display much imagination and true feeling. The few literary essays which he wrote in prose are among the best in the Russian literature. Viazemski lived for some time at Warsaw as a Russian employé. He became intimate with the first literary persons of Poland, and in conjunction with several of them formed a plan for establishing a connection between the Polish and Russian literature by means of reciprocal translations. Circumstances however prevented the execution of this project.

Prince Alexander Shakhovskoy (born in 1771) made metrical versions of several tragedies from the French, and wrote, both in verse and prose, a great number of comedies and vaudevilles, many of which are very popular.

Alexander Pushkin is undoubtedly the first poet of Russia: his character has been given in another place. [PUSHKIN.]

Pushkin was, on his mother's side, grandson of a black called Annibal, who was the son of a groom of Peter the Great, and rose in the Russian service to the rank of a lieutenant-general of engineers. Pushkin, who, with a white complexion, had the features of a negro, was proud of his African origin, and frequently made allusion to it in his poems.

Basilius Jookowski (born in 1783) was educated at Moscow. He was employed in a department of the civil service, but in 1812 he entered the army as a volunteer. He was afterwards appointed professor of Russian literature at the university of Dorpat; then nominated teacher of the Russian language to the grand-duchess, the present empress; poet-laureate, and finally tutor to the grand-duke Alexander, crown-prince of Russia. His poetical reputation was established chiefly by a very successful imitation of the German ballad of 'Leonora,' by Bürger. He translated with equal success several poems from the German, French, and English, and among them Gray's 'Elegy in a Country Churchyard,' Schiller's 'Jeanne d'Arc,' and Byron's 'Prisoner of Chillon.' His original poem, the 'Bard in the Camp of the Russian Warriors,' which he wrote during the campaign of 1812, amidst the turmoil of warfare, presents an animated picture of the life of a camp, and contains some passages of wild and original poetry. Jookowski has also earned the reputation of being one of the best Russian prose writers by his tale called the 'Wood of Mary,' and his translation of 'Don Quixote.' As a translator Jookowski is unrivalled: he adapts his style to that of the original in such a manner that each of his translations appears to have been made by a different person. Notwithstanding the favours of the court, which had been poured upon him, Jookowski preserved great simplicity of manners, and that kindness of heart which induced his friends, before he had become the favourite of fortune, to inscribe under his portrait the following line of Gray—

'He gave to misery all he had—a tear,'

taken from his own translation of the poem.

Constantine Batiooshkoff, born at Vologda in 1787, was educated in a private school at St. Petersburg, and served in the army in 1806-9. The severe wounds which he had received induced him to leave the service after the peace with Sweden in 1809; but he re-entered the army in 1812, and left it again in 1816. He was employed in 1818 at the Russian embassy at Naples. Soon afterwards he was attacked by a fit of melancholy, which baffled all medical skill: he tried in vain to counterbalance the effects of the malady by study and literary occupation. When he returned to St. Petersburg, his friends endeavoured to surprise him, by singing one of his finest compositions, accompanied by the harp. This produced a powerful effect on Batiooshkoff, but the contrary of that which was expected; for his mind, instead of recovering, was completely destroyed. In 1836 he was still alive, but in a state of insanity. Batiooshkoff's talent was formed chiefly by the literature of Italy, which he studied and imitated from his early youth. His poetry is distinguished by the great finish of his verses and their harmony, which sometimes remind one of the Italian language. No Russian author has shown so much delicacy, precision, and expressiveness of language as Batiooshkoff, both in poetry and in prose. His chief productions are:—'The Dying Tasso,' an elegy, which may be considered the most classical production in the Russian language, by the depth and truth of feeling, and the eminent art of the composition. All his poetical productions have an elegiac character. He did not compose much; the best of his writings, besides that which we have mentioned, are the 'Russian Captive,' and the 'Phantom,' imitated from the French of Parny. His prose writings, on different literary subjects, are marked by talent and a moral tendency.

John Kosloff, born in 1780, received a good education, and spent a great part of his life among the fashionable circles of Moscow and St. Petersburg: when about forty years of age a severe illness deprived him of the use of his legs, and his consequent retirement from the world directed his mind to literary occupations and developed his talents. Kosloff was already thoroughly acquainted with the languages and literature of France and Italy, and he now devoted himself to the study of English literature. He was doomed to a still severer trial by the loss of his sight. Yet this accumulation of misfortune broke not his spirit, but rather developed his poetical genius. He learnt German, notwithstanding his blindness, in a very short time. His memory was so powerful that he retained all that he ever read; and he translated Byron's 'Bride of Abydos' from memory. He composed and translated many small poems, which are characterised by an extraordinary harmony of versification: the most remarkable are 'The Monk' and 'The Venetian Night.'

Alexander Voyeykoff, born in 1773, translated Virgil, and several poems of De Lille, and wrote a descriptive poem entitled 'Arts and Sciences,' as well as satires, epistles, and other minor poems. He is also known as one of the first literary critics in Russia.

Dionysius Davidoff, a general officer of cavalry, who distinguished himself in the partisan or guerilla warfare during the campaigns of 1812-14, is the author of many fine poems, which being generally written in the midst of the occupation of war, have something inimitably wild and original. Baron Delvig died very young, but left some beautiful songs, and the first attempt towards a history of the arts in Russia. Anna Bunin, born in 1774, in the government of Rezan, received a scanty education, but a natural love for literature overcame all the difficulties of her situation. She was 27 years old when she came to St. Petersburg, where she began diligently to study French, German, and English, as well as mathematics and Russian literature. She soon expended her little means of subsistence; but her first poetical essays, entitled 'The Inexperienced Muse,' were favourably received by the empress Elizabeth, the wife of Alexander, who granted her a small pension; and the poems which she published subsequently obtained such success as to give her competence and reputation. She had the misfortune to be attacked by cancer, which resisted the skill of the best physicians. Supported by the bounty of the emperor Alexander, she came in 1815 to England for medical advice, but without deriving any benefit from it. She returned, after a residence of two years in England, to St. Petersburg, where she continued to linger till death released her from her sufferings, which had lasted seventeen years. Although she was prevented by illness from actively pursuing her literary occupations, she translated twenty of Blair's 'Sermons.'

Among the remaining poets of the present period we may mention Panayeff, author of eclogues; Krukofski, author of some tragedies; Raich; Katenin; and Viskovatoff, the translator of several foreign poems. We shall conclude with one who became celebrated by his talents, his daring spirit, and his tragical end.

Rileyeff acquired great celebrity in Russia and abroad as the chief promoter of the conspiracy against the present form of government in Russia, which ended in a fruitless attempt on the accession of the present emperor, in the beginning of the year 1826. Rileyeff was first known by translating from the Polish some of the historical ballads of Niemcewicz, and he also wrote similar compositions on subjects from Russian history. All these poems, like those of Niemcewicz are animated by a patriotic and liberal spirit. Rileyeff developed his political views chiefly in his tales 'Woynarowski' and 'Nalevayko.' The first is a history of a chief of the Ukraine, nephew of the celebrated Mazeppa, who while an exile in Siberia for his share in the attempt of his uncle to liberate, with the assistance of Charles XII., the Ukraine from the oppression of the Czar, relates his adventures to the German Müller, who met with him during his travels in Siberia. The most daring opinions expressed in beautiful verses are put into the mouth of the hero of the tale, although they are accompanied with notes condemnatory of them, or explaining them to be harmless, in order that permission to print them might be obtained from the censors, a stratagem which had the desired effect. The other poem 'Nalevayko' is the history of a hetman of the Ukraine, who was beheaded at Warsaw for a revolt against the Polish dominion. Only fragments of it appeared in the 'Northern Star,' an annual edited by the author and Bestujeff. The most striking is the confession which Nalevayko makes to a priest before raising the standard of insurrection, and the author has predicted his own fate, in an answer which Nalevayko gives to the priest, who represents to him the danger of his enterprise? His answer is as follows, expressed in beautiful verse: 'I know that peril awaits him who first rises against the oppressors of the people. Fate has already devoted me, but say when and where was freedom attained without sacrifices? I know that I shall perish for my native land, and I bless with joy my destiny.'

Rileyeff displayed during his imprisonment and trial, as well as at his execution, a firmness of character which inspired his judges with respect; and he was, according to universal opinion, a victim to his sincere convictions. He was executed in July, 1826, with four other leaders in the conspiracy.

Admiral Shishkoff, who was also president of the Russian Academy, and minister of public education, was distinguished as a prose writer. Besides the dissertation on the old and new Russian style, which has been already mentioned, he was the author of various literary works, and several relating to nautical science.

Alexis Merslakoff, professor of literature at the university of Moscow, is undoubtedly the first literary critic in Russia. He has translated several works relating to the theory of literature, and has written original works on the same subject. The most remarkable are his lectures on literature, which were delivered at Moscow.

Alexander Vostokoff is the author of a Slavonian grammar, and a dissertation on that tongue, which have gained him the reputation of being the first Slavonian scholar in Europe.

Nicholas Grech is the author of a course of Russian literature, a Russian grammar, and a great number of minor compositions, which are inserted in the periodicals, 'The Northern Bee,' and 'The Son of the Fatherland,' which he had edited: he is now one of the first critics in Russia.

Thaddeus Bulgarin, born in 1789, of an antient family in Lithuania, was educated at the military school of St. Petersburg. He served in the Russian guards during the French and Swedish wars; but in 1810 he left the Russian service, and having entered the Polish army of the grand-duchy of Warsaw, he joined the French armies in the campaigns of Spain, Germany, and France, till the peace of 1814. On his return to his native land, he published several compositions in the Polish language, but having gone to St. Petersburg on account of some law business of his family, he was induced by some of his early friends to try his talents in the field of Russian literature. His first attempts were successful, and he established, in 1823, a periodical called the 'Northern Archives,' which contained essays, historical, geographical, and statistical, and continued many years with great success. He is best known by his novel 'Veejighin, or the Russian Gil Blas,' which is a satire on Russian manners; but his pictures, although cleverly drawn, are often overcharged: it has been translated into several languages, and into English. 'The False Demetrius,' an historical novel, contains many good pictures of the manners and customs of Russia and Poland at the beginning of the seventeenth century, and several well-drawn characters; but there is perhaps too much of pure historical narration. Besides 'Mazeppa,' an historical novel, he has published Memoirs of his campaigns in Spain, a large work on Russia, its geography, statistics, history, and literature, and many minor compositions. His works are characterised by great talent of observation, and much wit; and his style is excellent.

Alexander Bestujeff (born in 1795) was educated in a military school, and served as an officer in the life-guards. Being implicated in the conspiracy of Rileyeff, he was degraded to the rank of a common soldier, and sent into the interior of Siberia. He was seen there by the German traveller Ermann, to whom he addressed, in French, an exceedingly clever letter, which contributed to obtain his pardon, and he was sent as an officer to the army of the Caucasus, where he was killed, in 1837, in a skirmish with the Circassians. Before his exile Bestujeff edited, with Rileyeff, the first Russian annual, entitled the 'Northern Star,' in which he wrote a very clever sketch of contemporary Russian literature, and several little novels. After he was pardoned, he wrote several novels under the name of Marlinski. In these works he displayed an uncommon talent in describing romantic scenes of a wild character, a power which was developed by the excitement of a constant warfare with the Caucasian mountaineers, in which he spent the last years of his life. His last work is 'Amaleth Beg,' a novel, containing the story of a Circassian chief, and animated sketches of Caucasian scenery. The best Russian novelist is undoubtedly Zagoskin, whose works belong to that branch of the novel to which Scott has given celebrity. His 'Youri Miloslavski, or Russia in 1612,' which has been translated into English, contains an admirable picture of Russian manners in those troubled times, and some exceedingly well sketched characters. His 'Roslavleff, or Russia in 1812,' is considered inferior to the other work: perhaps being obliged to describe scenes relating to a modern event of so much importance, he could not free himself entirely from many personal considerations. The other novelists of Russia are Ooshakoff, Dahl, Prince Odoyevski, Baron Korf, and Massalski, who also has written in Polish. The Russian literature is very rich in translations of foreign novels.

The present literature of Russia is producing many historical works. Ustrialoff has written, by order of the government, a history of Russia for the use of schools. It is certainly an able production, but the fairness of its views may be doubted, as it is a kind of defence of the successive usurpations of Russia on Poland. Polevoy, a merchant of Moscow, published a history of Russia, in which he attacked many of the views that were adopted by Karamsin. Polevoy is well known as the successful editor of a literary periodical called the 'Telegraph.' Polgodin has made some valuable researches into the period of the false Demetrius, the Annals of Plescov, &c.

Berg (died in 1834) published a history of the reign of Michael Federovich (1832), of Alexey Michaelovich (1834), and of Fedor Alexeyevich (1835). Several other special histories relating to Russia have been recently published. The campaigns against the French and the Turks have furnished materials for several works, among which there is one on the war of 1812-14, which was written by a female who had served in that war. Great attention is now paid in Russia to the collecting of materials relating to the national history. A systematic collection of various accounts of Russia, by Artzibashoff, is now publishing at Moscow. A similar work, under the title of the 'Library of Foreign Authors who have written on Russia,' was begun, in 1837, at St. Petersburg, by Semenoff, who promises to furnish the translation of one hundred foreign works on Russia. Several learned men have made successful researches in foreign countries relating to Russian history. Many works on the geography and statistics of Russia have lately been published. The most important of these are—the 'Military Geography of Russia,' by Yasikoff, 1838; 'Contributions to the Knowledge of the Russian Empire and the adjacent Countries of Asia,' is a very interesting work, which was commenced by the Academy of Sciences in 1830, and two volumes have appeared. The work on the Caucasian provinces, by Chopin, 1840, gives many new details on those countries. Many travels in different parts of Russia, as well as abroad, have been recently published.

The study of the Oriental languages is much encouraged in Russia. Besides the Oriental Institute at St. Petersburg, where all the principal languages of the East are taught, and which possesses a splendid Oriental library, numismatic cabinet, and a printing establishment for Oriental publications, there are chairs of Arabic, Persian, and Turkish in all the Russian universities. The university of Cazan, being situated in a country partly inhabited by a Mohammedan population, and having a great intercourse with the East, is specially endowed with the means requisite for Oriental studies. There are chairs of the Arabic,* Persian, Turkish, Chinese, Mongol, Armenian, and Tibetan languages, as well as rich collections of Oriental books, manuscripts, and coins. There is also a printing-press for Oriental works, whence the celebrated 'History of the Tartars,' by Abulgazi Khan, and other important works, have issued. The same university has a stipend for fourteen scholars, who devote themselves exclusively to the study of Oriental languages. The ecclesiastical seminary of Irkutsk has a separate class for missionaries among the Mongolian tribes. Japanese is taught in the gymnasium of the same town, and a special school for the Chinese was established in 1835, at Kiakhta.

Joseph Senkowski, a Pole, having completed his education at the university of Vilna, studied the Oriental languages at Constantinople and in Syria, where he resided for some time among the Maronite Christians. Senkowski is one of the most remarkable linguists of his time; he possesses not only a great knowledge of the languages of the East, but also a great familiarity with those of the West; he has published several well written things in the Polish (which is his native language), the Russian, and the French. He is now the chief editor of the 'Encyclopædical Dictionary,' to which he has contributed many valuable articles on Oriental subjects. His works display great learning, and a lively although somewhat satirical humour. Kowalewski, also a Pole, and a pupil of the university of Vilna, is now professor at Cazan. He is distinguished by his great knowledge of the Mongol languages, which he studied for several years among the native populations. He published, in 1838, very valuable extracts from the Mongol literature. The most eminent Chinese scholar of Russia is father Hyacinthus Bichoorin, who was for seven years a pupil of the Russian mission at Pekin, and subsequently for seven other years at the head of that mission. His principal works are—'Researches on Mongolia;' a 'History of the Calmucks,' 1834; and his 'Chinese Grammar,' which is considered to be the best that exists. There are also several foreign Orientalists of great eminence employed in Russia. Many scientific works have been recently published, and an 'Encyclopædical Dictionary' has been commenced. This work seems to have been formed on too extensive a plan, as the fifteenth volume (thick 8vo., printed with small type in double columns) has only reached the beginning of the letter D, the fifth in the Russian alphabet. It contains many well written articles, particularly on Slavonian and Oriental subjects. It contains the most minute details relating to Russia, but many of the geographical articles are too elaborate for a work intended to be popular. This work when completed will make about fifty volumes. The publication has been suspended, owing to the failure of the publisher.

In 1839 there were fifty-three Russian newspapers and periodicals, many of which were devoted to literature and science in general, as well as some special branches, as, for instance, military art, agriculture, technology, mining, &c.

The tendency of the present government is decidedly to destroy the provincial characteristics which are preserved in different parts of the Russian empire, and which had been respected under preceding reigns. We have in another place described the efforts of the Russian government to destroy the Polish language. [Polish Literature.]

The German nationality of the Baltic provinces (Livonia, Esthonia, and Courland) had been scrupulously respected since their incorporation with Russia. All the official transactions were in German, and the public education, which was under the superintendence of the university of Dorpat, was conducted in the same language, whilst the Russian was only taught like any other foreign language. These privileges are now beginning to be gradually undermined by successive enactments respecting the public education in the Baltic provinces. Not only the acquisition of the Russian language has been imposed on all the pupils in the public schools, but no one can be admitted as a teacher in these schools who cannot show his ability in the Russian language; and those teachers who are already employed are enjoined to acquire a competent knowledge of the Russian.

An Imperial ukase has decreed that from the 10th of December, 1845, no academical degrees shall be conferred by the university of Dorpat on individuals who shall not be able to show in a strict examination a complete knowledge of the Russian language. These measures are evidently preparatory steps for replacing the German language by the Russian in the public schools of the Baltic provinces.

* A Koran was printed in Arabic at St. Petersburg about the year 1820.

Many new regulations respecting the admission of pupils belonging to the different ranks of society have been lately introduced, and the admission of serfs to the higher schools is strictly prohibited unless they have been previously emancipated.

*Polish Language and Literature.*—The Polish language is considered to be more flexible and euphonic than the other Slavonian dialects. In conciseness of expression it can scarcely be surpassed by any other language. The nouns have a declension of seven cases, and the verb is equally well developed. The verb also has some delicate shades of distinction as to tenses and genders which do not exist in the Teutonic or Romanic languages. The juxtaposition of numerous consonants gives the language an appearance of harshness, but the consonants are softened in the pronunciation by melting them together. The Polish is the only Slavonian language which contains the nasal sounds like the French *en, on, in*, which are represented by the letters *a* and *e*, undermarked with a ʻ. The Polish language can imitate with great ease the beauties of classical prose, but it has not the same facilities for poetry, as all the words have the accent on the penultimate syllable. It seems to have separated at an early period from the other Slavonian dialects, and owing to the predominance of Latin since the introduction of Christianity, its forms have been moulded into those of that language, although its original purity was not affected by the admixture of foreign words, except in the transient period of a corrupted taste. Of all the Slavonian dialects it comes nearest to the Bohemian language.

*Literature.*—Learning was introduced into Poland by Christian missionaries, and particularly by Benedictine monks. During the middle ages there were parochial schools in Poland, and the statute of the archbishop of Gnezno, A.D. 1237, ordered that no German masters should teach Latin in these schools, unless they knew Polish. The earliest literary productions that have come down to us are chronicles; and the earliest known annalist is the biographer of St. Adalbert, who is mentioned by Martinus Gallus. Gallus wrote his chronicle between 1110-1115, and is supposed to have been a Frenchman who had settled in Poland. Mathias, bishop of Cracow (died in 1166), wrote a chronicle, which was used in the composition of his Annals by Vincent Kadlubek, also a bishop of Cracow, who died in 1223. Boguchwal, bishop of Posnania (died in 1253), wrote the Annals of Poland to the year 1249, which were continued by Baszko Custos, of the same town, to the year 1273. There are several other annalists of the thirteenth and fourteenth century, but the most celebrated Polish author of that period is the well known Martinus Polonus, whose family name was Strzempski; he is the author of a chronicle of the popes and emperors. He was a Dominican monk, confessor to the pope, and was nominated archbishop of Gnezno, but died on his way to Poland, at Bologna, in 1279. All these chronicles were in Latin. The most antient monument of the Polish language is a hymn to the holy Virgin, attributed to Saint Adalbert (died in 1107). Dr. Bowring has given a translation of it in his specimens of the Polish poets. Some other songs and hymns belong to the same epoch. Vitellio, a Pole, about 1300, wrote a treatise on optics. At an early period the Poles resorted to the foreign universities, and chiefly to Paris and Padua. Casimir the Great laid the foundation of a university at Cracow in 1347, but it seems to have completely fallen into decay during the reign of Louis of Hungary (1370-82). In 1400, Vladislav Jagellon founded, according to the last will of his queen Hedvige, a university at Cracow. This learned establishment, which was honoured with the name of the 'daughter of the Sorbonne,' was at first engaged in teaching divinity and scholastic philosophy; classical learning began to flourish there only in the latter part of the fifteenth century. Gregorius of Sanok, who afterwards died in 1477, as archbishop of Leopol, first explained the text of Virgil. He also boldly attacked the scholastical philosophy, which he called 'somnia vigilantium.' John of Glogov (died in 1509), a professor and canon of Cracow*, became known through Europe by his works on different parts of the Aristotelian philosophy. He also attempted to establish a system of phrenology. His work 'Quæstiones Librorum de Anima,' printed at Metz in Lorraine, 1501, contains the figure of a head with points indicating the seats of the various intellectual powers. He divides the brain into three compartments: the front, the middle, and the back; each of which is supposed to be the seat of different faculties, as apprehension, imagination, judgment, memory, &c. He admits however the existence of an immaterial intellect, or virtus divina, whilst the other faculties depend on material organs. A treatise by him, 'De Arte Memorativa,' was published at Cracow, 1504. John Stobnitzki, who succeeded John of Glogov in the chair of philosophy, published several treatises on metaphysics, and natural and moral philosophy, as well as on geography. Brudzewski, professor of mathematics at Cracow, published several works on astronomy before the year 1500, and had the honour of being the instructor of Copernicus. James of Kobylin, one of Brudzewski's disciples, wrote a work, celebrated in its time, entitled 'Declaratio Astrologica,' and Martin of Olkusz, who terminated his studies at Cracow, 1459, became afterwards physician and astrologer of Mathias Corvinus, king of Hungary, and assisted Regiomontanus in the composition of his 'Tabulæ Directionum Planetarum.'

King Casimir Jagellon (1446-1492) determined that every superior magistrate should be conversant with Latin and the sciences of that time. He intrusted the education of his children to Dlugosz, who may be considered as the first historian of Poland (1415-80). He was a man of great learning and superior talents, which is proved by the numerous diplomatic missions in which he was employed. He collected the antient chronicles, and formed of them a whole system of history, supplying their deficiencies from different public and private records. His work reaches to the year 1480, in which he died, and it becomes much more detailed and displays better judgment towards the end than in the early part. His Latin is not better than that which generally prevailed at that period. As a proof of his industry we may mention that he learned Russian at an advanced age, in order to profit by the chronicles written in that language. He tells us with sincerity what he believes to be the truth, without sparing the clergy, and this is supposed to be cause why his work was printed so late (1615): it has been reprinted many times. After Dlugosz's death the education of the royal princes was continued by the Italian scholar Buonacorsi, better known under the name of Callimachus Experiens, who published some works in his adopted country.

*Augustan Æra of Polish Literature.*—The brilliant æra of Polish literature begins with the sixteenth century and extends to the early part of the seventeenth: it may be considered as commencing with the accession of Sigismund I., in 1508. It was during this reign that the human mind received a new impulse from the Reformation, and the translation of the Bible tended in Poland, as well as elsewhere, to improve the national language. Poland was well prepared for this revolution by the Hussite doctrines which had circulated there widely during the preceding century. Sigismund I. was of a tolerant disposition, and his answer to Eckius, the antagonist of Luther, who had sent him the book of Henry VIII. against that reformer, 'Permitte mihi ovium et hircorum rex esse,' shows his opinion on this then all-engrossing subject. By an ordinance in 1539 he established the liberty of the press, but this permission was only required for the royal towns, as the privileges of the nobles prevented the king and the clergy from interfering with anything on their own estates. These privileges, which paralyzed the power of the clergy, facilitated the diffusion of the Reformation, as every noble who had embraced its doctrines gave the Roman Catholic church to a Protestant minister. Under the reign of his son and successor Sigismund Augustus, Protestantism made further progress, and the states, which assembled after his death in 1573, acknowledged the perfect equality of all Christian confessions.

The translation of the Scriptures into the vernacular languages was the first general consequence of the Reformation, and Poland was no exception to this universal rule. Not only did Protestants make great efforts to spread the Scriptures, but the Roman Catholics, in order to counterbalance the influence of the Protestant versions, published their own. The first translation of the Scriptures into Polish was the New Testament, by Seklucyan, a Lutheran version, published in 1552 at Königsberg. It was followed by the

* For some time it was customary to choose bishops from the professors of the university of Cracow, a circumstance which made the Polish prelates renowned for their learning, and several of them distinguished themselves at the council of Constance (1414-1418) Zbigniev, bishop of Cracow (died in 1453), was celebrated for his learning and virtue by Æneas Sylvius Piccolomini, afterwards Pope Pius III.

New Testament of Scharfenberger, a Roman Catholic version, Cracow, 1556; in 1561 appeared a Roman Catholic version of the whole Bible by John Leopolita, and in 1563 a Protestant version was published at Brest in Lithuania; this last-mentioned Bible, being published at the expense of Prince Radziwill, is also known nnder the name of the 'Radziwillian Bible.' In 1566 a Socinian version of the New Testament, by Falconius, appeared at Brest; and in 1572 a version of the whole Bible at Zaslav in Lithuania, by Budny, a Socinian; this latter translation is considered exceedingly correct, but the notes which Budny added were of such a character that he was expelled by the Socinians from their congregation as an infidel. In 1577 there appeared at Rakow a New Testament, by Czechowicz, a Socinian; in 1599, at Cracow, the Bible, by Wujek, a Jesuit—this edition, which was accompanied by a copious commentary, is considered canonical. In 1606 appeared at Rakow a New Testament by Smalcius, a Socinian; in 1617, at Cracow, the Bible, by Justus Rabe, a Jesuit; and in 1632, at Danzig, the Bible, by Paliurus, a Protestant. Thus Poland has eleven versions of the Bible and New Testament, which together have gone through more than forty editions. The chief productions of that period were polemical writings, which, although they did not immediately promote the national literature, contributed greatly to the general diffusion of knowledge by obliging the authors of those writings to severe study in order to answer the attacks of their antagonists.

Schools were also generally established by the Protestants; but the most celebrated was that of Rakow, a Socinian academy, which was attended by students of different confessions, and had a reputation all through Europe. The principal theological authors of that period among the Roman Catholics are, Hosius, Novicampianus (Nowopolski), Kuczborski, but particularly the Jesuit Skarga, the most eloquent preacher of that country, and the author of several works against the Protestants, and Sawicki, also a Jesuit, who wrote under the assumed name of Cichovius. Among the Protestants, there were Turnowski, Gregory of Zarnowietz, Dambrowski, Volanus, and John Laski or Alasco, who was invited by Cranmer to assist at the Reformation of the Anglican church.

The national language, having received a new impulse from the translation of the Scriptures, began to be generally cultivated. The first compositions were spiritual hymns and polemical and religious works. Nicholas Rey (1515-1568), having become a zealous Protestant, published a translation of the Psalms, a Postilla or explanation of several parts of the Scriptures, and other works of a religious as well as purely literary character; his style is now obsolete. John Kochanowski (1530-1584) received a superior education at Padua and Paris. On his return to his native country he was much patronised by the king and the first grandees: he rejected all the brilliant offers of preferment both in the church and in civil employment, and settling on his paternal estate, devoted himself to literature. His poetry is still classical, and it breathes a particular sweetness.* He translated the Psalms, the 'Phænomena' of Aratus, the third book of the 'Iliad,' and Vida's poem on Chess. Among his original productions several lyrical poems, but particularly his elegiac lines on the death of his young daughter, are beautiful. He wrote several occasional poems, satires, and the first drama in Polish, on the Greek model, with chorusses. The subject was the dismissal of the Greek ambassadors who came to claim Helena from the Trojans. He also wrote various fragments in prose, and four books of Latin elegies, as well as other poems in the same language, all of which are much admired. His brother Andrew Kochanowski translated the 'Æneid,' which was published in 1590; and Peter Kochanowski made a translation of the 'Gierusalemme Liberata' of Tasso, and the 'Orlando' of Ariosto. Szarzynski, a young man (died in 1581), who left some sonnets, hymns, and a translation of a few Psalms, is only second to Kochanowski. Valentine Brzozowski, a Protestant clergyman, published (1554) the first Polish collection of sacred hymns set to music. Mathias Rybinski, also a Protestant clergyman, published a translation of the Psalms which was adopted by the Protestant congregations of Poland. His son John Rybinski wrote some beautiful descriptive poems, one of which is 'Spring.' Zbylitowski was the author of the 'Village,' a didactic poem on rural economy, besides other productions chiefly of a satirical character.

* Some of his poetry has been translated into English by Dr. Bowring.

Grochowski, Miaskowski, and Klonowicz, are renowned for the beauty of their verses. Szymonowicz or Simonides, who belonged to a burgher family of Leopol (1558), distinguished himself not only by his beautiful Polish eclogues, but acquired a European reputation by his Latin poems. Justus Lipsius called him the Catullus of Poland. From his youth he was known to the great Zamoyski, who attached him to his person, made him the tutor of his son, and liberally provided for his support. Pope Clement VIII., who had been nuncio in Poland, held him in great esteem, and conferred on him the honour of a laurel wreath. His earliest works have gone through several editions; his Latin poems were collected and published at Warsaw in 1772, by the papal nuncio in Poland, Angelo Durini, who bestows on him the appellation of the Latin Pindar. Zimorowicz (died in 1624, at the early age of 25) translated Moschus, and wrote several original idyls. We may add to the Bucolic poets of that time Gawinski and Chelchowski.

The Latin poets of that period, besides J. Kochanowski and Simonides, are the following:—Krzycki, archbishop of Gnezno, and primate of Poland, distinguished himself in diplomacy; and when king Sigismund I. acknowledged as sovereign duke of Prussia, under the suzerainty of Poland, Albert of Brandenburg, the last grand-master of the Teutonic order, who had become a Protestant, Krzycki wrote a pamphlet in defence of that transaction, which was the first legal recognition of the secularization of a Roman Catholic religious order by its conversion to Protestantism. It was therefore no wonder that the clergy said that his pamphlet was more politic than Catholic. Krzycki corresponded with many eminent scholars of his time, but particularly with Erasmus, who bestowed extraordinary praise on his accomplishments, and particularly on his Latin poetry, which is compared by all competent judges with the best productions of antient Rome. Dantiscus, son of a burgher of Danzig, rose by his services to the episcopal dignity of Varmia, was employed principally on diplomatic missions, and became such a favourite of Charles V. that he was the only foreign ambassador who accompanied him to Spain after the battle of Pavia, A.D. 1525. He died in 1548, at 83 years of age, and left several Latin poems which were much commended by contemporary scholars, and particularly by Erasmus. Janicki, the son of a peasant (1516-1543), was educated by the liberality of Krzycki, and gained a great reputation when only ten years old. He remained a long time at Padua, and in other parts of Italy, and when he was only twenty years old, Pope Clement VII. crowned him with a laurel wreath. His poems are compared by many Polish and foreign authors with those of Tibullus and Catullus: they were collected and published at Leipzig by Böhm, in 1755, with the following title: 'Janitii Poloni Poetae Laureati Poemata,' &c. The best of them are of an elegiac character. The poems of Casimir Sarbiewski are well known to every lover of Latin literature, and he is universally admitted to be the first modern Latin poet. The other Latin poets of that period are Malinski, Szamotalski, Marszewski, and Kobylinski.

We must not omit mentioning a remarkable person, the particulars of whose life are unknown to us, but it appears that he lived for some time at Venice, and was a great friend of Aldus Manutius. His facility of making verses seems to have been extraordinary. He published a program in which he offered to answer on Candlemas-day, 1584, in the church of St. Paul at Venice, in verse, any question that was addressed to him on divinity or Aristotelian philosophy. He published at Venice, in Latin, a laudatory poem on Zamoyski, surnamed the Great, to which are appended six dithyrambs in the following languages: on Gideon, in Hebrew; Epaminondas, in Greek; Fabius Maximus, in Latin; Gran Capitan Hernando Gonzales de Cordoba, in Spanish; Marco Antonio Colonna, in Italian; and John Tarnowski, in Polish.

The same period produced many eminent prose writers in the Latin as well as in the native language. The most deservedly celebrated of them is Andrew Modrzewski, who was born in 1506. He early embraced the opinions of the Reformers, although he never publicly joined any of the Protestant confessions which were established during his lifetime. In 1534 he went to Wittemberg, where he completed his studies under the direction of Melanchthon, whose friendship he fully possessed. After having resided in several parts of Germany, he returned to his country, and having become secretary to Sigismund Augustus, gained the unlimited confidence of that king. His most celebrated work is 'De Republica Emendanda,' which was declared by John Justiniani, a celebrated professor of Padua, Peter Martyr, and some other eminent scholars, to be the best political work of that period. It has been translated into German, French, and Spanish; a Polish translation appeared in 1577. The work is divided into 5 books: 1, De Moribus; 2, De Legibus; 3, De Bello; 4, De Ecclesia; 5, De Schola. This last is decidedly of an anti-Roman Catholic tendency. It was published at Cracow in 1551, and at Basel in 1554-1559.

Orzechowski (Orichovius), born in 1512, was a Roman Catholic priest, who, having married a wife, maintained an animated dispute with Rome about the lawfulness of the marriage of priests, and became celebrated over all Europe by the eloquent invectives with which he attacked the papal power. He was afterwards reconciled to the church, and became as zealous an advocate of the papal authority as he had formerly been its opponent. Besides his polemical writings, he wrote several works of a political and historical character. His writings in Latin as well as Polish are distinguished by great beauty of style, but disgraced by extreme violence, which was however perhaps well calculated for producing a momentary effect. Being a zealous advocate for a war with the Turks, he supported his views by pamphlets; he wrote also Annals of Poland, but comprising only a short period. The number of pamphlets which he published on several occasions is about 50: the most remarkable is entitled Chimæra,' which was directed against the opponents of Rome, in which he attempts to establish the temporal authority of the pope.

Goslicki, bishop of Posnania (1537-1601), is the author of a valuable political treatise entitled 'De Optimo Senatore,' Venice, 1588. It was translated into English by Mr. Oldisworth, and published under the title of the 'Accomplished Senator,' in 1733, London. Adam Burski published, in Latin, at Zamosc, 1604, the philosophy of Cicero, entitled 'Dialectica Ciceronis quæ dispersa in scriptis reliquit,' &c., a much esteemed work, which is attributed by many to the great general and statesman Zamoyski, who was an intimate friend and patron of Burski. Moscicki was the author of a treatise on logic, besides many theological works. Gorski published, in 1663, 'Commentarii Artis Dialecticæ;' and left in manuscript several works on history and politics. The Jesuit Smiglecki published a work on logic, which was long used not only in the schools of Poland, but also abroad; it has been often reprinted, and among other places at Oxford. Petrycy published at Cracow, 1605-1618, a beautiful Polish translation of Aristotle's politics, ethics, &c.

The principal historians of this period are Mathias of Miechow (died in 1523), who wrote 'Descriptio Sarmatiarum Asianæ et Europeanæ,' and 'Chronica Polonorum usque ad annum 1504·' both these works had for some time great celebrity, being the first Polish histories which were printed, and they went through several editions in different countries. In the first work he defended his country against the aspersions of Æneas Sylvius, who wrote against Poland out of spite for the loss of the rich bishopric of Varmia, which was refused to him by the king, although granted by the pope. Martin Kromer (1512-89) was the son of a peasant, but rose by his services, chiefly in the diplomatic line, to the dignity of a bishop. He was the author of a work, 'De Origine et Rebus Gestis Polonorum Libri xxx,' Basil., 1555, which has been often reprinted; and 2, 'Polonia, sive de Situ, Populis, Moribus, Magistratibus, et Republicâ Regni Poloniæ Libri Duo,' Basil., 1568, also often reprinted, and among others by the Elzevirs. It is an admirable geographical and statistical sketch of Poland. Herburt, an accomplished lawyer, wrote a history of Poland in Latin, Basil., 1521; it was reprinted several times, and a French translation of it appeared at Paris in 1573. Neugebauer (died in 1618), a native of Prussia, left two works: 1, 'Historiæ Rerum Polonicarum Libri vii.,' Francofurti, 1611; and a continuation of the same work, entitled 'Hist. Rer. Pol. concinnata et ad Sigismundum III. usque Libris x. deducta,' Hanoviæ, 1618. In addition to an historical sketch, these works contain a political and physical description of Poland; they had considerable reputation abroad, although they are in fact nothing better than abridgments of Kromer and some other Polish historians, a fact which the author does not state.

Count Alexander Guagnini was a native of Italy, but having long served in the army of Poland, he was naturalised, and died in that country in 1614. He wrote 'Sarmatiæ Europeæ Descriptio,' Cracow, 1578, which has often been reprinted in the original text, and in Italian in Ramusio's collection, Venice, 1588. Guagnini was accused by Stryikowski, who had served under his orders, of having published his manuscript under his name. This accusation, made by a contemporary author, and not contradicted by Guagnini himself, appeared to be so well founded, that Mitzler, in his collection of Polish historians, printed this work under the name of Stryikowski, without even mentioning that of Guagnini; yet the critical acuteness of the learned Lelewel has disproved the imputation of this gross plagiarism against Guagnini, whose work is composed with much more method and order than that of Stryikowski. This last-named author published in Polish a 'Chronicle of Poland, Lithuania, and Russia,' Königsberg, 1582, and Warsaw, 1766. It is deficient in methodical arrangement, and in historical criticism, and is also disfigured by numerous absurd verses, for the author always describes the most important events in rhyme. Notwithstanding all these defects, it is a valuable work on account of the information which it contains, and which the author collected from traditions, manuscripts, and other sources no longer extant. Stryikowski himself was a very remarkable character (born 1547). He was educated at the university of Cracow, and continued his studies in several universities of Italy and Germany; for some time he served in the army. Having accompanied a Polish embassy to Constantinople, he made a voyage in the Levant, and was taken by pirates, on which occasion he lost his manuscripts, and remained several years in captivity until his family paid his ransom. On his return to Poland, he took orders, and died in 1600 as archdeacon of Samogitia. The anecdotes and traits of his adventurous life, which he sometimes intermingles in his narrative, give a romantic interest to his work. Lucas Gornicki (1520-80), secretary to king S. Augustus, wrote in Polish a history of his country from 1538 to 1572, which was published in 1637. He is also the author of the following works:—'The Road to a perfect Liberty,' 1590; and a 'Dialogue between a Pole and an Italian, on the Liberty, Laws, and Manners of Poland,' published 1616; 'The Polish Courtier, a free translation of the Libro del Corteggiano of Baltazar Castiglioni, adapted to the Polish court and manners of that time;' a Treatise on Orthography, and several translations of classical authors. His style is a pattern of purity and elegance even in the Augustan age of Polish literature.

Martin Bielski (1500-75) wrote, in Polish, a 'Universal History,' Cracow, 1550, which is characterised by the beauty of its style. He is also the author of a treatise on the art of war, and of several biographies of ancient philosophers. His son, Joachim Bielski, also wrote in Polish a chronicle of his country (Cracow, 1597), which in style is equal to the work of his father. Stanislaus Sarnicki published in 1587, at Cracow, 'Annales Polonorum et Lithuanorum Libri viii.' It contains some absurdities relating to the history of the fabulous times and the origin of nations, but the modern part is judiciously written. He was also the author of 'Descriptio Veteris et Novæ Poloniæ,' Cracow, 1585. Reynhold Heydensteyn, a learned lawyer, wrote 'De bello Moscovitico quod Stephanus rex Poloniæ gessit, commentariorum Libri vi.,' Cracow, 1584, which has often been reprinted. It is a very valuable contribution to the history of Poland, and has all the interest of historical memoirs, as the author was a witness of the events which he describes. His son, John Heydensteyn, castellan of Danzig continued the work to the year 1603, from his father's manuscripts, 'Rerum Polonicarum ab excessu Sigismundi Augusti, &c., Libri xii.,' Frankfurt, 1672. Solikowski, archbishop of Leopol (1526-1603), who took an important part in the affairs of his country, was the author of 'Commentarius Brevis Rerum Polonicarum à Morte Sigismundi Augusti,' 1579-1590, Danzig, 1647, a work not devoid of merit. Paul Piasecki, bishop of Przemysl (1583-1649), wrote a history of Europe, from 1572 till 1645, entitled 'Chronicæ Rerum Gestarum in Europa,' Cracow, 1645-48, a work distinguished by the soundness of its political views and great impartiality. The author's public career was guided by the principles which he advocated in his work, and his private character was in every respect worthy of praise, yet these very qualities, which give value to his work, brought upon him many bitter enemies, and the Jesuits attacked him violently for having spoken freely of their pernicious influence in Poland, and having called the authors of the Gunpowder Plot in England 'malefactors.' Braun, who wrote a critical work on Polish literature, gives the following judgment: 'This author (Piasecki) told the truth to his countrymen as well as to foreigners; he divulged the intrigues of the papal legate, Annibal of Capua; he discovered the perjury of another legate, Malaspina; he said that the French league had nothing holy but its name; he inveighed against intolerance in Bohemia and Hungary; he raised his eloquent voice in favour of liberty of conscience; he reproached the Jesuits with teaching regicide in the schools of France, and proved the justice of their expulsion from Venice, Bohemia, and England; he brought to light their intrigues at the court of Poland, and maintained that they were the cause of the wars with Sweden, Turkey, Muscovy,' &c. &c.

Among the historians of that period we may mention Bzowski, the continuator of Baronius's 'Ecclesiastical Annals.' He was born of a distinguished family in 1567. Having entered the order of St. Dominic, he was for some time professor of philosophy at Milan, and of divinity at Bologna. On his return to Poland he was made superior of the Dominican convent at Cracow. He went finally to Rome, where he engaged in his 'Ecclesiastical History,' and remained till his death in 1637. The continuation of Baronius, which contains the events from 1198 to 1572, is comprehended in twelve volumes, of which only nine were printed. The work is written with extraordinary research, but it raised much enmity against the author by three circumstances. In the first place, by not having spoken with sufficient respect of John Scotus, surnamed 'Doctor Subtilis,' he offended all the orders which follow the rule of St. Francis; 2dly, having mentioned in a slighting manner a production of St. Hildegarda, he excited the most violent hatred of the Jesuits; and 3dly, the Elector of Bavaria was so angry with him for having written against the emperor Louis IV. of Bavaria, that he ordered his chancellor Hervart to write a refutation of Bzowski, who was ultimately compelled to retract what he had written about the emperor. Bzowski published also a great number of works in Latin, and a few in Polish. Bayle, who gives in his 'Historical Dictionary' a very extensive article on him (under the name of Bzovius), states that it has been remarked of him that it would be no exaggeration to say that Bzowski wrote more works than other persons have read. Lasicki was the author of a history of the Bohemian brethren, and of a 'Treatise on the Samogitian or Lithuanian Mythology.' John Krasinski wrote a description of Poland, entitled 'J. Crassini Polonia,' &c., Bononiæ, 1574: it was written for Henry of Valois (III. of France), when he was elected king of Poland, and contains a political description of that country. It is remarkable for the beauty of its style, and was attributed by Thuanus to the celebrated Sigonius, who was the tutor of Krasinski. This assertion was however proved to be erroneous; Sigonius only induced Krasinski to undertake the work. The celebrated geographer Cluverius (1580-1623), born at Danzig, and partly educated at the court of Poland, belongs also to the authors of that country. We must add to the list of the Polish historians, Papiocki, the author of a genealogical work on the noble families of Poland, published at Cracow, 1578, with many wood-cuts. He also wrote a similar work on Bohemia and Moravia.

Many of the works which have been enumerated were published in the collection of Pistorius, at Basil, 1582, in 3 vols., folio entitled 'Polonicae Historiae Corpus,' &c., and in the Elzevirian collection, 'Rerum Publicarum,' entitled 'Reipublica, sive Status Regni Poloniæ,' &c., Leyden, 1626.

The study of law was not neglected in Poland during this period of its intellectual elevation. A collection of laws was made, containing the code of Casimir the Great (1374), and all the enactments from that time, with the addition of Saxon or Magdeburg law, by which the towns of Poland were governed; this was the work of Raymundus Neapolitanus, and was published, by order of King Alexander I., by the Chancellor John Laski, in 1506, at Cracow. This valuable collection is the only one which obtained a legal sanction. Another collection was published by order of King Sigismund I., at Cracow, 1532; but it never obtained a legal sanction.

James Przyluski was originally a Roman Catholic clergyman, but he embraced Protestantism, and became a public notary of the district of Cracow: he arranged the laws of his country according to the Roman method, 'secundum jus personarum, rerum, et actionum,' Cracow, 1553. This work, although undertaken by order of the king, never obtained a legal sanction, which was mainly owing to the great opposition of the Roman Catholic clergy, on account of the bitter invectives against that body in which Przyluski indulged in his 'Prototypon,' which he had published as a prospectus to his work. John Herburt, castellan of Sanok whom we have mentioned among the historians of his country, published, in 1563, a collection of the laws of Poland in Latin, arranged in alphabetical order. This collection, although never formally sanctioned, was recognised in the courts, and has been reprinted several times. Collections of laws in the national language were published at Cracow in 1560, 1578, and 1581. Stanislaus Sarnicki, already mentioned as an historian, published in Polish a large work, divided into twelve books, on the laws of his country. But the most ample and best collection of the Polish laws, published during this period, is that of Januszowski, Cracow, 1600.

The mathematical sciences and the different branches of natural philosophy were also cultivated with considerable success in Poland during this period. Besides Copernicus, the university of Cracow produced several eminent mathematicians. Martinus of Olkusz (not to be confounded with another mathematician of the same name) received his doctor's degree at Cracow, and became professor of astronomy in the university of that town. This university, being invited by Pope Leo X. to present a project for the reform of the calendar, commissioned Martin of Olkusz to perform this task, which he did in his treatise 'Nova Calendarii Romani Reformatio.' Leo X. signified to the university of Cracow his entire approbation of this work; but the reformation of the calendar was postponed by the important events which agitated Europe, and particularly the church, during Leo's pontificate, and it was not effected till 1583, under Gregory XIII. The change was made however entirely according to the plan proposed by Martin of Olkusz. Although his name was not mentioned on that occasion, an autograph copy of the treatise of Martin of Olkusz has been preserved, and serves as the means of restoring the honour of the reform of the calendar to the real author. He died in 1540.

Stanislaus Grzebski (1526-72) wrote the first work on geometry in Polish, 1566. Peter Slowacki, professor of mathematics in the university of Cracow, assisted in the reformation of the calendar at Rome; and a letter of Pope Gregory XIII., giving great commendation to this mathematician, is still extant; he left almanacs. Broscius, a name Latinized from Brozek (1581-1652), canon of Cracow and rector of the university, was not only deeply versed in the mathematics, but was well acquainted with Greek, Latin, and Hebrew, metaphysics, divinity, medicine, and even music. Besides several works on different subjects, he wrote several mathematical treatises, and a defence of Aristotle and Euclid against Ramus. He was also the author of a severe work against the Jesuits.

Sendzivoy or Sendivogius (1565-1645) acquired a certain reputation over all Europe by his alchemical vagaries. Andreas Mirowski published, in 1596, a 'Theory of Winds;' Willichius, in 1523, a treatise 'De Salinis Cracovianis;' Simon of Lovicz wrote 'De Herbarum Virtutibus,' with figures, 1537; Stephen Falimierz wrote in Polish on different branches of natural history connected with medicine, 1534; Hieronymus Spiczyuski, alderman of Cracow, and physician to King Sigismund Augustus, wrote in Polish a work on animals, plants, and the birth of man, 1534—one part relating to plants, entitled 'Herbarium,' &c., was published with many additions by Siennik, in 1568; the 'Herbarium' of Martin of Urzendow appeared in 1595. But the most remarkable of all the botanical works of that period was that of Simon Sirenski, professor of medicine at Cracow, 'On the Nature and Use of Plants,' Cracow, 1614: it was published at the expense of the Princess Anna Vasa, sister of King Sigismund III., who was a great lover of botany, and left an herbarium, which was collected and arranged with her own hands. The work contains all that was known at that time, and is adorned with many woodcuts. Many authors suppose Zaluzianski, who wrote in the latter part of the sixteenth century his 'Methodus Herbarum,' in which he establishes the sexual differences of plants, a discovery which was neglected till the time of Linnæus, to have been Pole, but it is more probable that he was a Bohemian.

There were several works on rural economy, the breedin of cattle, keeping of fishponds, bees, &c.. the best is 'Hippica,' or a work on horses, by Monivid Dorohostayski, grand-marshal of Lithuania, an accomplished nobleman. This work was published at Cracow, 1603, with many fine engravings.

Works on medicine were published by Wedelicki, Cyprianus of Lovicz, Peter of Kobylin, and others; but the most distinguished physician of the period was Joseph Strut, (1510-1668), who became professor of medicine at Padua, where he acquired a great reputation by reviving the doctrine of Galenus about pulsation, in his treatise 'Artis Sphygmicæ, jam mille ducentos annos perditæ et desideratæ, Libri V., Struthio Posnaniense,' &c., Venet., 1583, a work which makes an epoch in medicine. He wrote a large number of other works: and his renown was such that he was invited to Constantinople by Sultan Solyman, whom he treated with great success. He died as physician of King Sigismund Augustus.

Military science could not be neglected in a country like Poland, which was constantly involved in war. Albert, duke of Prussia, a vassal of Poland, wrote a great work on the art of war, which he dedicated to King Sigismund Augustus, and sent to him, in German and Polish, the manuscript copy: the work has never been printed. John Tarnowski, grand general of Poland, and one of the most eminent soldiers and statesmen whom that country ever produced, published, in his own estate of Tarnow, a treatise entitled 'Consilium Rationis Bellicæ,' 1557. A great work on antient and modern military science in Polish, was published in 1569. Adam Freytag, a native of Thorn, and professor at the Protestant school of Keydany, wrote in German a work on fortification, with many engravings: printed at Leyden by Elzevir, in 1631: it was dedicated to Vladislav prince royal of Poland, and was much esteemed all over Europe.

This is a brief outline of the state of Polish literature during its golden age, which begins with the reign of Sigismund I., 1508, and ends with that of Sigismund III., 1632. We have enumerated the causes of this extraordinary development of the national intellect during that period, which is mainly to be attributed to the prosperous condition of the country, its political importance, the political and religious liberty which did not yet degenerate into licence, and the safety from every kind of oppression enjoyed by its citizens, advantages which attracted to Poland many eminent foreigners, who sought there a refuge from persecutions. The progress of literature and science in Poland was particularly indebted to the exertions of the superior ranks of society, the court, the nobles, and the higher clergy. It is a particular trait which distinguishes this period of Polish civilization, that notwithstanding the bitterness of theological controversy, which divided the country into many parties, there were numerous instances of scientific and literary intercourse, carried on with all the marks of friendship and personal esteem, between individuals who were divided by religious tenets, which they warmly defended by their writings. There are indeed instances of eminent noblemen, and even prelates, patronizing individuals who professed a different faith. But the reign of Sigismund III. wrought a melancholy change in the intellectual condition of Poland. This narrow-minded and bigoted king, during a reign of 40 years, pursued only one object, the extirpation of all the confessions that were opposed to Rome, and the establishment of an undivided papal dominion in Poland. He attained that object by sacrificing every interest of the country; and although the great number of eminent men who were educated during the fortunate reigns of Sigismund Augustus and Stephen Battory counterbalanced for some time the growing evil, the mischievous policy of the king finally prevailed, as those distinguished persons gradually disappeared. Prevented by the laws of Poland, which guaranteed perfect religious liberty to its citizens, from employing open persecution, he, or rather the Jesuits, whose tool he was, advanced this project with great success, by artifice and cunning. Sigismund III. gloried in the nickname of 'the king of the Jesuits,' by whom he was surrounded, and whose patronage was the only road to preferment.

This patronage could only be secured by a display of zeal for the interests of Rome in general, and for those of their order in particular. The king having the distribution of all the chief dignities of the state, and the gift of the starosties, or crown domains, which were granted for life, these advantages were obtained not by services to the country, but by gaining the favour of the Jesuits, whose wealth increased by private donations so rapidly, that in 1627 they had 400,000 dollars (about 100,000*l.* English money) of yearly income. Their colleges spread over all Poland, and at the close of Sigismund's reign they had 50 schools, in which a great part of the children of the nobles were educated. Their riches and the number of their schools went on increasing, for their pupils became the most ardent promoters of their views. The system of education adopted in those schools was calculated not to elevate, but to depress the understanding, and was ably exposed by the learned Broscius, who, although himself a Roman Catholic clergyman, and attached to his church, severely attacked (in a book entitled 'Dialogue of a Landowner with the Parish Priest') the retrograde movement which these priests were giving to the national intellect. Unable to avenge themselves on the author, the Jesuits persecuted the printer, who was at their instigation publicly flogged and banished. There were several Protestant schools in Poland, but some of them were destroyed, as well as the churches of the same confession, by a lawless mob excited by the Jesuits, whose protection insured the impunity of these rioters. The Socinian academy of Rakow, which was celebrated all over Europe, and where pupils belonging to different religions were educated, was abolished by a decree of the diet in 1638, in consequence of two pupils of that school being charged with having thrown stones at a cross. This measure, obtained by the growing influence of the Jesuits, was followed by the abolition of the two remaining Socinian schools, Kisielin and Beresteczko in Volhynia. The Protestant schools, generally supported by voluntary contribution, were unable to enter into competition with those of their antagonists, which had ample endowments. Many of the former schools, deriving their support from the liberality of great families, ceased to exist, or were converted into Roman Catholic establishments, as soon as their patrons returned to the old faith. The consequences of all this were fatal to the national intellect of Poland; and the literature of that country, which produced so many splendid works in Latin and in Polish, can scarcely boast of any production of merit from that epoch to the second part of the eighteenth century, which was the period during which the Jesuits had unlimited power over the national education. The Polish language, which had attained a high degree of perfection during the preceding period, was soon corrupted by an absurd admixture of Latin and barbaric phrases, called 'macaronic,' which disgraced Polish literary productions for more than a century. As the chief object of the Jesuits was to combat anti-Romanists, the principal subject of their instruction was polemical divinity; and the ablest of their students, instead of acquiring information which might enable them to become useful members of society, lost their time in dialectic subtleties and quibbles. The Jesuits, well aware that vanity is the most accessible of human weaknesses, were as prodigal of praise to their partisans as they were lavish of abuse on their antagonists. Thus the benefactors of their order became the objects of the most fulsome adulation, which nothing but the corrupted taste acquired in their schools could have rendered palatable. Their bombastic panegyrics, lavished on the most insignificant persons, were almost the only literature of the country. The censorship was established in 1618, and the first 'Index Librorum Prohibitorum' was published about that time. Not only the progress of literature was arrested by the influence of the Jesuits, but a great number of valuable productions of the preceding period were destroyed by them, in order to obliterate every vestige of heresy. The families and individuals who passed from Protestantism to Romanism surrendered their libraries to the Jesuits, who delivered them to the flames; they even purchased at a high price all books and documents relating to Protestantism, in order to destroy them. Thus although they were unable to exterminate literary productions belonging to a period of religious liberty with the same violence as they did in Bohemia, they destroyed a great quantity of valuable documents relating particularly to the religious history of Poland.

Notwithstanding this melancholy decline of mental cultivation, Poland produced, in the beginning of this period, some few authors of note. Such were Twardowski (1600-1560), author of several descriptive poems in Polish; Bardzinski, translator of Lucan and other Latin authors; Birkowski, a celebrated Roman Catholic preacher; Kochowski, a Latin poet, and author of a history of Poland from 1648 to 1675, in Latin; Rudawski, a history of Poland, 1641-

1660. Starovolski, who died in 1656, at a very advanced age, is the author of a great number of historical and biographical works. Wengierski, a Protestant clergyman, is the author of a history of the Slavonian churches; and Lubieniecki, a learned Socinian, is the author of the 'Historia Reformationis Poloniæ.' Siemienowicz, a native of Lithuania, an officer who served a long time in the Dutch armies under the Prince of Nassau, wrote a work on artillery, entitled 'Artis Magnæ Artilleriæ Pars Prima; auctore Cazimiro Siemienowicz, equite Lithuano, olim Reg. Pol. Artilleriæ Propræfecto,' Amstelodam, 1650. Death prevented the author from publishing the second part; but this work, even in its incomplete state, was considered as classical in all Europe, was translated into French and German, and the military authors of the seventeenth century cited Siemienowicz as the most important authority on all that referred to artillery. To this period belongs also the astronomer Hevelius (1611-1687), a native of Danzig, and alderman of that city, where his works were published. He was liberally supported by John Sobieski, in honour of whom he named a constellation Scutum Sobiescianum. The Protestant high school at Leszno or Lissa, supported by the powerful family of Leszczynski, attracted students not only from Poland, but also from Prussia, Silesia, Moravia, Bohemia, and even Hungary. At a time when the university of Cracow and the Jesuits' colleges in Poland, and the Roman Catholic as well as Protestant schools of Germany, followed the old methods of instruction, which were calculated only to waste the precious time of the pupils, the professors of Leszno dared to open a new road in that important field. Comenius, who acquired celebrity over all Europe by his efforts to improve the methods of education, composed for the school of Leszno his celebrated work 'Janua Linguarum reserata,' which greatly facilitated the acquisition of foreign languages. The same school was honoured by the co-operation of another learned individual, Dr. Johnstone, who acquired a great reputation all over Europe by his works, particularly on natural history. He was born in 1603, at Szamotuly or Sambter, in Grand Poland, of a family descended from the Johnstones of Craigbourne in Scotland, and which like many other Scotch families have settled in Poland. After having received a preparatory education in the schools of his native land, he went, in 1622, to England, and continued his studies there and in Scotland till 1625. He returned thence to Lissa, which he left in 1628, and studied medicine in some of the universities of Germany, and in Leyden, London, and Cambridge. Having returned to Poland, he left it after some time again as tutor of two Polish noblemen, with whom he revisited London and Cambridge, where he received the degree of Doctor of Medicine, after which he continued to travel over other parts of Europe till 1636, when he settled at Lissa. He refused the chairs of medicine which were offered to him in 1642 by the universities of Leyden and Frankfort on the Oder; but the wars which agitated Poland from 1653 to 1660 compelled him to leave that country. He retired to Silesia and remained on an estate which he had purchased, till his death in 1675. His principal works are:—'Thaumatographia Naturalis in 10 classes divisa,' &c., Amsterdam, 1632, 34, 61, and 66; 'Historia Universalis, Civilis, et Ecclesiastica, ab orbe condito ad 1633,' Leyden, 1633 and 34, Amsterdam, 1648; Frankfort, 1678, continued till that year; De Naturæ Constantia,' &c., Amsterdam, 1632; translated into English and published at London, 1657, under the title 'The History of the Constancy of Nature,' wherein, by comparing the latter ages with the former, it is maintained that the world does not universally decay, &c. 'Systema Dendrologicum,' &c., Lissa, 1648; 'Historia Naturalis de Piscibus et Cetis,' Frankfort, 1646; 'De Quadrupedibus, Piscibus, Avibus, Insectis, et Serpentibus,' 2 vols., Frankfort, 1650; this edition is much praised on account of the plates executed by the celebrated Merian; 'Idea Medicinæ Universæ Practicæ,' &c., Amst., 1652-64; Leyden, 1659. 'Hist. Nat. de Insectis,' Frankfort, 1653; 'Hist. Nat. Animalium, cum figuris,' 1657, 2 vols., translated into English and published at Amsterdam, under the title 'A Description of four-footed Beasts, illustrated by copper-plates,' &c. 'Notitia Regni Vegetalis,' Lipsiæ, 1661; 'Dendrographia, seu Hist. Nat. de Arboribus et Fructibus, Syntagma Medicinæ,' Jena, 1674; 'Idea Hygeinæ,' Jenæ, 1674. 'Notitia Regni Mineralis,' Lips., 1661; 'De Festis Hebræorum et Græcorum,' Breslau, 1660; 'Polyhistor, seu Rerum ab Ortu Universi usque ad nostra Tempora, per Europam, Asiam, Africam, et Americam, in sacris et profanis gestarum, succincta et methodica Enarratio,' Jena, 1660. The number of books which Johnstone published, and that of their editions, prove his great talents and learning, as well as the high esteem in which he was held by his contemporaries.

The wars in which Poland became involved under the reign of John Casimir extinguished the remnant of learning in that country, which was overrun by Swedes, Muscovites, Transylvanians, and the revolted Cossacks; and it was also distracted by domestic factions. Leszno was burnt with its school, in 1656, and many learned establishments, private and public libraries, shared the same fate. From that time Poland continued to be agitated by foreign and domestic wars, till it found a momentary interval of repose under the rule of the heroic John Sobieski, whose brilliant victories threw a halo of glory over the declining fortunes of Poland, although they assured no real or permanent advantage to the country. The first part of the reign of king Augustus II., elector of Saxony (elected in 1696), was agitated by the invasion of Charles XII., who dethroned him, and by his misunderstandings with the nation, which were settled by the diet of 1717. The calamities of every kind which had desolated Poland during nearly 70 years, plunged that country into a stupor, and the profound peace which it enjoyed from 1717 to the demise of Augustus III., 1763, except the transient disturbance which took place at his election, deprived it of all its energy. Poland had still a large territory, and preserved its antient institutions, but it was plunged into a kind of intellectual and political lethargy.

There were some individuals, educated chiefly abroad, who deeply felt the moral degradation of their country, and exerted themselves to awake the slumbering energies of the nation. Stanislaus Lesczinski, having been expelled from the throne of his country for the second time in 1733, became sovereign of Lorraine, where his paternal and enlightened rule proved what a misfortune it was for Poland to have lost such a king. He educated many young Polish nobles at Luneville, and made them into useful and patriotic citizens, who greatly contributed to the restoration of learning in their country. The man to whom Poland owes most in that respect was Stanislaus Konarski, who was born in 1700, of a distinguished family. At the age of seventeen he entered the congregation of the Patres Pii; and in his 25th year went to Rome, where he continued his studies for four years. He afterwards travelled through Italy and France, and remained for some time at Paris. On his return to his country he was struck with the miserable state into which it was plunged; and he perceived that among the numerous causes of mischief there was the want of a regular code of laws, and that the existing collection served only to increase the confusion. Resolving therefore to obviate that defect, he collected with great care all the laws of Poland from the time of Casimir the Great to the year 1739, which he published under the title of 'Volumina Legum,' with a learned preface on the legislation of Poland. Having joined the party of Lesczinski during the interregnum of 1733, he followed him to Lotaryngia; but returned to Poland in 1738, and devoted himself to teaching in the schools of his congregation. Being entrusted with the office of the provincial of his order in Poland during the years 1742-3-4, he reorganised its schools, and introduced a better system of instruction. He established a college at Warsaw under his own direction, wherein he educated, with the assistance of the most enlightened members of his congregation, a great number of youths, who became most useful citizens. In his works he attacked not only the corrupt state of literature and of public eloquence, but even dared to point out the vices of the constitution, and particularly the mischief of the 'Liberum Veto.' This brought on him a great number of enemies, but created at the same time many friends and admirers. His house became a point of union for the most enlightened patriots. Konarski refused the episcopal dignity, which had been offered to him several times, lest he might be disturbed in the pursuit of his useful avocation, which he continued till his death, at the age of seventy-three. This enlightened and patriotic clergyman was also a pattern of Christian piety and charity. The impulse which he gave to his congregation of the Patres Pii continued for a long time, and this congregation ranked among its members many eminent authors. Next to Konarski, the two brothers, Andreas Zaluski, bishop of Kieff, and Stanislaus, bishop of Cracow, did great service to learning in Poland by collecting at their own expense an immense library of 200,000 vols., of which 20,000 were Polish works. The former of them, who possessed extraordinary erudition, particularly in all that related to Poland, was the author of several works. They gave this splendid library to the public in 1745. Many distinguished persons patronised literature, but none so much as the family of the Princes Czartoryski. This powerful family undertook to effect a great and salutary revolution in Poland by transforming the disorderly republic into a well-organised monarchy; and as this could only be done by preparing public opinion for such a change, they sought out and patronised men of superior talents, and such as by their writings exerted or might exert an influence on public opinion. This revival of the national intellect continued to advance, notwithstanding the melancholy circumstances of the country, which lost a great part of its territory by the first dismemberment of 1772. King Stanislaus Poniatowski, although a weak man, and unfit to hold the helm of the state in such troubled times, was an accomplished scholar; and Poland owes him a debt of gratitude for having promoted national education, which is the main cause of that unconquerable spirit of nationality which continues to animate the Poles under the most adverse circumstances. He patronised literary men of merit, admitted them to his intimacy, and invited them regularly one day in the week to his table, where a perfect freedom of speech animated a lively and learned conversation. A board of public education, composed of the most eminent men of the country, was instituted in 1775; and Poland thus set the example of establishing a department for the promotion of the most important object of national welfare. The estates of the order of the Jesuits, which was abolished in 1773, were assigned to the support of schools, which were organized chiefly by the exertions of Count Ignatius Potocki, who formed a complete plan of instruction for the schools preparatory to the universities. By his advice a society for the composition of school-books was instituted, and programs for that object were issued, by which all the authors of Europe were invited to enter into competition for the prizes which were offered. The school-books which were written in consequence of this measure were introduced into the schools. The Institute of Cadets was established under the superintendence of Prince Czartoryski, where the union of a classical and military education produced many distinguished individuals, several of whom, like Kosciuszko and Niemcewicz, reflected honour on their country during the eventful times which preceded its destruction. The universities of Cracow and Vilna, which had fallen into a state of decay, were entirely re-organized and rendered highly efficient, the chairs being supplied with able professors, both natives and foreigners. The libraries and cabinets were also increased by the acquisition of books and instruments.

The Polish clergy participated in the intellectual movement which animated Poland, and the church of that country may claim for many of its members the honour of having greatly contributed to the moral and intellectual progress of the nation. Several individuals who had belonged to the order of the Jesuits distinguished themselves by their literary labours.

Adam Naruszewicz, born in 1733, of an antient Lithuanian family, entered the order of the Jesuits in 1748. He continued his studies at their college at Lyon in France; and on his return to Poland, was professor in the schools of the same order till its abolition. He was created, by King Stanislaus Poniatowski, bishop and secretary of state of Lithuania, and died in 1796. His translation of Tacitus (1772), in the conciseness and energy of the style, is equal to the original. His History of Poland, which contains the period from the establishment of the Christian religion to the death of Louis of Hungary (965-1382), first edition 1780-1786, from vol. 2 to 7, is written in a style equal to his translation of Tacitus, with much impartiality and sound criticism; and it is founded on materials collected with immense research. Death prevented Naruszewicz from completing this work; and the first volume, containing his valuable researches on the state of Poland previous to the introduction of Christianity, was published from his manuscripts only in 1824. Naruszewicz occupies an equal rank as a poet by his satires, odes, eclogues, and many successful translations of the classics, particularly of Horace and Anacreon.

Count Ignatius Krasicki, born in 1734, of a distinguished family, and destined for the church from his earliest youth, received a part of his education at Rome, travelled over different parts of Europe, and, having taken orders, was rapidly advanced, and became bishop of Warmia or Ermeland, an exceedingly rich see, with the title of prince attached to it. The diocese being seized by Prussia at the first dismemberment of Poland, he could no longer take any active part in the affairs of his country, but he continued to render it great services by his literary productions. In 1795 he was created archbishop of Gnezno, and died at Berlin in 1801. Krasicki is the most remarkable, and deservedly the most popular author of Poland. His fables, which all the children in Poland know by heart, are generally so short that they resemble epigrams: they are characterised by great wit, charming simplicity, and a pure morality. His satires may vie with the best productions of this kind in any language, and are written in the most beautiful and easy verses: they are free from every personality; they attack national but not individual foibles. He strictly adheres to the following precept, established by himself in one of his satires: Satire tells the truth, but insults no person: it honours the government, reverences the king, but judges the man.' These satires, although they scourge vice in all its forms, are written in such a tone that they may be safely read by persons of every age and sex, a praise which unfortunately cannot be bestowed on the satires of Naruszewicz. Myszeis, that is, the 'Mouseide,' or the 'War of Cats and Mice,' an heroic-comic poem, full of wit, animated description, and cutting raillery against the national faults. 'Monachomachia,' or the 'War of Monks,' a burlesque poem in six cantos, contains a witty satire on the ignorance and laziness of the religious orders. Yet although the clergy are severely lashed in this poem, the author is never guilty of throwing ridicule on religion. It is related that when the author came on a visit to Frederick II. at Potsdam, he lodged him at Sans Souci, in the same apartments which had been occupied by Voltaire, saying that he should write there something very clever, and it was in that apartment that the 'Monachomachia' was composed. This poem having irritated many persons, Krasicki wrote his 'Antimonachomachia,' in which he attacked the offended parties with so much wit and good satire, that they became reconciled to him. His epic poem, the 'War of Khotzim,' which describes the memorable events of 1621, cannot claim the name of a real epic poem, but it contains many beautiful images, and some passages which may called sublime. He also made an excellent poetical translation of 'Fingal and some other parts of Ossian, which rendered those poems exceedingly popular in Poland, and he wrote a great number of fugitive poems. Among his prose works the most remarkable are 'Podstoli,' which exhibits a virtuous landowner, a work designed to correct the defects of the Polish gentry, and which contains a beautiful picture of the national manners and customs; and a novel entitled 'Doswiadczynski' (that is, The Experienced), of a moral and satirical description. He left several comedies, which were published under the name of his secretary, Mowinski. Bohomolec (died in 1790) wrote the first comedies in Polish, the 'Lives of John Zamoyski and George Ossolinski,' &c., and he edited 'A Collection of National Chronicles.' John Albertrandy, a bishop, born of an Italian parent, devoted his long life (1732-1808) to archaeological studies and historical researches relating to Poland, for which purpose he visited several countries, and particularly Sweden. He left some valuable works on national history, of which the greatest part remain still in manuscript. Wyrwicz was the author of several esteemed historical and geographical works. Wengierski (died in 1787), was a witty and agreeable, but sarcastic poet, whose works are unfortunately tainted with the loose morality of the French school of that age. Kniaznin was a successful writer of odes, eclogues, and fables. Trembecki, who died at a very advanced age (1812), has not written much, but his poems, chiefly lyrical and descriptive, are splendid. The best is 'Sophiofka,' or a poetical description of a celebrated park in the Ukraine belonging to the countess Sophia Potocki. Francis Karpinski translated the Psalms, and wrote eclogues and songs, which are characterised by great simplicity and deep feeling, and have become so popular, that they are sung by the common people in all parts of Poland. Having received, in 1771, an estate from the king, situated in the forest of Bialaveja, a wild part of Lithuania, he remained in that rural retreat till his death in 1825, devoted to literature and to the welfare of his tenantry. He wrote also several other works, and among them an 'Autobiography,' published at Wilna, 1834.

Many literary journals appeared during this period, but the best was the 'Monitor,' which was continued from 1764 to 1784, on the same plan as the English 'Spectator,' from which it contains many translations adapted to circumstances and the national manners.

The political dissolution of Poland in 1795 did not arrest the intellectual movement by which the nation was animated. A number of patriotic citizens founded at Warsaw the Philomathic Society, with the object of promoting science and national literature. The university of Wilna, which was included in that part of Poland that was taken by Russia, received a new and superior organization, and an excellent system of public education was established, under the superintendence of the same university, in all the provinces dismembered from Poland. This was done chiefly by the instrumentality of Prince Adam Czartoryski, as a preparatory measure for the restoration of Poland under the sovereignty of the emperor Alexander, an idea which was suggested by Prince Czartoryski, and which seems to have been fondly cherished for some time by Alexander.

The patriotic exertions of Prince Czartoryski were powerfully supported by those of Count Czacki, who by his exertions established the High School of Krzemieniec, in Volhynia, which has promoted education in a very effective manner in the southern provinces of antient Poland that have been incorporated with Russia. The same Count Czacki is the author of a 'History of the Polish and Lithuanian Laws,' and other justly esteemed works.

Niemcewicz, born in 1765, and educated in the School of Cadets, distinguished himself by his eloquent arguments in favour of the introduction of useful reforms, and the abolition of antient abuses, at the diet, which lasted four years (1788-92), and which established a new constitution, by which the 'liberum veto' was abolished, and the hereditary character of the throne established. In 1794 he fought for the independence of his country as an aide-de-camp of Kosciuszko, was made prisoner with him, and kept in the dungeons of St. Petersburg till the emperor Paul released them both on his accession to the throne. He accompanied Kosciuszko to England and the United States, where he married and remained several years. He returned to his country only after the creation of the duchy of Warsaw in 1807, in order to devote his service to the re-awakened hopes of the national restoration. He filled several important offices, and after the establishment of the kingdom of Poland by the congress of Vienna, he was made secretary of the senate. During the national insurrection of 1830-31, he was created a senator by a decree of the national representation, and died in 1841, as a refugee at Paris, occupied, till his last moments, with literary pursuits tending to patriotic subjects. The numerous works published by this eminent individual are not only written with great talent, but have always a patriotic object. His principal productions are 'Historical Songs of Poland, with Music and Engravings,' a work composed with the view of rendering popular the most important events of the national history, and which has been attended with the greatest success; 'The History of the Times of Sigismund III.,' 3 vols., with engravings; 'A Collection of Memoirs relating to the Ancient History of Poland;' 'Levi and Sara, a Novel in Letters, or a Picture of the Condition of the Polish Jews,' which has been translated into English; 'John of Tenczyn,' an historical novel; 'Fables and Tales in Verse,' distinguished by their beauty, wit, and agreeable versification. He has also translated many poems from foreign languages, amongst others, that of the 'Rape of the Lock,' by Pope. John Sniadecki is equally distinguished by his works on astronomy and on literature; and his brother Andrew, by his works on different branches of natural philosophy. Woronicz (died in 1829, as archbishop of Warsaw) was an eminent poet and a first-rate preacher; but the authors who have exercised the greatest influence on their countrymen, and who enjoy the highest reputation among the Polish writers, are Lelevel and Mickiewicz.

Joachim Lelewel, born at Warsaw in 1786, was educated in his native town. He completed his studies at the university of Wilna in 1809. He became professor of history, at Krzemienietz in Volhynia in 1814, and public lecturer on the same subject at Wilna. In 1816 he was called to the newly created university of Warsaw as professor and librarian, and in 1821 he obtained the chair of history at Wilna. His popularity continued unabated till 1824, when the Russian government, taking the alarm, deprived Lelevel of his chair He retired to his native town, and continued to devote himself to his literary pursuits; but he was elected nuncio to the diet of 1829, and the revolution of 1830 called him to great activity. He was elected member of the supreme executive government, and retired, after the fall of the Polish cause, to Paris, which he was obliged to leave in 1832, at the instigation of the Russian ambassador; he remained for some time in the country-seat of his friend General Lafayette, but was finally obliged to retire to Belgium. The number of his works, which are full of the deepest historical research, is startling. The principal are a 'History of the Nations which inhabited central Europe previously to the tenth century;' 'Researches on the Geography of the Antients;' 'The History of Antient India and of its Influence on the Nations of the West;' 'The Discoveries of the Carthaginians and Greeks in the Atlantic;' besides many other works relating to the history, bibliography, legislation, and diplomacy of Poland. During his exile, he published at Brussels 'Numismatique de l'Europe en Moyen Age;' 'Histoire Numismatique de la Gaule,' &c. Many of his works are translated into German.

Adam Mickiewicz was born at Nowogrodek, in Lithuania, in 1798, of an antient family. He entered the university of Wilna in 1815, and was appointed a few years afterwards teacher in the school of Kowno. His poetical talent developed itself at an early age, but although he became in the course of his studies thoroughly acquainted not only with the beauties of classical poets, but also with those of the modern nations of Europe, his muse chose the hitherto untrodden path of the popular poetry. Mickiewicz perceived the beauties which were contained in the songs, traditions, and tales of the people of Lithuania, and he created from those materials a really national poetry. His ballads and other poems of a similar description, published in 1822, obtained at once a great and deserved popularity throughout all parts of Poland. In 1823, when the Russian government began to oppress the university of Wilna, Mickiewicz, being accused of belonging to a secret patriotic society, was kept for some time in prison, and afterwards sent, with many other young men, into the interior of Russia. His talents, agreeable manners, and high moral qualities inspired the Russians among whom he was placed with the greatest respect, and his exile proved to him a source of triumph, for he was treated with the greatest distinction, and Russians learned Polish in order to read the productions of Mickiewicz, which were translated into their language, and were no less admired by them than by the Poles. Prince Gallitzin, general governor of Moscow, attached him to his person, paid him the greatest attention, and took him to St. Petersburg, where he met with the most flattering reception in the drawing-rooms of that capital. Yet neither the favour of the Russian public, nor the most flattering distinction of the powerful which insured for him a rapid preferment and a situation of comfort and ease, could shake for a moment the patriotic feeling of Mickiewicz, which breathes in all his productions written and published during his residence in Russia. The principal of these productions are, 'Dziady,' that is, 'Ancestors,' founded on the festival of that name, which has been retained from the pagan times to the present day in Lithuania, and the object of which is to propitiate the souls of departed ancestors with meat and drink. This wild and original poem contains many beauties of the first order. 'Grazyna, a tale;' 'Ode to the Youths,' and 'Faris, or the Arabian Horseman,' both splendid compositions; a beautiful English translation of the last appeared in the 'Metropolitan Magazine,' November, 1831. 'The Polish Mother,' is a heart-rending elegy; Conrad Wallenrod,' a tale in verse, from the history of Lithuania, displays great poetical beauties, and is full of patriotic allusions to the present times. It has been translated into several languages, and a fine metrical translation in English by Mr. Catley appeared in 1841, besides one in prose at Edinburgh in the same year by Jablonski. The 'Books of the Polish Pilgrimage,' of which an English translation appeared in 1833, is a pure imitation of the Biblical language, and contains a poetical image of the past of Poland, and a prediction of its futurity. The Abbé de Lammenais took from it the idea of his 'Paroles d'un Croyant.' Both these productions, although full of a deep religious feeling, were condemned by the pope as having a democratic tendency. 'Pan, or Mr. Thaddeus,' a tale in verse, contains an exceedingly clever picture of country-life in Lithuania, and has a great value on account of its truly national character. Mickiewicz, who has been for some time professor of Latin literature at the university of Lausanne in Switzerland, was lately appointed professor of the Slavonic languages and literature at Paris.

Casimir Brodzinski (1791-1835) served in all the French wars from 1809 to 1813, as an officer of Polish artillery, and was afterwards professor of literature at the university of Warsaw. He perceived, even before Mickiewicz, that the songs of the Polish people presented rich materials for a truly national poetry, and in 1811 he published his 'Village Songs.' When Mickiewicz's poems appeared, they created a great sensation, and found not only warm admirers, but also violent antagonists, chiefly amongst the adherents of the French school, who, calling themselves classical, condemned the opposite, or Romantic school; Brodzinski warmly espoused the latter, and contributed greatly to its success by his writings, being one of the best critics in Poland. He left a great number of works on different branches of literature which have not yet been collected: several of his poems have been translated into English by Dr. Bowring. Louis Osinski, who was for a long time director of the theatre at Warsaw, translated several tragedies of Corneille and Racine. Felinski wrote a tragedy called 'Barbara Radziwill,' which, with that of 'Ludgarda,' by Kropinski, are considered the best in the Polish language. The greatest services to the national theatre were however rendered by Boguslawski, who began his dramatic career in 1778, and continued it almost to his death, in 1829. He left about eighty plays, original and translations, and was himself an excellent performer. To the principal authors of this period we may add Kozmian, Madame Hofman, Wenzyk, Morawski, and Odyniec, who made a beautiful translation of Byron's 'Corsair,' and many equally successful ones from Scott, Moore, Southey, &c. Great service was rendered to the Polish language by the Lexicon of Samuel Linde, 6 vols. 4to., Warsaw, 1807-14. It contains not only all the Polish words, with their etymology and quotations from the writers who have employed them, after the manner of Johnson's 'Dictionary,' but also their translation into all the written Slavonian dialects, as well as Latin and German: it is perhaps the most extensive and complete work of its kind.

The unsuccessful insurrection of 1831 was followed by the most melancholy consequences to the national language and literature of Poland. The university of Warsaw was abolished, and its library and collections, as well as those of the Philomathic Society, were transferred to St. Petersburg. The splendid library of Prince Czartoryski at Pulawy sharod the same fate. The university of Wilna was also abolished, and the library and museum transferred to Kieff, where a new university was founded. The same was done with many schools. The Russian language was substituted for the Polish in the schools of the antient provinces of Poland incorporated with Russia, where the Polish language was also abolished in judicial proceedings, in which it had been hitherto preserved. Yet notwithstanding these unfavourable circumstances, many Polish works, some of which are of considerable merit, continue to be published. The refugees in Paris have published a great number of books and pamphlets, the most remarkable of which is the 'History of the Insurrection of Poland in 1831,' Paris, 1834, 2 vols., by Mauritius Mochnacki, a young man of eminent talent. Death prevented him from completing this work, which belongs to the most valuable modern historical productions. He had published in Poland a work on the literature of that country in the eighteenth century. Wrotnowski, Pietkiewicz, and Jelowicki have also furnished valuable contributions to the history of the same insurrection. Czaykowski wrote some historical romances not devoid of merit, particularly those which relate to the Ukraine. This country, which literally signifies 'borders,' being on the boundaries of Poland, Russia, and Turkey, was for a long time the scene of many daring adventures, and the abode of a bold and enterprising but lawless race. It furnishes therefore a fine field for romance and poetry; this latter was cultivated with great success by Goszczynski, Malczewski, and Zaleski, whose poems are founded on local traditions, songs, and tales. Padura composed ballads in the dialect of the Ukraine, which frequently unite the wildness of the original poetry of that country with beauties of a higher order. The national songs and traditions of all parts of Poland have been recently collected and published at Warsaw, Wilna, and Leopol, 1833-1840.

Count Alexander Fredro published, in 1839, five volumes of comedies, which are considered the best in the Polish language, and have been performed with great success. His brother, Count Maximilian, produced, in 1837, at Leipzig, several tragedies. Many plays of Shakspere, translated by Holowinski, were lately published at Wilna. Two dramatic poems, although written in prose, and not calculated for the stage, produced a considerable sensation by the boldness of their conception and ideas, as well as the many beautiful images which they contain, and the profound grief of a wounded mind, which revolts against the existing order of things, and of which his country is a victim. One of them, 'Niebowska Komedia,' the 'Not Divine Comedy,' represents a deadly struggle between the old and new ideas which are now agitating the world. The other entitled 'Irydion' represents a young Greek born of a Scandinavian woman, who is with his sister at Rome in its most corrupted time under Heliogabalus, and who devotes all his energies in order to avenge the wrongs of his own and other conquered nations by destroying Rome through a conspiracy of gladiators and barbarians. These productions were published anonymously, but their author is known to be Count Sigismund Krasinski, a young man of great talent, who has written some historical novels. Witwicki, Gorecki, and Slowacki have recently published at Paris many successful minor poems.

Historical researches are not neglected by Polish writers. The history of Slavonian legislation, by Macieyowski, and his Memoirs on the history, literature, and legislation of the Slavonians, produced a great sensation not only among all the Slavonian nations, but among the learned Germans, into whose language they were translated. Kuchavski's work on the most antient monuments of Slavonian legislation, in 1838, was no less successful. Count Edouard Raczynski published a description of Polish and French medals with engravings. He also published at his own expense several inedited memoirs and other historical documents. The same Count Raczynski established at his won expense a public library at Posen, and supported its librarian Mr. Lukaszewicz, in his researches into the religious history of Poland, the result of which was several valuable contributions to the history of the Reformation in that country. Narbutt published in 1837, at Wilna, a detailed history of Lithuania, and many other historical contributions have recently appeared, and several literary periodicals continue to appear in different parts of Poland. We may conclude this article by observing that it is a striking proof that the love of national literature continues unabated in Poland notwithstanding its unfortunate political condition, that many works in the Polish language are frequently published and reprinted at Leipzig, and are excellent speculations.

The sources for the study of the history of the Polish language and literature are—Bentkowski's *History of Polish Literature*, Warsaw, 1814; Ossolinski's *Critical Notices on the History of Polish Literature*, 4 vols.; Juszynski's *Dictionary of the Polish Poets*; Chodyniecki's *Dictionary of Learned Poles*; Wiszniewski's *History of Polish Literature*, of which the first volume appeared in 1840.

*Bohemian Literature.*—The national literature of Bohemia is older than that of any other Slavonian country, and its monuments extend as far back as the tenth century. The most valuable remnants of antient Bohemian literature were however only recently discovered; they consist chiefly of the so-called *Kralodvorski* (queen's court manuscript), discovered by Professor Hanka in 1817, which contains the fragments of a collection of epic and lyric poems, composed apparently in the thirteenth century. This collection must have been considerable, as the fragments contain only the twenty-sixth and the twenty-eighth chapters of the third book: the loss of the remainder is much to be lamented, as the fourteen songs which have been preserved surpass all similar productions of the middle ages in their poetical beauties, deep and tender feeling, and purity of language; the form in which they are composed is peculiar, and truly national. Besides this collection of poems, there are extant about twenty poetical and more than fifty prose compositions, belonging to the earliest period of Bohemian literature, that is, before the time of John Huss. Dalimil's 'Rhymed Chronicle of Bohemia' was written in 1314; the 'Book of Instruction to his Children,' by the knight Thomas of Sztitny, in 1376; the fabulous poem entitled 'The Council of Animals,' by an unknown author of the same period, is still in general repute; a work on the judicial organization of Bohemia, by the Baron An-

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dreas of Duba, chief-justice of the country, was written in 1402 and a politico-didactic poem by the Baron Smil Flaszka of Richebourg, chief-secretary of state in 1403. To the beginning of the fourteenth century there belong several historical songs, as, for instance, on the battle of Cressy, where king John of Bohemia was killed. Many foreign works were also translated into Bohemian during that period, as, for instance, the 'Alexandreide;' 'King Arthur's Round Table;' the story of 'Tristram;' the 'Travels of Marco Polo,' &c. The emperor Charles IV. king of Bohemia founded the university of Prague, and was a zealous promoter of the national language, of which he was so fond, that he recommended in his golden bull that the electors of the empire should acquire a knowledge of it.

John Huss commenced a new period of literature for Bohemia, as Luther did afterwards for Germany. He introduced that simple and precise orthography of the Bohemian language which is still used, and it is to be regretted that the treatise which he wrote on that subject has not been printed. Huss wrote several pieces in Bohemian hexameters; he revised and corrected the old Bohemian version of the Bible, and left in his native tongue about twenty compositions. The followers of Huss produced an extraordinary number of religious works, and there are still extant many tracts of a polemical, dogmatical, and ascetical nature, written by the several sects of Hussites during the fifteenth century. Many of these tracts, by no means devoid of merit, were composed by common mechanics, peasants, and women. Several of the Hussite religious compositions, which were much valued in the time, are however lost, having been chiefly destroyed by the enemies of that sect. Some of the religious hymns of the Hussites contain high poetical beauties, but in general the national poetry of that period degenerates into a mere rhyming; although the imperfectly preserved poems of Prince Hynek, son of king George Podiebrad (who reigned from 1458 to 1471), are not devoid of merit. But although the poetical literature of Bohemia declined during the fifteenth century, the prose style was developed, as the national language was exclusively used in all public transactions in Bohemia, instead of the Latin. The state papers of Bohemia, and the letters of the Bohemian statesmen during that period, are considered patterns of concise, clear, and energetic language, but unfortunately the Bohemian chancery, towards the end of the fifteenth century, abandoned this fine style, and began gradually to imitate the diffuse pomposity of the Germans. The national language, the study of which was promoted by the University of Prague and the example of the court, acquired a high degree of perfection, and a great superiority over all the Slavonian dialects, which were at that time in an uncultivated state, and without almost any national literature. Owing to this circumstance, its use began to spread over other Slavonian countries, but particularly Poland, the idiom of which country is very similar to that of Bohemia. The Poles also resorted in great numbers to the university of Prague, where they had a separate college.

Besides these religious compositions, the national literature of Bohemia contains other important works belonging to this period. Ziska, the celebrated leader of the Hussites, was also an author. He composed a war-song to animate his soldiers, and military institutions for their use. A work of the same kind, which contains more particulars about the military science of that time, was written by his contemporary the knight Hajek of Hodetin. Venceslav Wilczek of Czenow, an experienced commander, wrote, in the second part of the fifteenth century, a strategic work, which has been recently discovered, and which throws great light on the tactics of the Hussites; but it contains numerous technical expressions, now entirely obsolete, which often render the work unintelligible. The national history was however not cultivated in a manner as it would have been desirable on account of the great events which took place in Bohemia during that period. A collection of the histories of that time was published by Palacky, in his 'Scriptores Rerum Bohem.,' Prague, 1829. A great deal of very interesting information on the geography of several countries, as well as the manners and customs of that period, is contained in the following travels:—Baron Albrecht Kostka of Postupic, to France, 1464; Baron Leon of Rosmittal, over Europe, 1469; the Bohemian brother (a member of a sect of the Hussites) Martin Kabatnik, to the East and Egypt, 1491; and of Baron John Lobkowitz, to Palestine, 1493. Among the political works of that period the most remarkable are those of the governor of Moravia, Baron Ctibor, of Cimburg and Tobitchow (died in 1494), which are characterized by great talent and powerful eloquence; and that of the knight Victorin Cornelius of Visehrad, the eloquence and precision of whose style almost equals the best writers of antiquity. The 'Art of Governing,' by Paul Zidek, canon of Prague, dedicated to King George Podiebrod, is a composition of superior merit, as well as his great encyclopædical work. There are also many works on various branches of economy, and other similar subjects, belonging to this period.

The period from 1520 to 1620 is called by the Bohemians the golden age of their literature, and indeed science, literature, and art were cultivated in Bohemia during that period with much success. Public instruction in Bohemia was in a more flourishing state than in other countries. Prague alone contained, besides three universities, sixteen educational institutes, among which there were several for girls; and parochial as well as higher schools were established over all the country. The Bohemian language attained its perfection, and the number of works of every description published in that language increased very greatly. But notwithstanding this universal diffusion of information, and the great number of native works produced at that period, few of them are of superior merit. Not a single native has distinguished himself in science, although Kepler and Tycho Brahe had for some time the care of the observatory of Prague.

No truly great poetical genius appeared in Bohemia during this period. George Streyc translated the Psalms, and Symon Lemnicki, of Budecz, was the poet-laureate of the emperor Rudolph II. Oratory however acquired during the same period an eminent degree of perfection, and the few productions of that description which have reached us make us regret the loss of the remainder. The 'Memoirs' of Baron Charles of Zerotin, governor of Moravia (1574-1614), and his 'Bohemian Letters,' are still patterns of a finished epistolary style. The next celebrated historian of that period is Venceslav Hajek, of Luboczan (died in 1553), but his 'Chronicle of Bohemia' is rather an historical romance than a trustworthy history. Considerable merit is displayed by the following historians, whose works still remain in manuscript:—Bartosz of Prague, public notary (died in 1544), who depicted in glowing colours the religious disturbances of Bohemia in 1524; and Sixtus of Ottersdorf, chancellor of the old city of Prague (died in 1583), who gives a very circumstantial account of the events that brought about the celebrated bloody diet of 1547. John Blahoslav (died in 1521), the author of a history of the Bohemian brethren; the anonymous author of a Universal History, of which only the first volume, preserved at Stockholm in Sweden in MS., is extant; and finally Vaclav of Brzezan, an excellent genealogist and biographer, whose works are distinguished by clearness of exposition, brevity of style, and deep research. Among the historians of that period whose works were printed were, Daniel Adam of Veleslavin, an industrious and patriotic writer; and the Pole Paprocki, who wrote an account of the noble families of Bohemia and Moravia. Valuable materials are furnished by the travels and adventures in the East of the knight Ulrich, prefect of Wlkanowa, 1546; as well as by the travels of Mitrovic, 1599; and those of Christopher Harant of Palzic, 1608. The other remarkable authors of that period are, Nicholas Konac of Hodislav (died in 1546) one of the superior judges of the country; the bishop of the Bohemian brethren, John Augustus (died in 1572), the cathedral canon of Prague; Thomas Bavorowski, an eloquent preacher (died about 1560); the senator of Prague, Paul Koldin (died in 1589); the linguist Mathias Benesowsky (died in 1587); the eminent classical scholar Abraham of Ginterod; the justice baron of Budova (died in 1621); and the two distinguished religious writers, Martinus Philadelphus Zamrsky (died in 1592), and Gallus Zalansky (died in 1620). Perhaps the most remarkable production of that period is the Bible of Kralic. Baron John Zerotin assembled in his castle of Kralic, situated in Moravia, eight of the most learned men of the Bohemian brethren, who, in the course of fifteen years, made a new version of the Scriptures from the original tongues, with a commentary: the work was published in six 4to. volumes, 1579-1594. No nation at that time could boast of a similar work. The Bible of Kralic was always considered a pattern of a pure, elegant, and correct style: its merits were even admitted by enlightened Jesuits, and it is studied now by all those who wish to write the Bohemian language with purity and correctness.

A melancholy period for the language and literature of Bohemia began with the Thirty Years' War, and particularly from the battle of Weisenberg, when the Palatine of the Rhine, who was elected king of Bohemia by the Protestant party, was defeated by the Imperialists; and the rapidity with which Bohemia fell from a high degree of civilization into an almost barbarous state is unexampled in history. The most distinguished individuals of the nation perished either on the scaffold, or on the field of battle, or from pestilence. Others who were distinguished for talent and superior education left the country; first the clergy and the teachers, then the burghers, and finally the nobles. The places of those exiles could not be easily supplied, and the want of able men was particularly felt in the schools, which were provided with teachers who either distinguished themselves by their zeal for the dominant party, or were employed only for want of better. Crowds of Spanish, Italian, Belgian, and Irish adventurers flocked to Bohemia, and became principal landowners, occupying public places, and giving the tone to society. The Bohemian nationality was morally destroyed. A native Bohemian was, according to the new order of things, synonymous with rebel and heretic. Many natives, in order to avoid suspicion, renounced their nation, Germanised their Bohemian names, and feigned a foreign origin. The emissaries of the Jesuits, who ruled the country, accompanied by soldiers, visited every house in order to take away and to destroy all books suspected of heresy. As it was an admitted principle that all books written from 1414 to 1625 might be heterodoxical, it was no wonder that the emissaries, who did not make a scrupulous examination amongst so great a number, and chiefly their companions the soldiers, committed all Bohemian works to the flames. Some enlightened Jesuits, as Balbinus, protested in vain against this barbarous persecution, which was continued till about the middle of the eighteenth century. The Jesuit Anthony Kenios, who died in 1760, boasted of having burnt about sixty thousand books. It is indeed astonishing that, notwithstanding this destruction, there are any monuments of old Bohemian literature extant. A mental darkness spread over the country was a natural consequence of those proceedings. There were still however some able writers, who had received their education previously to the beginning of the Thirty Years' War. Count Slavata, who died in 1658, wrote in Bohemian a history of his own time, in fifteen volumes in folio: this work has not been printed. The exile Paul Skal of Zhor wrote from 1620 to 1642, first at Lübeck, then at Freyberg in Saxony, a Universal Ecclesiastical History, in ten large folios, filled with a small hand-writing. This work also is still in manuscript; it contains much important information about the ecclesiastical affairs of Bohemia up to the year 1624. Amos Comenius, the last bishop of the Bohemian brethren in his country, was also the last ornament of the national literature.

The emperor Joseph II., by the decrees of 1774 and 1784, ordered the introduction of the German language into all the schools of Bohemia, and the inhabitants were no longer permitted to learn in their national language anything except reading, writing, the catechism, and the elements of arithmetic. This was a severe blow to the Bohemian language and literature, and the more dangerous as the decrees promoted real information, though they established the superiority of German over Bohemian civilization by introducing the exclusive use of the German language in all matters of administration. Yet this measure appears to have awakened the slumbering energies of the nation, and to have stimulated it to new exertions. The first man who raised his voice in behalf of the nationality of his country was General Count Francis Kinsky, who rendered great services to the military organization of Austria, and to the civilization in Bohemia. He advocated the cause of Bohemian nationality in a work written in German in 1774; 'Recollections on an important subject.' His example was followed in 1775 by Pelzel, the author of an excellent history of his country in the national language. In 1779 the government found it necessary to recommend instruction in the Bohemian language in the superior military schools. The awakened intellect of the nation, promoted by the improved system of public education, began to exercise a salutary influence on the study of the national language and on its literature; new original compositions were written; foreign works of merit were translated; and many valuable monuments of the antient literature were brought to light. The following individuals also distinguished themselves in the noble work of regenerating their national literature: Franz Faustus Prochazka, a Pauline monk, 1792-1804; Waclaw Kramerus (died in 1808), who published many excellent popular works; Albert Vincent Parizek (died in 1823), who composed and translated many valuable works for schools and the use of children; and particularly Joseph Dobrowsky, who is justly considered the patriarch of Slavonian literature in modern times, not only by his own countrymen, but by the scholars of all other nations of that race. He was born of Bohemian parents at Gyomar in Hungary, in 1753, and entered the church in 1772, after having received an excellent classical education. He continued his theological study at Prague, and became about 1776 rector of the seminary of Olmütz. He soon however left that place, and became tutor in the family of Count Nostitz. He settled after that time at Prague, and the study of Slavonian became his passion and the object of his life. He was noticed by the first families of the country, who wished to attract him to their circle; but Dobrowsky, fond of independence, was rarely induced to receive any assistance. His habits were of the utmost simplicity, and he travelled a great deal about the country on foot, visiting the most remote corners, in order to observe any antient ruin or monument, or place remarkable for any historical event; and to collect at the same time the remains of national language and history, preserved in the local songs and traditions. Having acquired a considerable reputation in his country, supported by some powerful friends, he made a journey to Sweden in 1792, in order to examine the manuscripts which were carried from Bohemia by the Swedes during the Thirty Years' War. He returned from that country by St. Petersburg and Moscow, where he examined the collections of Slavonian manuscripts. In 1796 he published an account of his literary researches made during these travels. In order to restore his health he went to reside in a country-house of his former pupil Nostitz, and during that time studied botany with so much success, that he was able to write a very clever botanical dissertation. Universally beloved on account of his great learning and the simplicity and honesty of his character, he spent his life among his friends, constantly engaged in the pursuit of his favourite studies, and he kept up a learned correspondence with several of the most eminent scholars of his time. He died at Vienna in 1827, in the 78th year of his age. He left a great number of works, chiefly on Slavonian subjects, the most important of which are, a 'History of the Bohemian Language and Literature,' last edition, Prague, 1818; 'Slavina, a message from Bohemia to all the Slavonian nations,' containing a collection of treatises on Slavonian subjects; on Cyrillus and Methodius, the apostles of the Slavonian nation, &c.: the number of his works on different subjects is about forty.

Francis Tomsa (died in 1814) was the author of some excellent grammars, and several valuable works for popular instruction. There were also Waclaw Stach, John Rulik, the brothers Tham, and several others. This literary movement was shared by the Slovaks of Hungary, who use the Bohemian language; and the principal writers among them who may claim merit for their services to the national language and literature are Leski, Rybay, Tablic, Palkowic, and Roznay.

The labours of the authors who have been enumerated, were chiefly directed to promote education and the national language, and were confined to prose. But the learned clergyman Anthony Puchmayer attempted (1795), with considerable success, to revive the poetry of Bohemia, and he also made his countrymen acquainted with the cognate literatures of Poland and Russia. The example was followed by others, and amongst them chiefly by the brothers Albert and John Negedly, Joseph Rautin, Kranz, Francis Stepniscka, Sebast Hnewkowsky, Francis Swoboda, &c., but particularly Joseph Jungman, professor in the university of Prague. The persevering efforts of these patriotic writers were however, for a long time, unproductive of any important result, as the nobility and the greater part of the more educated classes had become complete strangers to the language of their forefathers. They had therefore to contend with great difficulties; and it is owing only to their unwearied exertions, assisted by some fortunate circumstances, that the national literature of Bohemia begins finally to assume a steady progress in its own country. The year 1818 may be considered as opening a new æra for Bohemian literature, by the publication of the antient national poems, contained in the 'Kraledworsky' manuscript, which has been already mentioned, and which produced a powerful effect on the literature of Bohemia. The establishment of a national museum at Prague, by Count Kolvrat in 1829, has exercised a most salutary influence on the progress of the national intellect. Several decrees of the government, published in 1816-1818, recommended the study of the Bohemian language in the gymnasia of the country; but these decrees were annulled in 1821. Since that time, the language and literature of Bohemia have been advancing with great rapidity. A scientific terminology for all the branches of human knowledge, and which the western languages of Europe have chiefly derived from the Greek, was created from pure Slavonic roots; and the merit of this difficult task belongs to the professors of the university of Prague, Joseph Jungman and John Presl. The poetical diction was much improved by the study of the Kraledworsky manuscript, and the successful imitation of its metre, an improvement which is mainly due to the efforts of the historian Palaly, Schaffarik, and Hanka, the most eminent Slavonian scholars of their time. Many alterations in the Bohemian orthography were introduced according to a plan recommended by Dobrowsky. This innovation was however strongly opposed by several zealous partisans of the antient orthography, and particularly by the professors of the Bohemian language, Negedly at Prague, and Palkowic at Presburg. This difference, although relating to a subject of minor importance, created a violent dispute. The advocates of the new orthography were accused by their opponents of promoting innovations dangerous to religion and morality; and the study of the other Slavonian dialects was considered by some as implying a political tendency to the interest of Russia. Fortunately these absurd accusations vanished before the good sense of the public and of the government, and the Bohemian literature has continued to advance in its development, and to increase in popularity among all classes.

The following is a brief notice of recent Bohemian authors:—Francis Vladislaw Celakowsky, born in 1799, possesses a vigorous and highly cultivated talent, original and thoroughly national. His principal works are:—'Various Poems,' Prague, 2nd edition, 1830; 'Echo of Russian Songs,' ibid., 1829; 'Echo of Bohemian Songs,' ibid., 1830. His productions are considered equal in merit to the best poetical compositions of modern times. Vaclaw Klicpera, born in 1792, has composed more than thirty dramatic works, of which several have obtained great success.

John Kollar, born in 1793, of a Slavonian family in Transylvania, received his preparatory education in his native land. In 1817 he went to study divinity at the university of Jena, where he became passionately attached to the daughter of a clergyman. This love inspired his muse, and in his 'Slavy Dczera' (the daughter of glory), (Ofen, 1824), he expressed his feelings for his beloved Mina, whom circumstances permitted him to marry only in 1835. This production, which established his reputation as the first poet in the Bohemian language, comprises 150 sonnets, of which many contain the description of his love, whilst in others he deplores the fall of several Slavonian nations which had once occupied the shores of the Baltic and the banks of the Elbe. Many of these sonnets may be compared with those of Petrarca, and it is admitted that he has created a new poetical language for the Bohemians. In 1832 these sonnets were republished, with the addition of new ones, which describe the Slavonian heaven and the deeds of the Slavonian heroes received into it, while others depict the Slavonian hell, the abode of the unworthy Slavonians and of the enemies of their race. A great knowledge of the Slavonian history is displayed in these compositions, but this very circumstance renders them on the whole cold and prosaic, notwithstanding many beautiful passages. He has also published a collection of minor poems and songs. In 1819 he became clergyman to a newly created Slavonian Protestant congregation at Pesth, and the great difficulties with which he had to struggle in the discharge of his duty are said to have changed the animated poet into a serious and even morose person. The collection of sermons which he had preached before his congregation, and which he published in 1831, display profound piety and an extraordinary knowledge of the human heart, as well as great beauty of language. He has paid much attention to the schools of his parish, and composed some books for their use. Kollar occupies also a distinguished place among Slavonian philologers and historians. He is the author of 'Dobre wlasnosti narodu Slovanskeho,' *i.e.* 'the good qualities of the Slavonian nation,' Pesth, 1821, and of Researches on the names and antiquities of the Slavonian nation and its branches. He has rendered great service to Slavonian literature by his collection of the national songs of the Slovaks of the Carpathian mountains. Kollar is one of those who have perceived the necessity of an understanding among all Slavonian scholars, in order to promote by their united efforts the progress of their literature, and he made an appeal to them for that object in his work, in 1828, 'O wzajimnosti Slowian,' on the reciprocity of the Slavonians. Kollar's merits as a Slavonian scholar are universally acknowledged, and he is continuing his labours with the greatest success.

J. Langer, born in 1806, is an original writer, but has not had sufficient cultivation. He has written clever national eclogues and tales, and several satirical poems. Charles Machacek, born in 1799, is the author of the best Bohemian comedy, entitled the 'Wooer;' the national opera owes likewise to him the great improvement which it has received since 1822. Charles Schueller, a popular author, wrote the best Bohemian ballads, published in 2 vols., 1823-30. J. N. Stzepanck, born in 1783, director of the national theatre at Prague, is the creator and promoter of the Bohemian theatre, for which he has written 16 volumes of plays. Vincent Zahradnia, a clergyman, born in 1790, has distinguished himself by his fables. Tales and songs have been written by Winarecky, Kamaryt, Chmelensky, Marek, and Swobada, as well as Magdalena Retty, and the nun of St. Elizabeth, Maria Antonia.

Scientific subjects have been treated chiefly by J. Presl, director of the national museum at Prague, born in 1791, who has published several works on different branches of natural philosophy: works of a similar description have also been published by Charles Schadek and Professor Albert Sedlacek. Eminent service has been rendered to the national language by Joseph Jungman, professor of the university of Prague, by his great critical dictionary of the Bohemian language, on which he was occupied more than thirty years; he has published also 'Slovestnost,' *i.e.* 'literature,' Prague, 1820; a history of the Bohemian literature, in 1825; besides many other compositions of less importance. Francis Palacky, born in 1798, is now one of the most accomplished writers of Bohemia; he has published several works on literary subjects, and made a particular study of the national history. The states of Bohemia commissioned him to write a complete history of Bohemia, and settled on him a pension for life, in order to enable him to devote himself entirely to the task: for that purpose he made extensive researches not only in his own country, but even abroad, and particularly in the archives of Italy. The result of his labours is a history of Bohemia, in German, of which two volumes, already published at Prague, bring it down to the extinction of the national dynasty of the Przemyslaidi, 1306. It is founded on original documents chiefly in manuscript.

We shall conclude with a short notice of the most celebrated Slavonian living scholar, Paul Joseph Schaffaric, born in 1795, in Northern Hungary. After having gone through his preparatory studies in his native land, he completed them at the university of Jena, where he applied himself to divinity, metaphysics, general literature, and natural philosophy. His first work was a collection of the national songs of the Slovacks (Slavonians of Northern Hungary), published in 1819. He also translated into Bohemian the 'Clouds' of Aristophanes, and 'Maria Stuart' of Schiller. After his return to Hungary he diligently continued his Slavonian studies, and was appointed professor in and director of the Non-united Greek gymnasium at Neusak, established by the Austrian government for its Servian subjects. He resigned however, in 1825, the direction of that school; but he retained the professorship till 1833. His residence in that place afforded him ample opportunities for the study of the dialects of the Southern Slavonians, Servians, Croatians, and Bulgarians, the result of which was his historico-critical researches on those dialects, which appeared in 1833, at Pesth, in German, under the title of 'Serbische Lesekörner,' &c. He had previously published in the same language a manual of the history of the Slavonian languages and literature, at Ofen, in 1826, which was well received. He also published in German, 1828, at Ofen, 'Researches on the Origin of the Slavonians,' which is a critical and enlarged edition of a similar work published in Polish by Surowiecki. Since 1833 Schaffaric has settled in Bohemia, and prosecutes his literary labours in the language of that country, in which he had published in 1818, conjointly with his friend the historian Palveky, 'Elements of Bohemian Poetry.' His principal work is his 'Slavonian Antiquities,' published in Bohemian, at Prague, 1838, a production distinguished by extensive learning, as well as acute criticism, and which has been received with unanimous approbation by the first scholars of all the Slavonian nations. Since 1838 he has edited the 'Journal of the National Museum of Prague.' He is now employed in collecting the monuments of the Servian and Bulgarian languages of the eighteenth century, and on an extensive history of the literature of all the Slavonian dialects.

*Servian Language and Literature.*—The Servian language has more resemblance to the Russian than to the Polish or Bohemian languages. It is considered more melodious than any other Slavonian dialect, a circumstance which is ascribed to the influence of the Greeks, by whom the Servians were converted to the Christian religion, as well as to that of the Italians, with whom they had many commercial relations. The dominion of the Turks was also not without influence on the Servian language. It has however preserved all the characteristics of other Slavonian languages. It is spoken by a population of about five millions, and it may be divided, according to Vook Stephanovich, into three dialects: 1, that of Herzegovina (comprehending Montenegro); 2, Razava; and 3, of Sirmia and Slavonia (provinces of Hungary). The Bulgarian language, which is spoken by about half a million of Slavonians, who inhabit Bulgaria and some parts of Macedonia, may also be considered a dialect of the Servian, although it differs in grammatical construction from all the other Slavonian idioms, being the only one which has adopted the article. The Servians, as well as the Bulgarians, make use of the Cyrillic alphabet. Some works, however, which have been recently published in Servia, are printed in the Russian character, with some slight alterations, which are required by the peculiarities of the Servian language. A dictionary of this language, containing more than thirty thousand words, with a German and Latin translation, was published by Vook Stephanovich at Vienna in 1819. The same author published also a Servian grammar (Vienna, 1814), of which a translation, by T. Grimm, with a preface and annotations by Vater, appeared at Berlin in 1824.

The oldest monuments of Servian literature date from the thirteenth century, and are composed in the Slavonian idiom, which was employed in the version of the Scriptures by Cyrillus and Methodius, with some admixture of the language which is now spoken by the Servians. There is a great probability that the Slavonian of the Bible was originally in common use among the population of the present Servia, as it constituted a part of the kingdom of Great Moravia, where the Slavonian version of the Scriptures was made by Cyrillus and Methodius in the ninth century, but that it became by degrees estranged from its original, through the various revolutions to which that country was subject.

The monuments of the Servian literature to which we have alluded are, the 'Rodoslov,' that is, genealogical register, by Daniel, archbishop of Servia, which contains the history of the reigns of the kings Urosh, Dragutin, Milutin, and Dechanski (1272-1336). The manuscript is preserved at the monastery of Mount Athos. The Servian king (czar) Stephen Dushan the Great (1336-56) gave to his nation a code of laws, which bear a purer stamp of the Slavonian character than the laws of any other nations belonging to the same race, and are drawn up in a spirit of great moderation. There are also some religious books of the same period. The defeat of the Servians by the sultan Murad I. destroyed their national independence, and created in their literature a chasm of two centuries.

A new era for Servian literature was commenced by George Brankovich (born in 1645), who was ambassador of the emperor Leopold I. at Constantinople, but having afterwards fallen into disgrace with the court, died, in 1711, a state prisoner. He wrote in Slavonian a history of the Servians from their origin to the reign of the emperor Leopold I. The manuscript is preserved in the archiepiscopal library at Carlovitz. Many years however elapsed from the death of Brankovich before any other works were added to Servian literature. The archimandrite John Raich (1726-1801) wrote a history of the Slavonians in general, and of the Servians, Khorvates, and Bulgarians, in particular. (four volumes, Vienna, 1792-95). It is composed in the Slavonian of the Bible, but much intermingled with Russian and Servian words.

The Servian was employed as a written language for the first time by Dositheus Obradovich (born in 1739), who, after having spent twenty-five years in different parts of Europe, died in 1811 at Belgrade, where he occupied the post of senator, and was at the same time tutor of the children of the celebrated Servian leader George Cherny. The example of Obradovich was only partially followed by other Servian authors; and it created such confusion in their literature, that among the 400 Servian works which had been published since 1750, only a few are written either in pure Slavonian or Servian, the remainder of them being written in a mixture of the two above-mentioned idioms, exhibiting a great variety of orthography and grammatical construction. This mongrel style was strongly combated by Demetrius Davidovich, secretary to Prince Milosh, who edited (1814-22) a Servian gazette and a Servian annual at Vienna. The same object has been successfully promoted by Vook Stephanovich Karadgich, who is the first Servian scholar of the age, and has rendered the greatest services to the language and literature of his country. He was born in 1786, in Servia. At an early period he devoted himself to the noble task of raising his native language to the same degree of perfection which has been attained by other Slavonian tongues, and he has promoted his object without intermission, particularly by his continual travels among all the populations which speak the different dialects of the Servian. After many efforts, he succeeded, with the assistance of Davidovich, in persuading the Servian writers to abadon the Slavonian of the Bible for the exclusive use of their national language. The greatest service which he has rendered to the literature of his country is the collection of national songs which he published at Leipzig in 1823. A German translation of these songs by Mrs. Robinson,* under the assumed name of Talvi, appeared at Halle in 1825. Some of these songs had already been known to the public through a collection of them made by the Franciscan monk Casich Miossich, printed at Venice in 1759. The songs however published by Vook Stephanovich were chiefly collected by himself during his travels, and he added to them valuable critical and explanatory notes. These songs, inspired by the splendid scenery of Servia, the patriarchal life of the inhabitants, and the recollections of their eventful history, are considered the finest of all the Slavonian national songs. Full of the wildest romance, they admirably depict scenes of love and war, and express in the most animated manner feelings of a simple and tender, as well as of a glowing and impassioned character. Some of them belong to a period previous to the arrival of the Turks in Europe. Several allude to the seat of the Ottoman empire at Adrianople; whilst many are of a much more recent date, describing the oppression exercised by the Turks, as well as different scenes of intercourse with that nation. The same author published in 1836, at Cettigne in Montenegro, a collection of Servian proverbs, amounting to about 4000, with a preface, containing much valuable information on the Slavonian idioms spoken in the vicinity of the Adriatic; and he edited (1826-38) at Vienna five numbers of a Servian annual, called 'Danitza,' *i.e.* 'the morning star.' Simeon Milutinovich, born at Sarayevo in Bosnia, received

* Mrs. Robinson is the wife of the Rev. Edward Robinson, professor and librarian of Andover College, Massachusetts U. States, and well known as the editor of the 'Biblical Repository,' as well as the translator from German of several works relating to the study of the Scriptures and the author of a recently published work on Palestine. She is the daughter of Professor Jacob, author of several political works of considerable reputation. Having spent her early youth in Russia, where her father was successively employed (1807-1816) at the university of Kharkoff and at St. Petersburg, she had an opportunity of learning the Russian language. After her return to Germany she devoted herself to literary pursuits. She became acquainted with Vook Stephanovich at Halle, and translated, with his assistance, the Servian songs mentioned in the text. Having married Mr Robinson in 1828, she followed him to the United States, where she began to write English, and published several excellent articles on Slavonian literature in the 'North American Quarterly Review,' as well as a very valuable work on the same subject in the 'Historical View of the Slavic Languages,' Andover, 1824.

some education in the gymnasium at Carlovitz in Hungary; and after having spent the early part of his life among very agitated and trying circumstances, which have perhaps contributed to develop his poetical genius, he received assistance from the Russian government, which enabled him to devote himself to literature. He composed a series of lyrical and heroic poems on subjects taken from the history of the Servian insurrection in 1804-15. These poems, which imitate the tone of the songs published by V. Stephanovich, appeared under the name of 'Serbianka,' at Leipzig, 1826, in 4 volumes, 12mo. He also added some new poetry, published at the same place in 1826 and 1827. All his productions are characterised by a bold originality, warmth of feeling, and a glowing patriotism. Having studied for some time at the university of Leipzig, he retired into Montenegro, where the metropolitan's patronage afforded him the means of pursuing literature. He collected there the national songs of Montenegro and Herzegovia, and wrote a history of Servia during the years 1804-1815. Both these works were published at Leipzig in 1837. Among the other Servian authors we may mention the present vladika, or metropolitan, of Montenegro, who is considered to be a very accomplished poet. Anna Obrenovich, niece of Prince Milosh, has published some works, original and translations.

Prince Milosh Obrenovich has done much for promoting the education of his countrymen, having established sixteen schools for the training of teachers, and founded a printing-office at Kragoyevatz, the place of his residence. The Austrian government pays great attention to the education of its Servian subjects, for which purpose it has established gymnasia or higher schools at Karlovitz and Neusatz in Hungary. There are now Servian printing establishments, besides that of Kragoyevatz, at Vienna, Buda, Venice, and at Cettigne, the residence of the metropolitan of Montenegro.

A society for the promotion of Servian literature by giving prizes for the best works has been recently established, under the name of the 'Servian Mother,' and a periodical is published in the same language.

SLEAFORD. [LINCOLNSHIRE.]

SLEEP, the periodical repose of the organs of the senses, and of the greater number of the intellectual faculties and voluntary movements. The above indeed is by no means a satisfactory definition; but it is, as with life, far easier to describe its phenomena than to define its nature.

True sleep is peculiar to the mammalia and to birds; the lower animals, indeed, rest from time to time, and withdraw themselves from the external world, but having no external eyelids, they cannot exclude all influence from without. Fish conceal themselves behind a stone or near the bank of a river, crocodiles hide themselves in the mud, and tortoises creep into holes. The higher animals likewise usually seek out some place of retirement to sleep in, and dispose themselves in a posture which either is maintained with little muscular effort, or is favourable to the preservation of warmth.

The approach of sleep is announced by diminished activity of mind and loss of the power of attention. The senses become blunted to external impressions, and we feel an unconquerable desire for stillness and repose. Our ideas grow more confused, our sensations more obscure, our sight fails us, and if our ears still perceive sounds, they are indistinct, and seem as though distant. The eyelids close, the joints relax, we instinctively assume an easy position, and fall into a sleep, which at first is deep, then soft and gentle, and becomes gradually less sound as the time for waking approaches.

Physiologists are accustomed to distinguish what are termed the organic or vegetative from the animal properties of living beings. By the former are understood development, growth, excitability, &c., those powers in short which are common to plants and animals; by the latter, those properties which are peculiar to animals, such as sensation and voluntary motion. During sleep the organs of vegetative life continue to discharge their functions with scarcely less activity than in the waking state. Their repose is independent of sleep, and occurs at very different times. The heart rests between each pulsation, the muscles of expiration and inspiration are in a state of alternate action and repose, and the peristaltic motions of the intestines have their distinct periods of remission. The pulse and respiration however become slower during sleep, and digestion seems to go on then less perfectly than in the waking state The temperature of the body sinks during sleep, owing to diminished nervous energy, and to the same cause may be ascribed the increased susceptibility of persons to rheumatism and other effects of cold when asleep.

Not only are the functions of organic life little affected by sleep, but even those of animal life are not in a state of complete repose. It would not be possible to make a dead body remain in those postures which we assume when asleep, and our eyelids are not closed except by muscular action. Some animals sleep standing, as the horse; birds do so also, sometimes standing on one leg. When very weary, we sleep even in the most constrained positions; soldiers have been known to sleep while marching, postilions on horseback, and fiddlers at a fair have continued to play even when through weariness they had fallen asleep. The numerous instances of somnambulism on record show how high a degree of activity of the animal functions is compatible with sleep. For remarks on this subject however, as well as on the condition of the senses during sleep, we refer to the article DREAMS.

Animals in general require less sleep than man; thus, for instance, four hours are sufficient for the horse. Those animals whose blood circulates very rapidly, whose motions are peculiarly energetic, and their senses very acute, usually sleep more lightly, and for a shorter time than others. The timid herbivorous animals sleep less, and less profoundly than the bolder carnivora. In man the want of sleep varies at different ages; the new-born infant sleeps almost continually, while persons in middle life can do with less sleep than children or very old persons, and women require less sleep than men. From six to eight hours a-day are usually passed in sleep, but habit exercises a great influence in determining the amount of repose required. John Hunter and Frederick the Great did not sleep for more than four hours daily, while some sluggish persons spend nearly half their time in sleep. In extreme old age much sleep sometimes becomes necessary. De Moivre, when eighty-three years old, was awake only during four hours out of the twenty-four, and Thomas Parr towards the close of his life was almost constantly asleep. Children sleep very soundly, old persons are easily disturbed, men sleep more profoundly than women, and sleep is always sounder after considerable weariness.

There are some conditions which favour the occurrence of sleep. Stout and full-blooded persons, and those of an excitable but easily exhausted frame, require more sleep than such as are thin, or who, though equally excitable, are more energetic, and less easily tired. Abundant food induces sleepiness, and also wine and other stimulants. A class of medicines are known by the name of narcotics, whose peculiar action is to induce sleep. Ease and quiet of mind conduce to it, but the weariness of hopeless grief is likewise followed by sleep. Certain external causes favour sleep, such as the warm bath or friction of the surface of the body. Extreme cold is a powerful and most dangerous narcotic; it induces a sleep from which there is no waking. Such a sleep it was which nearly proved fatal to Dr. Solander when with Sir J. Banks in Tierra del Fuego.

We have not yet noticed one very important character of sleep—its periodical return once in every twenty-four hours. The idle person sleeps as well as the diligent, who has passed his time in exerting his powers of mind or body. Sleep usually occurs at night-time, and we are awake during the day, but the day may become the time for sleep, and night for watching, if a person's occupations so require. Many animals sleep during the day, and watch or pursue their prey at night. We cannot then regard the periodical return of sleep as dependent on the simple alternation of day and night, or merely as the result of bodily fatigue, since it is known that extreme weariness will prevent sleep. The alternation of sleep and waking is essentially connected with something in the nature of animals, to which there are many analogies. The succession of the seasons and of day and night, the ebb and flow of the sea, the daily variations in the electricity of the air, in the rise and fall of the barometer and the regular declination of the magnetic needle eastward and westward, at different hours, illustrate the same law of periodical action which is displayed in the unvarying alternation of sleep and waking. 'We may,' says Professor Müller, one of the most eminent physiologists of the present day, 'regard sleep and the waking state as the result of a species of antagonism between the organic and the animal life, in which the animal functions, governed by the mind, become free to act, while at other times they are repressed by the organic force acting in obedience to a law of creative nature. In sleep, when the animal functions entirely or for the most part cease, the organic processes are almost the only ones which continue, and during that state even the organs of animal life are rendered capable of renewed action by the organising force which proceeds without the consciousness of the animal, though accordant with a well-constituted plan and with reason.'

Little need be said of the uses of sleep. 'Nature's soft nurse,' it invigorates body and mind when worn out by toil, and the occurrence of sleep in the course of a disease is one of the most favourable signs of returning health. After a night's sleep we are nearly an inch taller than before; the intervertebral cartilages, which had been compressed by bearing the weight of the body during the day, having regained their natural form and proportions. The powers exhausted by our intercourse with the external world, recover themselves during sleep, and our senses in the morning are alive to all impressions. It is however pre-eminently the rest of the brain, which, when fatigued by the constant action of the mind, becomes incapable of continuing that action, just as the eye, if long fixed upon one spot, ceases to perceive any object distinctly.

Since then sleep is not a mere torpor of the system induced by fatigue, long watching, or any external cause, but a natural state whose periodical recurrence is essential to the harmonious performance of our functions, it need excite in us no surprise to find that in certain animals this condition lasts for a long time, even for months; and that in it the activity of the organs of animal life is suspended more completely than in diurnal sleep. To this state the name of

*Winter Sleep, or Hybernation*, is applied. Hybernation occurs in some mammalia, in all the amphibia, and in some of the molluscous and insect tribes. Birds do not hybernate, and the vulgar notion with reference to the sleep of the swallow in winter is erroneous. Hybernation is either perfect or imperfect. In the former, of which the marmot affords an instance, the lethargy is profound and undisturbed by any sense of thirst or hunger, and the animals do not awake until the period of sleep is completely past. In the latter, intervals of wakefulness occur, during which the creatures rouse themselves and seek for food, as in the case of many insects and spiders, also the hedgehog, bat, and dormouse. The time during which hybernation continues varies much. In some animals it lasts for four months only; in others for five or six; but almost all awake either in March or April. The situations which animals select for hybernation, and the position in which they await it, differ, as might be expected, in accordance with their various habits, but all seem to subserve one great purpose, the preservation of a moderate and equable temperature. Most creatures hybernate in solitude, but some, as the marmot, pass the winter in company.

The approach of winter sleep is not sudden, but it comes on gradually; the activity of the animals diminishing as their sense of hunger grows less keen. In some animals, as in the hedgehog, a diminution or total loss of appetite precedes hybernation for some weeks. When hybernation is perfect, the senses become so completely blunted, that severe wounds and electric shocks are insufficient to rouse the animal.

The phenomena of organic life go on far more sluggishly during hybernation than in diurnal sleep. The pulsations of the heart sink to a fourth or even a tenth of their natural frequency. The respiration becomes slow, intermits frequently and for a long time, or even becomes altogether imperceptible. An animal in this condition, if placed in a pneumatometer, will produce no change in the air which it contains, or may be kept for a considerable time in irrespirable gases without sustaining any inconvenience. The temperature of the body depends on the activity with which respiration and circulation are carried on; hence during hybernation it sinks greatly, and in some animals is not higher than that of the surrounding atmosphere.

Hybernation is not mere torpor from cold; all animals may be benumbed by cold, but those which hybernate are comparatively few in number. A moderately low temperature indeed is favourable to hybernation, but instinct teaches the animals to defend themselves from the cold, and their death results from exposure to its severity. Suspended animation from cold is a morbid state; hybernation and sleep are preceded by similar phenomena, and both terminate alike, after a certain time, in renewed activity.

If, lastly, we inquire what uses are answered by winter sleep, we shall see that it is a provision for the maintenance of life at a season when those animals in which it occurs would be unable to obtain their natural food. It serves likewise for their protection against a degree of cold to which they could not bear to be exposed. Nor is it merely against extreme cold that annual sleep and the instinctive preparations of animals for that condition supply a defence, but extreme heat is followed in some animals by a lethargy similar to hybernation. Thus the Tanrec, or rat of Madagascar, sleeps during the height of summer. Changes in the system generally, and renewed activity of the various functions, follow hybernation, as they do diurnal sleep. It would lead us into discussions beyond our limits, if we were to examine the various peculiarities of hybernating animals, or to inquire into what may be termed the proximate cause of annual sleep.

The revolutions of the seasons produce changes in plants not unlike those which we have just noticed in hybernating animals. There is however a still closer analogy between diurnal sleep and the so-called

*Sleep of Plants*, a condition first discovered by Linnæus to be general, though some of the phenomena had long been noted in the tamarind-tree, and in some leguminous plants with pinnated leaves, natives of Egypt.

The attention of Linnæus was called to this phenomenon by the following circumstance:—Having sown some lotus seed, he watched the progress of the plants, and at length discovered upon one of them two flowers. When evening came, he could not find the flowers again, and supposed that some one had plucked them. On the following morning he again observed them, and they once more disappeared at evening. He then examined the plants with care, and saw that at evening the leaflets had approached each other, and thus concealed the flowers from view. Struck by this fact, he took a lantern in his hand and visited his flower-beds, when to his surprise he found the appearance of all things changed, and thus discovered the sleep of plants.

As night approaches, flowers close, the leaves of plants become more erect and fold themselves together, while vitality seems to retire from the periphery. Thus during sleep the leaves of the sensitive-plant lose their peculiar sensibility, which retires to the petiole. With the approach of night too an important change takes place in the functions of plants, for instead of exhaling oxygen and absorbing carbon from the atmosphere, as in the day time, their action at night is directly the reverse.

The sleep of plants usually occurs at night time, owing to the withdrawal of the stimulus of light, to which they are subjected during the day. The experiments of De Candolle indeed have proved that by producing artificial day and night it is possible to change the time for the sleep and waking of plants. There must however be some cause of sleep more intimately connected with their organism than the mere withdrawal of light; for not only are there plants which, like certain animals, sleep through the day and are awake at night, but it has been ascertained that the leaves of plants kept constantly in the dark open and close at regular intervals, as during sleep.

Much information concerning sleep and hybernation will be found in Müller's 'Physiology,' translated by Dr. Baly, vol. ii., p. 1410, &c.; in the article 'Hybernation,' by Dr. M. Hall, in the 'Cyclopædia of Anatomy and Physiology;' and in the 'Dictionnaire des Sciences Medicales,' under the word 'Sommeil.'

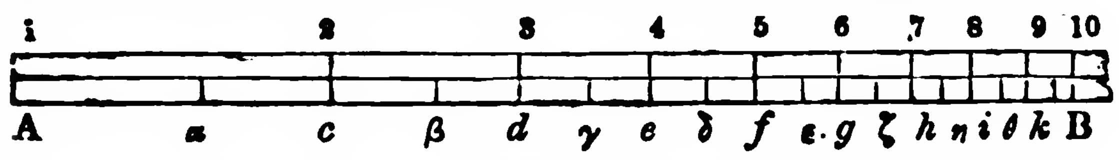
SLEEP OF PLANTS. [SLEEP.]

SLEEP-WALKING. [SOMNAMBULISM.]

SLESWICK. [SCHLESWIG.]

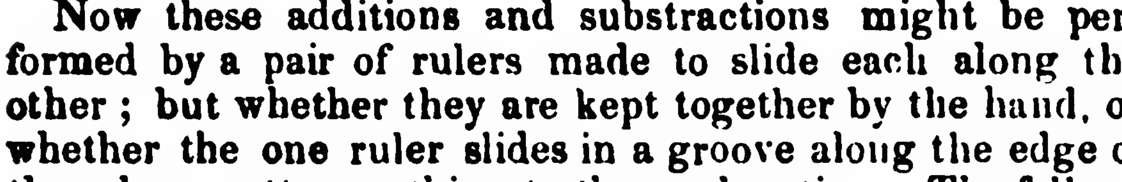
SLIDE (or SLIDING) RULE. The sliding-rule is an instrument for the mechanical performance of addition and subtraction, which is converted into an instrument for the mechanical performance of multiplication and division by the use of logarithmic scales, instead of scales of equal parts.

This instrument has been greatly undervalued in our country, in which it was invented, and is very little known on the Continent: for though a French work on the subject, published in 1825, which is followed by the writer of a very recent mathematical dictionary in the same language, assures us that in England the sliding-rule is taught at schools at the same time with the letters of the alphabet, we feel safer in saying that nine Englishmen out of ten would not know what the instrument was for if they saw it, and that of those who even know what it is for, not one in a hundred would be able to work a simple question by means of it. For a few shillings most persons might put into their pockets some hundred times as much power of calculation as they have in their heads: and the use of the instrument is attainable without any knowledge of the properties of logarithms, on which its principle depends.




We have before us a logarithmic scale, of which AB, called the *radius*, may stand for the logarithm of 10, 100, 1000, &c.: but if AB should be, say the logarithm of 100, then A*c* is that of 20, A*d* of 30, and so on. If this scale be repeated several times, beginning again at B, and if it be also large enough to be subdivided to a greater extent than can be shown in the diagram, any multiplication can be approximately performed by addition, and any division by subtraction; which may be done with a pair of compasses. That is to say, the figures of the product may be found, exactly or approximately, and the meaning of the figures must be settled from the known character of the result. For example, to find 4 times 15:—First let AB mean the logarithm of 100, then A*a* is that of 15: next let AB mean the logarithm of 10, then A*e* is that of 4. Take A*a* on the compasses, and set it on to the right of *e*; it will be found that the point *g* is attained, directly under 6. But 4 times 15 must be tens; therefore 60 is meant, or 4×15=60. Next to divide 90 by 45: from A*k* take Aδ, or set off Aδ from *k* towards the left. The point *c* will be attained, under 2, which is the quotient. Next to find 7 times 5; set off A*f* from *h* towards the right, and the point γ of the scale following B will be attained, and 35 is the answer. But had it been to multiply 7 by ·5 or 5-tenths, this 35 would have meant 3·5 or 3½. Attempts are made in works professing to explain the sliding-rule to give rules for the determination of the character of the figures in the answer, but without any success. It is all very well for a few chosen examples, but an attempt to do without the book soon shows the insufficiency of rules. If, on a large scale, 653 should be the figures of an answer, common sense, applied to the problem, must say whether it is ·0653, ·653, 6·53, 65·3, 653, 6530, 65300, &c. which is meant. A knowledge of decimal fractions is therefore indispensable.

Now these additions and substractions might be performed by a pair of rulers made to slide each along the other; but whether they are kept together by the hand, or whether the one ruler slides in a groove along the edge of the other, matters nothing to the explanation. The following diagram represents the two rulers in one relative position. Here 1 on the slide is made to match 2 on the fixed ruler, and the instrument is now in a position to multiply by 2, to perform every division in which the quotient is 2, and to work every question in the rule of three in which the ratio of the first term to either the second or third is that of 2 to 1, or of 1 to 2. And here let us observe, that much the best way of beginning to use the sliding-rule is not by working given questions, but by setting the slide at hazard, and learning to read the questions which are thus fortuitously worked.

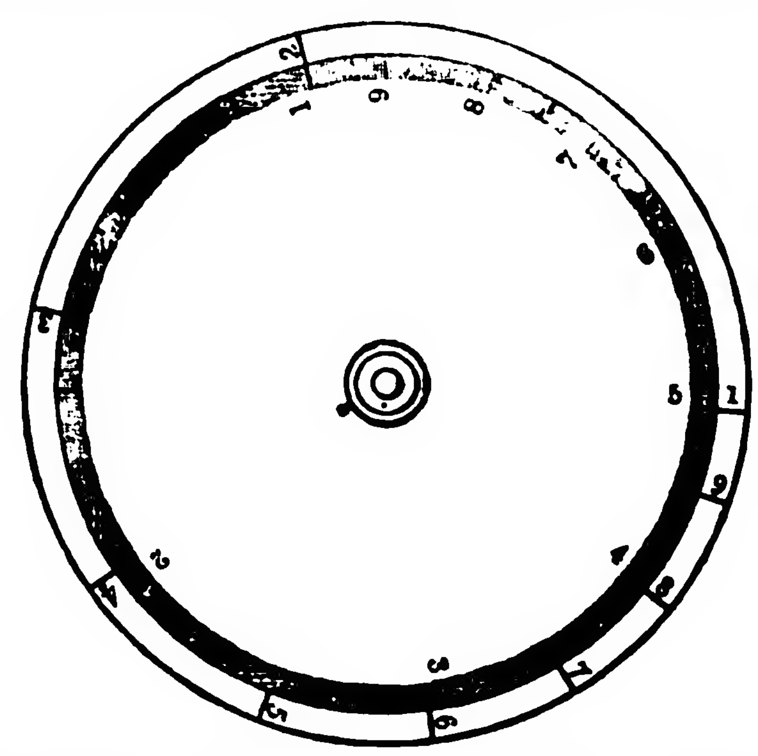



In the cut before us we have the 1 of the slide placed at 2 of the fixed ruler; consequently 6 on the slide comes under what would be 12 of the fixed ruler if the secondary graduations were inserted. Again, 4 comes over 2, and 9 over 45, giving 4 : 2 :: 9 : 4·5, the decimal point being inserted by intuition. To show the sort of results which we obtain from such a slide of 5½ inches radius (or from 1 to 1), we take one of this sort, and throw 1 of the slide at hazard between 225 and 230 on the fixed ruler, a little farther to the right than it is on the preceding diagram; guessing at the interval, it seems 228·5. We detect it more exactly by looking at 5 on the slide, which is hardly visibly in advance of 114 on the scale. As far then as the divisions, aided by our judgment of this interval, inform us, we have 114÷5 =22·85, the truth being 22·8. Again we find 628 (fixed) just over 275 (slide), the 8 being estimated: hence, by the scales we learn that 628÷275=2·285; the truth being 2·2836. Thirdly, we estimate that 1725 (fixed) falls over 757 (slide), and that 276 (fixed) falls over 121 (slide). That is, the ruler informs us that 1725 : 757 :: 276 : 121; the fourth term should be 121·12, as found by computation. We take a larger scale, having 7½ inches of radius, and setting 1 on the slide to 228·5, we find 1725 appears to fall over what we should judge to be 756 rather than 757. Now 1725÷757=2·2787, and 1725÷756=2·2818. Both give on the scales 2·285, so that the advantage is slightly in favour of the larger scale, but not so much as we should have expected. We now try one of 24 inches radius, and setting 1 on the slide to 2·285 on the fixed ruler, we find that 1725 (fixed) falls over 754·7 (slide), the last 7 being estimation. Now 1725÷754·7=2·2857, which gives the advantage again (but not so decidedly as might have been expected) to the large rule. The fact is, that it is rather ease than proportionate accuracy which is gained by the large rules: the preceding results required care and close attention on the 5½-inch rule; were obtained with moderate care on the 7½-inch; and taken off instantly from the 24-inch rule. Moreover, divisions on wood, made in the usual way, do not allow accuracy to increase with the size: if these rulers were divided on brass, and with the precautions taken in astronomical instruments, it would be a very different thing; but after all, the wonder is that the common wooden rules should be so accurate as they are.

*a*
*b*

The next step in the description is as follows:—It matters nothing whether the second scale be really made consecutive with the first, or occupy any other part of space provided that when 1 and 1 are brought together on the first scale, 1 and 1 also come together on the second, and that the first slide and its continuation slide equally. We see this in the diagram before us: *a b* is one slide, and A B are two rulers on opposite sides of the groove. When *a b* is pushed home, A and *a* present coinciding scales, as do B and *b*: we should rather say, that the last is not one scale, but the end of one and the beginning of another; the 1 of B and *b* being in the middle. The consequence is, that as long as 1 of the scale *b* is not pushed out so far as to fall out of the groove (which is never necessary, since there is a whole scale on B), there is always the power of reading every result of the multiplication in hand. In the diagram, 1 on *b* is pushed out to 2 on B, and on the upper scales (A and *a*) we see 2×2=4, 2×3=6, 2×4=8, 2×5=10; on the lower (B and *b*), 2×4=8, 2×5=10, 2×6=12, 2×7=14, 2×8=16, 2×9=18, 2×10=20. This modification was invented by Mr. Silvanus Bevan (Nicholson's *Journal*, vol. xlix., p. 187); but thirty years before this Mr. Nicholson (*Phil. Trans.*, 1787, p. 246) had pointed out how to divide the whole radius into four parts, two on each face.

But the most simple plan, and, but for difficulty of dividing, the best, is to make a revolving circle turn upon a fixed one, in which case the scale is its own continuation, as in the following diagram. The two circles have a common



pivot, and the upper one turns round on the lower; the rim of the inner circle being bevelled down to the plane of the lower. A complete logarithmic scale is marked on each circumference, and it will readily be seen that the scales are placed so as to point out multiplications by 2, as in the former instances, and also that the recommencement of the scale begins its continuation. Instead of two circles there might be two thin cylinders, turning on a common axis, the graduations being made on the rim. Twelve or fifteen years ago, an instrument-maker at Paris laid down logarithmic scales on the rims of the box and lid of a common circular snuff-box: one of two inches diameter would be as good an aid to calculation as the common engineer's rule. But either calculators disliked snuff, or snuff-takers calculation, for the scheme was not found to answer, and the apparatus was broken up. There can, we think, be little doubt that when the knowledge of this instrument is extended, and consequently its sale, a pair of well-graduated brass circles will be the form it will take.

The form first proposed by Oughtred (presently to be mentioned) was a modification of the preceding. Instead of two circles, two pointing radii were attached to the centre of one circle, on which a number of concentric circles were drawn, each charged with a logarithmic scale. These pointers would either move round together, united by friction, or open and shut by the application of pressure: they were in fact a pair of compasses, laid flat on the circle, with their pivot at its centre. Calling these pointers antecedent and consequent, to multiply A and B the consequent arm must be brought to point to 1, and the antecedent arm then made to point to A. If the pointers be then moved together until the consequent arm points to B, the antecedent arm will point to the product of A and B.

It will be observed that in every construction the logarithmic spaces are very unequal, those near the end of the scale being small when compared with those at the beginning. This is not so great a disadvantage as might be supposed, for it makes the liability to error increase in nearly the same proportion with the result, so that the *per-centage* of error in the sliding-rule is nearly the same thing in all its parts. For example, the scale going from 10 to 100, the interval from 10 to 11 is to that from 99 to 100 as 207 to 22, nearly in the proportion of 10 to 1. The tendency to absolute error will be inversely as these intervals, or nearly in the proportion of 1 to 10: the tendency to error is therefore about ten times as great precisely when the result estimated becomes ten times as great. Oughtred appropriated two circles to his logarithms of sines, and it would be easy in his construction of the 'circles of proportion,' as he called them, to distribute the scale among different circles in such a manner that the graduations should be nearly equal throughout. But the mathematician will easily see that the most perfect mode of developing this idea would be to lay down the scale on a revolution of a logarithmic spiral, having the pointers joined at its pole. The graduations would then be absolutely at equal distances from each other on the arc of the spiral.

Another modification of the principle of the sliding-rule is as follows:—Let the divisions be all made equal, and the numbers written upon the divisions in geometrical proportion. If this were done to a sufficient extent, any number might be found exactly or nearly enough upon the scale; the only difficulty being that very small divisions do not give room enough to write the numbers. This modification of the principle has been applied in two very useful modes by Mr. MacFarlane. In the first, two cylinders moving on the same axis, on one side and the other of a third, give the means of instantaneously proposing and solving any one out of several millions of arithmetical questions for the use of schools and teachers. In the second, one circle revolving upon another gives the interest upon any sum, for any number of days, at any rate of interest under ten per cent.

The rules for using the sliding-rule, in its most simple form, may be symbolically expressed in the following manner:—

| | | | | | |
|---|---|---|---|---|---|
| 1 | B | A | B | A | C |
| A | AB | 1 | B÷A | B | C×B÷A |

Thus, if 1 on either ruler be brought opposite to A on the other, B on the first ruler is brought opposite to AB on the other. But if the slide be taken out and inverted, we have the following rules:—

| | | | | | |
|---|---|---|---|---|---|
| 1 | B | A | B | A | C |
| A | A÷B | 1 | A÷B | B | A×B÷C |

We now proceed to some of the additions which are frequently made to sliding-rules, premising that we do not describe any one in particular, but refer for detail to the tracts which are afterwards cited. For the extraction of square or cube roots, or the formation of squares or cubes, the following method is adopted:—In the case of squares and square roots, for instance, there is a pair of scales, one on the slide and one on the fixed ruler, of different radii, the radius of one being twice as long as that on the other: for cubes and cube roots the radius of one is three times as long as the other. On the former scale (that of squares and square roots) the rules are now as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Longer Rad. | 1 | A | √A | 1 | B | √(B:A) |
| Shorter Rad. | 1 | AA | A | A | AB² | B |
| | A | B | A√B | A | C | A√(C:B) |
| | 1 | B²·A² | B | B | BC²:A² | C |

The denomination of the answer, or the place of the decimal point, must be determined by independent consideration, as before: but there is one circumstance to be attended to in every case in which two of the data are to be read on the shorter scale. For example,* suppose it is required to estimate √(2:7). By the second formula, 7 on the shorter scale is placed opposite to 1 on the longer, and 2 on the shorter scale is then opposite to 1693 on the longer. The answer from the scale is then ·1693, to all appearance; but this is not √(2:7), but √(2:70). The place on the longer scale which should give the answer has no slide opposite to it, but only empty groove. But mark where 1 on the shorter scale is opposite to a part of the longer (between 119 and 120), and push the slide in from left to right till the first 1 on the shorter scale comes where the second now is; then look under the second 2 of the shorter scale, we have 534; and ·534 is the true answer as far as the scale will give it. We have taken the most straight-forward plan of reading the rule, and have not space for all the details which are in works on the subject, particularly the method of using the slide of numbers with a scale of numbers above and of square roots below. The following is the general principle applicable to the preceding case:—

It is well known that whereas in common division the place of the decimal point has nothing to do with the significant figures of the quotient; yet in extracting the square, cube, &c. roots, the figures of the root are altered by a change of the decimal point, unless it be changed by an even number of places in extracting the square root, by three or a multiple of three places in the cube root, and so on. In extracting the square root, a number may either have two figures in its first period, or one; thus ·07616 and ·7616 must (in the rule for extraction) be pointed

·076160 and ·7616.

Let us call numbers *unidigital* or *bidigital*, according as there are one or two significant figures in the first period. Then the application to the sliding-rule is, that on the shorter scale numbers of the same name must be read either on the same radius or with a whole radius intervening, while numbers of different names must be read on different radii In the scale for the extraction of the cube root, numbers must be distinguished into unidigital, bidigital, and tridigital; and signifying these by their initial letters, and taking the succession UBTUBT, &c., there must be the same relation between the scales on which they are read that there is between the places of their letters in the preceding list. Thus if U be read on one radius, T must either be read on that immediately preceding, or on the next but one. Thus in the preceding question, which we first solved wrongly, we have 2 and 7 to consider on the shorter scale, the pointing of which is—

2·0000 and 7·0000,

and both are unidigital numbers. Bringing 7 on the shorter scale to 1 on the longer, we see that the next 2 is on a different radius; it would do then for 70, or ·7, or ·007, but not for 7. By the process we followed we took not indeed a 2 on the same radius with our 7, but on the next radius but one; and thus obtained the correct answer. These points, and others (such as the meanings of the lines of sines, tangents, &c., annuities, &c., which are found on several rules) can only be mastered by those who are acquainted theoretically with logarithms, trigonometry, &c.; for after all the sliding rule will not teach the method of

* The reader will not understand this, unless with the scale in his hand. The common carpenter's rule or Bevan's rule will do, in which two consecutive radii are on the shorter scale, and one radius of twice the length on the longer.

working any question, but will only afford aid in computation—in common multiplication and division, to any one; in higher rules, to those who understand their principles. Oughtred, the inventor, kept the instrument by him many years, out of a settled contempt for those who would apply it without knowledge, having 'onely the superficiall scumme and froth of instrumentall trickes and practises:' and wishing to encourage 'the way of rationall scientiallists, not of ground-creeping Methodicks.' A little distinction between that portion of its use which is generally attainable, and that which requires mathematical knowledge, would have been more reasonable.

On the carpenter's and engineer's sliding-rule are engraved a number of numerals in columns with headings, of which the following is a specimen :—

| | SQUARE. | | | CYLINDER. | | GLOBE. | |
|---|---|---|---|---|---|---|---|
| | FFF | FII | III | FI | II | F | I |
| CAST IRON | ·0022 | ·323 | 3·878 | ·411 | 4·935 | ·0043 | 7·406 |

These divisors (called gauge-points) are intended to convert into pounds the weight of a rectangular prism, cylinder, or globe, of cast-iron; the first, on three suppositions, namely, all dimensions in feet, one in feet and two in inches, and all in inches; the second, on the suppositions that the length is in feet and the diameter in inches, and that both are in inches; the third, on the supposition that the diameter is either in feet or in inches. We shall here content ourselves with verifying one of these, say the first of those marked 'cylinder,' which will show the nature of the divisor.

The specific gravity of cast-iron is 7·207, and the content of a cylinder of D *inches* diameter and L *feet* of length is ·7854 × $D^2L$ divided by 144, in cubic feet. A cubic foot of water weighs 62·321 pounds avoirdupois; one of cast-iron therefore weighs 62·321 × 7·207; whence the weight of the cylinder is, in pounds,

$$62{\cdot}321 \times 7{\cdot}207 \times {\cdot}7854\ D^2L \div 144, \text{ or } \frac{D^2L}{G};$$

$$\text{where } G = \frac{144}{62{\cdot}321 \times 7{\cdot}207 \times {\cdot}7854}, \text{ or } {\cdot}4082;$$

near enough to ·411 to illustrate our object, but showing that the computer of this divisor used a specific gravity slightly differing from the above. The rule in all the cases is to multiply the three dimensions together, diameters or lengths, and to divide by the divisor given in the table. The term gauge-point, which properly belongs to the part of the scale on which the divisor is marked, has passed to the divisor itself.

The following list of sliding-rules, now on sale in London, contains all or nearly all which can be useful to any one :—

1. Common Engineer's Rule, or Carpenter's Rule in its best form. A double 12-inch rule, a slide of two radii with the same scale on one side, and a scale of one radius of double length on the other, with divisors (sold by all rule-makers). The newest description is Kentish's 'Treatise on a Box of Instruments,' &c., London, 1839.

2. Bevan's Engineer's Rule, 12 inches. Has slides on both faces (which may be exchanged), and serves for squares, cubes, square roots of cubes, &c. There are scales on the backs of the slides and in the grooves, for sines, tangents, inverted numbers, compound interest and annuities at 5 per cent. (Cary, Strand; with an explanatory treatise.)

3. Henderson's Double-Slide Rule, 12 inches. Has two parallel contiguous slides, with scales of numbers fixed above and below, and solves at one operation most sets of multiplications and divisions not exceeding five operations. At the back are tables of divisors for solids. (Jones, Holborn.)

4. Woollgar's Pocket Calculator, 8 inches. The two slides work in either of the grooves: the backs and the grooves have scales of sines, tangents, areas of polygons, circular segments; interest, annuities, certain and for lives, at several rates of interest. An addition may be made by a metal slip, giving the solution of the same questions as the last rule. (Rooker, Little Queen Street; with an explanatory tract.)

5. Woollgar's Pocket-Book Rule, 6 and 8 inches. Two radii, one under the other, as described in the preceding part* of the article; a line for sines, and duplicate proportions at the back of the slide. At the bottom of the groove are sometimes inserted lines for finding the relations of right-angled triangles, for cask gauging, and for cuttings and embankments. (Rooker.)

* The maker of this slide has them of various lengths up to 24 inches.

6. Excise Officer's Sliding Rule, modern form. Sold at the Excise Store-office, and by some of the instrument-makers. The old Excise rule was a thick block, with a slide on each face.

Among separate treatises not yet noted are Flower's, 8vo., London, 1768; Mackay's, 8vo., 2nd edit., London, 1811; do., Leith, 1812; 'Instruction sur la Manière de se servir de la Regle à Calcul.,' petit-in-8vo., Paris et Dijon, 1825; 'The Universal Ready-Reckoner,' by an Idle Gentleman, 12mo., London, 1839; and there is a good deal on the subject in Ingram's 'Concise System of Mathematics,' 12mo., Edinburgh, 1830; and Bateman's 'Excise Officer's Manual,' 12mo., London, 1840.

Between the sliding-rule and the book of logarithms comes the card of four-figure logarithms, published by Messrs Taylor and Walton (explained in the 'Companion to the Almanac' for 1841), to which has very recently been added a similar card for sines and tangents. A sliding-rule which would *in all parts* compete with these tables in accuracy must have a radius of from 8 to 10 feet, and would be unmanageable. At what length the card begins to be more easily used than the rule we cannot determine, but we should suspect that the former would be preferable to a rule of four feet radius. We have found the rule of 24 inches extremely useful in checking the material figures of more minute calculations, particularly when there are many divisions by the same divisor.

The history of the sliding-rule, had it ever been properly given, would be matter for a few lines of our work, in the way of abbreviation and reference. As it is, we have not only to establish the main points, but also to point out a specimen of the manner in which the account of early English science has been written. Harris's 'Lexicon Technicum' (1716) informs us that sliding-rules 'are very ingeniously contrived and applied by Gunter, Partridge, Cogshall, Everard, Hunt, and others, who have written particular treatises about their use and application.' Stone's 'Mathematical Dictionary' (1743) has the same words. Dr. Hutton (*Math. Dict.*, 1815) informs us that they are variously (not ingeniously) contrived and applied by different authors, particularly Gunter, Partridge, Hunt, Everard, and Coggleshall. Other writers repeat this sentence in their own ways, and the summing up is this:—the recognised history of the sliding-rule consists in the names of five persons; all our best English authorities are unanimous in stating that these men 'contrived and applied' sliding-rules, either ingeniously or variously; but to the credit of this century be it spoken, that it was our historian who altered the chronological order, and spelt Coggleshall's name right: had it not been for the research of Dr. Hutton, it might have been Cogshall to this day.

We now go on to something more like history. It is generally stated that Gunter invented the sliding-rule. This is not correct; Gunter neither invented this rule nor wrote about it; and though he was the first (*On the Crosse-staffe*, book i., cap. 6) who used a logarithmic scale, it was in the manner described at the beginning of this article, compasses being used to make the additions and subtractions. Gunter's rule is used up to the present time, under that name, in the navy, without any slides.

The real inventor of the slide was OUGHTRED, who was also the first writer upon it. He was a man who set but little value upon instrumental aids, unless in the hands of those who had previously learned sound principles, which (as we have seen) he himself testifies. In the year 1630 he showed it to his pupil William Forster, who obtained his consent to translate and publish his own description of the instrument, and rules for using it. This was done under the following title: 'The Circles of Proportion and the Horizontal Instrument,' London, 1632; followed, in 1633, by an 'Addition, &c.,' with an appendix, having title, 'The Declaration of the Two Rulers for Calculation.' The following extract from W. Forster's* dedication to Sir Kenelm Digby will explain the whole:—

'Being in the time of the long vacation 1630, in the Country, at the house of the Reverend, and my most worthy friend, and Teacher, Mr. William Oughtred (to whose instruction I owe both my initiation, and whole progresse in these Sciences), I upon occasion of speech told him of a Ruler of Numbers, Sines, and Tangents, which one had be-

* This man must not be confounded with the Gresham professor of his name; nothing more than his connection with Oughtred is known of him. The one whose name is so much connected with Gunter is Samuel Foster (died 1652), Gresham professor of astronomy.

spoken to be made (such as is usually called Mr. Gunter's Ruler) 6 feet long, to be used with a payre of beame compasses. He answered that was a poore invention, and the performance very troublesome: But, said he, seeing you are taken with such mechanicall wayes of Instruments, I will show you what devises I have had by mee these many yeares. And first, hee brought to mee two Rulers of that sort, to be used by applying one to the other, without any compasses: and after that he shewed mee those lines cast into a circle or Ring, with another moveable circle upon it. I seeing the great expeditenesse of both those wayes, but especially of the latter, wherein it farre excelleth any other Instrument which hath bin knowne; told him, I wondered that he could so many yeares conceale such usefull inventions, not onely from the world, but from my selfe, to whom in other parts and mysteries of Art he had bin so liberall. He answered, That the true way of Art* is not by Instruments, but by Demonstration: and that it is a preposterous course of vulgar Teachers, to begin with Instruments, and not with the Sciences, and so in-stead of Artists, to make their Schollers only doers of tricks, and as it were Juglers: to the despite of Art, losse of precious time, and betraying of willing and industrious wits unto ignorance, and idlenesse. That the use of Instruments is indeed excellent, if a man be an Artist: but contemptible, being set and opposed to Art. And lastly, that he meant to commend to me the skill of Instruments, but first he would have me well instructed in the Sciences. He also showed me many notes, and Rules for the use of those circles, and of his Horizontall Instrument (which he had projected about 30 yeares before) the most part written in Latine. All which I obtained of him leave to translate into English, and make publique, for the use, and benefit of such as were studious, and lovers of these excellent Sciences.'

Oughtred gave his right in the invention (as soon as it was settled to be published) to Elias Allen, a well-known instrument-maker, near St. Clement's church, in the Strand. In walking to and fro from this shop, he communicated his invention to one Richard Delamain, a mathematical teacher whom he used to assist in his studies. This Delamain not only tried to appropriate the invention to himself, but wrote a pamphlet of no small scurrility against Oughtred, which the latter answered in an 'Apologeticall Epistle' fully as vituperative; which epistle was printed at the end of W. Forster's translation. It contains some quantity of biographical allusion, and must not be forgotten by a mathematical historian of the times. W. Forster's work was republished in 1660, by A. H. (Arthur Haughton, another pupil of Oughtred), with Oughtred's consent, but the dedication and epistle were omitted.

The next writer whom we can find is Seth Partridge, in a 'Description, &c. of the Double Scale of Proportion,' London, 1685. He studiously conceals Oughtred's name: the rulers of the latter were separate, and made to keep together in sliding by the hand; perhaps Partridge considered the invention his own, in right of one ruler sliding between two others kept together by bits of brass. Coggleshall's ruler was made in both ways, that is, with the rulers attached and unattached; it appears to have come in at the end of the seventeenth century. Since that time several works have been written, and various modifications of the ruler proposed. Ward (*Lives of Gresham Professors*) is incorrect in saying that Wingate carried the sliding-rule into France in 1624: it was Gunter's scale which he introduced there. In fact the slide was little used and little known till the end of the century. Leybourn, himself a fancier of instruments, and an improver (as he supposed) of the sector, has 30 folio pages of what he calls instrumental arithmetic in his 'Cursus Mathematicus' (1690), but not one word of any sliding-rule, though he puts fixed lines of squares and cubes against his line of numbers in his version of Gunter's scale.

Finding so meagre an account on this matter in publications professedly mathematical, we did not at first think of having recourse to any others. When we had finished the preceding however, we thought of consulting the 'Biographia Britannica,' and there we found, in the middle of a very full life of Oughtred, the whole account of the invention of the sliding-rule, exactly as above, and from the same authorities. On looking at Dr. Hutton's account in the Dictionary, we perceive that he has either used this memoir or some copy of it; but without giving any information on the subject of the present article.

* Here is the old use of the word art we should now say science. [SCIENCE.]

We shall conclude this article by some account of a new species of sliding-rule, invented by Dr. Roget (*Phil. Trans.* for 1815), which would be very useful in the hands of writers on statistics, and would sometimes save much trouble to the mathematician. The slide contains a common logarithmic line of two radii, each 10 inches in length. The fixed ruler has not logarithms, but logarithms of logarithms denoted by its spaces. For instance, reckoning from 10 (remembering that log log $10=0$), the space from 10 to 100 is log log 100, or log 2, the same space as from 1 to 2 on the slide. And since log log $x$ is positive or negative, according as $x$ is greater or less than 10, we have the *logo-logarithms* laid down on the left for numbers less than 10, and on the right for numbers greater. This instrument is constructed by Mr. Rooker (Little Queen Street), and in this manner: 10 is on the middle of the upper ruler, which ends on the right at $10_{10}$, or ten thousand millions; and on the left at 1·25. At the extreme right of the lower ruler we find 1·25 again, from which we recede to 1·0025 on the extreme left. The upper and lower rulers are so adjusted that from the end of one to the beginning of the other it is exactly two radii, so that a setting on the upper ruler applies also to the lower, but it may be necessary first to slip the slide a whole radius forwards or backwards, in the manner described in the preceding part of the article. And here again the meaning of the reading on the slide must frequently be determined by common sense applied to the problem.

When 1 on the slide is placed opposite to $a$ on the ruler, we have $b$ on the slide opposite to $a^b$ on the ruler. Or using the preceding rotation—

| | | | | | | |
|---|---|---|---|---|---|---|
| Rule | $a$ | $a^b$ | $a$ | $\sqrt[b]{a}$ | $a$ | $\sqrt[b]{a^c}$ |
| Slide | 1 | $b$ | $b$ | 1 | $b$ | $c$ |

The approximations of this rule are equally easy whether applied to fractional or integer exponents, and Dr. Roget justly observes that it gives a much better idea of the rapid increase of powers than simple reflexion. It is so little known even to mathematicians, that we put down some of its results as specimens of its powers. Set 1 on the slide opposite to 3·14 on the rule, and we find for the approximate powers of this number by simple inspection 9·85, 31, 97, 300, 960, 3000, 9500, 29,500, 93,000, &c. The square root is 1·772, the cube root 1·463, the fourth root 1·331, the fifth root 1·257. We must now change the slide, as above directed, so as to put it in connection with the lower scale, and the proceeding roots are 1·216, 1·178, &c. All questions of increase of money, population, &c. are in this manner reduced to simple inspection, and very easy trial gives that approximate solution of exponential equations which the mathematician must find before he applies his more extensive methods. Thus, to form the table of logarithms in SCALE (p. 506) the base of which is $\sqrt[12]{2}$:—Set 12 on the slide opposite to 2 on the ruler, and the table is ready, as far as the instrument will give it. Thus, opposite to 3, 4, 5, &c. we find 19·0, 24, 27·9, 31·0, 33·7, 36·0, &c. almost exactly as in the table cited. It is also worth notice that each division of the upper fixed ruler answers to the hundredth power of the division directly beneath it on the lower fixed ruler. Thus, wishing to know what effect would be produced in 100 years upon a population which increases 3·46 per cent., we set unity to 1·0346 on the lower scale, and find at once 30·025 on the upper ruler, being the number by which the present population must be multiplied.

Mr. Woollgar (to whom we are indebted for much information in this article, and who has made a particular study of the sliding-rule) has carried to a considerable extent the principle of making the slide or the rule (no matter which) bear not the logarithms of the numbers marked on its graduation, but those of the values of a function of those numbers (*Mechanics' Magazine*, No. 849, vol. xxxii.). Let a slide be so graduated that the interval from a given point to the graduation $x$ represents log $\phi x$. When $x$ is then ascertained (by the common scale, if necessary), the formula $a\phi x$ is immediately deduced from the common scale and the new slide. Nor need there be a new slide: for any scale being laid down in the groove, the common slide, by having its end made to coincide with one or another division of the scale in the groove, may be rendered capable of answering the purpose of a new slide.

Since the above article was written, we have obtained from Paris a circular logarithmic scale in brass, altogether resembling the one figured and described in the preceding part of this article, with the addition only of a clamping screw. This instrument, the scale of which is 4½ inches in diameter, is so well divided that it will stand tests which the wooden rules would not bear without showing the error of the divisions. But here arise disadvantages which we had not contemplated. In the first place, no subdivision can be well made or read by estimation, unless the part of the scale on which it comes is uppermost or undermost, which requires a continual and wearisome turning of the instrument. In the next place, to make the best use of it, and bring out all its power, requires (we should rather say renders worth while) such care in setting and reading, as, unless a microscope and tangent screw were used, makes the employment of the four-figure logarithm card both shorter and less toilsome. For rough purposes, then, a wooden rule is as good; for more exact ones, the card is better. We made a fair trial of both on the tables in SOLAR SYSTEM, and are perfectly satisfied that though the French brass arithmometer did, with great care, bring out the results required, the four-figure card did the work more easily. But, had we wished to abandon two or three units in the last places of figures, there would then have been no doubt that the instrument would have been the easier of the two: but then a straight wooden rule of the same radius would have done quite as well, and been more convenient still. (*Mechanics' Magazine*, No. 949.)

SLIGO, an Irish county in the province of Connaught, extending along the southern shore of that great inlet of the Atlantic Ocean which separates the provinces of Ulster and Connaught, and of which Donegal, Sligo, and Killala bays are subordinate parts. The county is bounded on the north by the sea, on the north-east by the county of Leitrim, on the south-east by that of Roscommon, and on the south-west and west by that of Mayo. Its form is tolerably compact: the greatest length is in a direction nearly east and west, from the junction of the three counties of Leitrim, Roscommon, and Sligo, to the mouth of the river Moy in Killala Bay, thirty-five miles; the greatest breadth at right angles to the length is from the village of Clossibawn, on the Atlantic, to the shore of Lough Gara, thirty-four miles. (*Ordnance Survey.*) The gross area, according to the Ordnance Survey, is 461,753 acres, or 721½ square miles; of which 12,740 acres, or 20 square miles, are loughs, leaving 449,013 acres, or 701½ square miles, of land. The gross area is about equal to the area of the English county of Worcester. The population, in 1831, was 171,765, which gave nearly 245 inhabitants to a square mile of land. It is the smallest and least populous county in Connaught except Leitrim, but the population is more dense than in any other except Roscommon. Sligo, the county town, is at the bottom of Sligo Bay, in 54° 18′ N. lat. and 8° 25′ W. long., 109 miles in a direct line north-west of Dublin, or 132 miles by the road through Lucan, Leixlip, Mullingar, Longford, Carrick-on-Shannon, and Boyle.

*Coast-Line, Bays, and Islands.*—The coast from the mouth of the river Moy, at the western extremity of the county, runs north-north-east seven miles in a tolerably direct line, forming the eastern side of Killala Bay, and terminating in Lenadoon Point. From Lenadoon Point the coast runs eastward to Cooanmore Head five miles, and then south-east for as much more, to the neighbourhood of the post-town of Dromore West, at which point it turns to the north-east, and runs twenty or twenty-two miles in that direction to the headland near the small harbour of Clossibawn or Classybaun, the outline being broken in this part by Sligo Bay. From the neighbourhood of Clossibawn the coast runs for about five miles first south, then east to the mouth of the little river Duff, which forms the boundary between this county and Leitrim. Except in Sligo Bay and along the coast eastward from it the shore is rocky. There are cliffs in some places on the shore of Killala Bay, and between Lenadoon Point and Dromore West, and near the entrance of Sligo Bay on each side, and again about the headland near Clossibawn. Off that part of the coast which extends north-eastward from Sligo Bay, distant between three and four miles, is Innis Murray, a small island, about a mile long from east to west. It rises precipitously on every side except just at the east point; and it is highest on the north and west sides (74 to 77 feet), where it faces the open sea. It contains about 209 acres of cultivable land, chiefly pasturage, and is inhabited by about a score families. About two or three miles farther out to sea are the Boabinshy rocks. Sligo Bay is nearly six miles across at the entrance, and about ten miles deep to the town of Sligo. On the south-west side of the entrance is Aughris Head, and on the north-east side is Roskeeragh Point. The bay is divided by projecting headlands into three smaller bays which penetrate inland in an east or south-east direction. The northernmost of these smaller bays is called Drumcliffe Bay: it is useless as a harbour from its being shallow, but has an oyster-bank on its northern shore near Lissadill House, which yields good oysters. The middlemost bay is that at the bottom of which the town of Sligo stands; it is in great part occupied by a large bank called Cummeen Strand, but has a channel navigable up to Sligo town for vessels of small burden. The mouth of this bay is protected by Coney Island (area 388 acres), which stretches across the entrance, and forms a natural breakwater, within which large vessels, which cannot get up to the town, lie at anchor. There is another much smaller island in the bay, called Oyster Island, on which are two lighthouses; and westward from Coney Island extends a reef, on the western extremity of which, the Black Rock, dry at low-water, a lighthouse has been built. There is another still smaller island, Maguin's Island, off the headland between this bay and that of Ballysadere. The southernmost of the three bays, Ballysadere or Ballysadare Bay, forms the æstuary of the Ballysadere river: it is shallow, except just in the channel of the river, by which ships of 100 tons burden can get up to the village of Ballysadere. There are extensive sands or other strands in Killala and Sligo bays, and along the coast eastward of Sligo Bay. A narrow channel in the strand between Sligo Bay and Clossibawn, the mouth of a small rivulet, runs for several miles nearly parallel to the coast, and is known as Milk Haven. Two small islands lie between it and the sea.

*Surface and Geology.*—The mountains of this county form three principal groups. The Ox Mountains extend from the river Moy at Foxford, in the county of Mayo, north-east to the shore of Ballysadere Bay. The mountains which overspread the counties of Fermanagh and Leitrim extend into this county and occupy the north eastern border; these form the second group. The third group consists of such portions of the Braughlieve and Curlew Mountains [ROSCOMMON] and the mountains round Lake Gara as are in the county. The Ox Mountains (to which, in the Map of Ireland, published by the Useful Knowledge Society, the name of Slievh Gauff is also given) form a considerable range, about twenty-five miles long and five or six in breadth. They consist chiefly of mica slate, with occasionally granite, hornblende slate, gneiss, and quartz rock; the strata dip rapidly towards the south. The summits have a mean height of 1300 feet above the level of the sea at low-water; on the north-west side they present abrupt rocky peaks, with intervening ravines of no great depth. On the south-east the ascent is more gradual and less rocky. Knock-a-Chree, the highest of the peaks, near the north-eastern termination of the range, is 1778 feet high; it is composed of hornblende slate. Streams are more abundant on the south-eastern slope than on the north-western; and amid the group are two small lakes, Lough Easkey and Lough Talt, the former 607 feet and the latter 455 feet above the level of the sea at low-water. The mica slate, of which the Ox Mountains are composed, extends eastward across the Ballysadere river, and along the south side of Lough Gill into the county of Leitrim, forming a range of hills which may be regarded as a prolongation of the Ox Mountains. At the base of the Ox Mountains the old red-sandstone and conglomerate are observed skirting on both sides of the range the primary rocks, and sinking below the carboniferous limestone, which occupies the lower lands extending on one side to the sea and on the other to the Curlew and other mountains on the border of Roscommon. The strata are generally very distinct; in some places however the conglomerate graduates insensibly into the subjacent quartz rock, especially on the south-east side of the range, where the two formations lie conformably on the inferior beds; but on the north-western slope the conglomerate rests on the outcrop or edge of the older beds. Garnets are found near Lough Easkey in the Ox Mountains.

Of the mountains on the border of Roscommon, the Braughlieve Mountains, which rise in one part 1346 feet above the level of the sea at low-water, belong to the carboniferous group, and the Curlew Mountains, which rise in one part 1062 feet above the level of the sea, to the old red-sandstone group.

The same group (the sandstone) occupies the headland on the north-eastern side of the entrance of Sligo Bay. The rest of the county is occupied by the formations of the carboniferous limestone group. A ridge of mountains west of Lough Gara consists of the yellow sandstone which constitutes the lowest member of this group; but very little of this ridge, if any part of it, is within the county. The lower limestone, the member next above the yellow sandstone, is found at the base of the Curlew Mountains, near Lough Arrow, and yields grey and dove-coloured marble. The mountains on the north-eastern border of the county are formed of the calp and shale division, which is next above the lower limestone, and of the upper limestone, which is the uppermost division of the group. These mountains form part of the mountain district of Fermanagh, Cavan, Leitrim, Roscommon, and Sligo, the limestone of which bears a striking resemblance in character and composition to the mountain limestone of Derbyshire, Cumberland, and the north-west of Yorkshire, and which exhibits in perfection the whole series of formations belonging to the carboniferous limestone and the millstone-grit series of Ireland. In Benbulben, one of the loftiest mountains of the group (1722 feet above the level of the sea), situated several miles north of Sligo, the upper limestone is 500 feet thick. Its upper strata are frequently associated with irregular beds of semi-crystalline brown spar rock, the disintegrated surfaces of which so much resemble ordinary grey sandstone in appearance, that this rock has frequently been mistaken for it. Brown spar of this kind occurs on the summit of the mountain Knockaree, or Knock-na-ree (1057 feet high), which occupies part of the headland that separates Sligo Bay from Ballysadere Bay. The northern face of the mountain Benbulben is nearly perpendicular, while on the south side a more gradual slope leads to the summit, which is a table-land of some extent. The other principal mountains of this north-eastern and eastern group are Trusk More (2113 feet high), Trusk Beg, Ben Weskey, King's Mountain (1965 ft.), Castlegal (1447 ft.), and Culogua Buy (1430 ft.).

This county and the adjacent one of Mayo are traversed by trap dykes unexampled for length, directness, and parallelism. Their direction is nearly east and west. Trachyte, a formation not observed elsewhere in the British Isles, is found on the shore of Killala Bay. (Archdeacon Verschoyle, *On the North Coast of Mayo and Sligo*, in *Geol. Transactions, second series*, vol. v., pp. 149, &c.; Griffiths, *On the Geology of Ireland*, in *Appendix to Second Report of Irish Railway Commissioners*. The heights are from the *Ordnance Survey*.)

Copper and lead mines were formerly wrought in the primary district to which the Ox Mountains belong; but there are not any carried on at present. Garnets abound above Lough Easkey, and asbestos is found to the eastward. The Arigna coal-works are just beyond the boundary of this county. A considerable part of the district extending northward from the foot of the Ox Mountains to the sea is covered with bog; and there is a considerable extent of bog in the southern part of the county, but very little in the part which lies north of the town of Sligo.

*Hydrography and Communications.*—The western side of the county is watered by the Moy and other smaller streams which flow into Killala Bay, or into the open sea. A stream, called by some authorities the Moy, but in the Society's map the Owengarrow, has part of its course in this county and part in Mayo. It joins what is marked in the Society's map as the Moy, above Foxford. The united stream touches the western border of the county just below the town of Ballina, and forms the boundary of the county of Sligo and Mayo, until it falls into Killala Bay. It is navigable for vessels of considerable burden up to Ballina. Nearly all the rest of the county is drained by the streams which flow into Sligo Bay, of which the most important are the Ballysadere, and the river Sligo or Garvogue, which, flowing from Lough Gill, passes the town of Sligo. The Ballysadere is formed by two streams, the Awinmore and the Arrow or Unshin or Awinshien (the latter flowing from Lough Arrow), which unite near the town of Collooney, and, falling over a ledge of rock which crosses the bed, enter Ballysadere Bay. These rivers are all small, and of little use for navigation.

The lakes are tolerably numerous, and have an aggregate area of 20 square miles. The principal are—Lough Gara, on the southern boundary, 222 feet above the level of the sea at low-water, and having an area in this county of 3684 acres, or above 5¾ square miles; Lough Arrow, in the south eastern corner, 181 feet above the level of the sea, area in this county 2977 acres, or 4¾ square miles; and Lough Gill, on the eastern boundary, 20 feet above the level of the sea, and having an area of 3131 acres, or nearly 5 square miles, in this county, beside a portion in the county of Leitrim. Among the smaller lakes are Lough Talt, or Tait, 455 feet above the sea, and Lough Easkey, 607 feet above the sea, area 168 acres, in the Ox Mountains; and Lough Car, or Glencar, 97 feet above the sea, having an area of 113 acres in this county, and a still larger area in the county of Leitrim, on the north-eastern border. Lough Gill is nearly six miles long from east by north to west by south, and about two miles wide. It is studded with islands, some of them richly wooded, and two of them, Church island (42 acres) and Cottage island (14 acres), inhabited. Lough Arrow, and Lough Gara, nearly as large as Lough Gill, but of more irregular outline, are also picturesque and studded with islands. Lough Arrow affords fine fishing in the spring; Lough Talt, imbedded amid precipices, abounds with trout, and is much frequented in the summer by water-fowl.

The principal roads are the mail-road from Dublin to Sligo, with a branch mail-road to Ballina and Castlebar; and the mail-road from Sligo to Ballyshannon (county of Donegal), from which place it continues to Donegal, Lifford, Strabane, and Londonderry, with a branch road to Enniskillen. The inland traffic to and from Sligo is very considerable, greater than to and from any other town in Ireland, except these six: Dublin, Cork, Belfast, Limerick, Galway, and Waterford. There are a mail-coach daily and another coach three times a week from Dublin to Sligo; a mail-coach daily from Sligo to Castlebar, and one from Sligo to Londonderry; a mail-car daily from Sligo to Enniskillen, and cars from the same town six times a week to Ballyshannon, and twice a week to Ballinacarem, about nine Irish (between eleven and twelve English) miles south of Sligo. (*Appendix to Second Report of Irish Railroad Commissioners.*) The Ox Mountains are traversed by several passes; that through which the Dublin and Sligo mail-road runs presents some very picturesque scenery. The roads on the eastern side of the county are numerous, and those leading to the market-towns are, generally speaking, well laid out and well kept. Much has been done of late years, partly at the cost of the landlords, but in some places much remains to be done. There is scarcely any inland water-carriage, but in the parts about Sligo Bay produce is carried to market by water.

*Soil; State of Agriculture; Condition of the People.*—A considerable part of the soil, 168,711 acres, is occupied by unimproved bog or mountain; 257,217 acres are under cultivation. In the north the soil is thin and poor, but it improves as we advance southward. The vicinity of Sligo is a plain of great fertility: in the west the soil is light and gravelly, with large tracts of bog. The following particulars, extracted from the *Appendix to the First Report of the Commissioners for inquiring into the State of the Poor in Ireland*, apply to the barony of Carbery, which includes the town and neighbourhood of Sligo, and all that part of the county which lies north of that town, but may probably be taken as applying to most other parts of it.

About one half of the barony is held under resident landlords, the greater part of the remainder under landlords who have agents resident in the barony. About one-half of the land is held under middlemen, but as their leases expire, the landlords are putting down the system. The generality of farms are held under leases; these never exceed 21 years, and the general tendency is to shorten the term. One extensive landowner grants no leases, or scarcely any. The consolidation of small holdings has been actively going on for some years, but the farms are still very small. On the large estate of Sir R. G. Booth there were no farms over 30 acres, not six over 20, and the majority between 5 and 10. In the parish of Drumcliffe, the tithes are levied on holdings which average 3½ acres each; and the holding on the average of the barony is estimated at from 3 to 5 acres: some few have 30, 40, or 50 acres of tillage, and grazing-farms average 80 acres. Want of capital, combined with want of skill and the quantity of ground lost by the numerous and irregular fences, keep down the productiveness of the farms. The people know nothing of artificial manure, and many think of nothing but sea-weed; but the consolidation of farms, and the engagement by some landlords of Scotch agriculturists to instruct their tenantry, will tend to improve the present wretched methods of farming. It is difficult, from want of capital, to find persons to occupy large farms, where an attempt is made to form them. Considerable emigration has taken place of late years, especially to the United States: the emigrants have been chiefly persons possessed of a little money, and a considerable number of them have been Protestants. The competition to obtain land is great, consequently rents are so high as to leave the occupier nothing but a bare subsistence. Yet the destitution of a large part of the population has not been any check to improvident marriages, and the distress prevalent among the people has led to occasional outrages, and created a sense of insecurity which has kept capitalists from taking farms when offered them. The 'con-acre' system is very prevalent; but from the superabundant population, many of the labourers occupy less than a rood of land, and some can obtain none.

The usual course of tillage is potatoes followed by two white crops, then potatoes again, after which a few of the larger farmers allow the land to remain fallow; but among the smaller farmers the course is an alternate crop of potatoes and grain. It is only by the help of sea-weed used as manure, which is often carried 20 miles, that the land is enabled to bear this constant exhausting process. Near Sligo, lime and animal manure are used as well as sea-weed. After gathering the potato crop, the land is manured with sea-weed; and in the spring it is ploughed, and the oats, wheat, or barley sown. Very little wheat is sown in November, as, if the season afterwards should prove wet, it does not succeed; besides it is difficult to get the potatoes off the ground in time. 'Some attention is paid to weeding the corn crops during their growth, but the farmers are not aware of the benefit of rolling the land, and there are consequently but few rollers in the barony; they generally defer cutting the corn till it has become dead ripe, by which delay it becomes thick-skinned, and the sample is greatly deteriorated in appearance and in the produce of flour.' But this delay is often the result of the farmer being obliged to do duty-work, or of other causes arising from his poverty. The same cause obliges him to bring his corn early to market, and thus the market at Sligo (from which port large quantities are shipped both to London and Liverpool) is glutted.

Clover and vetches, turnips, and mangel-wurzel may be seen on the demesnes of the proprietors, and some few patches on the lands of the tenantry, among whom the landlords are striving to introduce them. Few of the farmers require any further help than that of their own families, except in the hurried times of spring and harvest, when it is procured either by an exchange of labour or by hiring the smaller occupiers; when more constant help is required, one or two lads are kept. The grazing farmers are generally men of more capital than the tillage farmers, but the pasture-land is commonly poor. The labourers are placed on the worst land in the farm, from which their con-acre is taken. The number of cows kept varies from one to ten. The butter produced in the district is counted only second or third rate at the Sligo market, which itself ranks in London next below those of Cork and Belfast in the quality of its butter. The quantity of butter sold in Sligo market in 1833 was 53,452 firkins, weighing on the average 2 qrs. 15 lbs., of which 4 lbs. 'tret' is allowed; in 1834 the quantity sold was 48,525 firkins. Not many sheep are kept, except by large farmers, and a few by those who hold mountain farms: no improvement has been made in the breeds kept by the farmers, but there has been an improvement in those kept by gentlemen. The large Irish breed, and the mountain breed, which is smaller, are the most common. The farmers keep the Irish cattle; the proprietors and those persons who live near the town of Sligo, the Ayrshire, or a cross between the Ayrshire and the Irish; the latter are coming more and more into use for the dairy. Few cattle are fattened. The houses both of the dairy and tillage farmers are generally very poor, usually consisting of two or at most three rooms, a kitchen and two bed-rooms, one of which serves also for a dairy. The fences are usually dry stone walls or earthen banks. Draining is little attended to.

The average rent of tillage-land and pasture-land together appears to be from 1*l.* 5*s.* to 1*l.* 10*s.*, rising in some places to 2*l.*, and in others falling to 1*l.* Pasturage alone may be considered to average about 15*s.* The rent of con-acre ground varies from 4*l.* to 10*l.* per acre.

Employment is scarce and precarious, and the demand for labour has of late years much diminished, through the decay or removal of the linen-manufacture, the increase of population, and the subdivision of land. Wages have been decreasing; the farmers pay 5*d.* or 6*d.* a day in summer, and 4*d.* in winter, with diet. Gentlemen give 10*d.* a day in summer, and 8*d.* in winter, without diet. Young men boarded in the house receive 4*l.* or 5*l.* a year. Few men earn more than 6*l.* or 7*l.* a year; and of that less than 4*l.* in money, the rest being rent, &c. received in return for labour. It is the con-acre that maintains them. From the miserable insufficiency of their wages to procure proper sustenance, they are unable to do a full day's work. Early and inconsiderate marriages are exceedingly common; labouring men generally marry under twenty, and it is rare to find an unmarried person, of either sex, above thirty years of age. The labouring class, or cottiers, generally rent a cabin with or without a few perches of land: the rent is frequently paid in labour, so many days in the week. A few of them manage to keep a cow; for grass for which, during the summer half-year, they pay 1*l.* 10*s.* or 2*l.* Women can rarely get any out-of-door labour; a few are employed in harvest or hay-making time, and earn 3*d.* or 4*d.* a day. The earnings obtained by flax-spinning are very trifling, not more than a halfpenny a day. Children get no employment except from their parents. Few of the cottiers keep poultry; and only those who hold above half a rood of land have a sufficiency of refuse potatoes to enable them profitably to keep a pig. Herds are sometimes paid in money, sometimes by giving them a cabin and a small plot of grazing-land, with or without a small sum of money.

The cabins of the peasantry are of the most wretched description, built of sods or of loose stones, coated outside with a mixture of clay and mortar, with a clay floor, and a roof formed by laying branches of trees across the rafters, and covering them with sods of turf, over which is laid a thin and inadequate thatching of straw. The greater part are without chimneys, and are not large enough to be divided into apartments: a small pane of glass, kept in its place by mortar or mud, is the usual window; most have a wooden door on hinges, but others have wicker doors, and in a few the doorway is closed by a hanging of straw mats. Most have pigstyes or cowhouses, however wretched; but privies are not thought necessary, even for new houses built for farmers holding 12 or 13 acres of land. The rent of a cabin with a rood of land varies, according to the quality of the soil, from 1*l.* to 2*l.*, or even more. Turf is the ordinary fuel, and constitutes a serious item in the expenditure of a poor family, when they have not liberty to cut it on the estate.

A large portion of the labouring classes never get any food but potatoes with a little salt, and at prosperous seasons milk: those who live near the sea-shore get less milk, but occasionally they have fish. They get commonly three meals a day, but in scarce times only two. Considerable distress prevails yearly between the decay of the old potato-crop and the coming-in of the new, an interval varying from two to eight weeks. The clothing of the peasantry is very miserable, especially of the women and children; the last are at all times in rags. Many cabins have rude bedsteads, but frequently with no other bedding than straw or hay, with a single quilt or sheet of sacking, or perhaps a blanket for the parents and one or two of the younger children; the other children have often nothing but a little old hay. A table, a few stools, and a chest, perhaps with a metal pot and a pair of tongs, compose in the majority of cases the rest of the furniture. Drinking and illicit distilling have much diminished; though in some parts of the county they are still carried on to a considerable extent.

*Division, Towns, &c.*—The town is divided into six baronies, as follow:—

| Barony. | Situation. | Area in Acres. Land. | Water. | Total. | Population in 1831. |
|---|---|---|---|---|---|
| Carbery or Carbury | N. and N. E. | 76,279 | 2,605 | 78,884 | 48,887 |
| Coolavin | S. | 25,449 | 3,708 | 29,157 | 8,596 |
| Corran | Central | 44,988 | 640 | 45,628 | 17,431 |
| Leyny or Leney | Central and S.W. | 120,624 | 1,062 | 121,686 | 32,849 |
| Tirraghrill or Tirerrill | E. | 75,199 | 4,397 | 79,596 | 28,736 |
| Tireragh or Tyreragh | W. | 106,474 | 328 | 106,802 | 35,266 |
| | Total area | 449,013 | 12,740 | 461,753 | 171,765 |

It contains the county town of Sligo, the market and post towns of Collooney and Ballymote; the market-towns of Coolaney, Tubbercurry, and Easkey; and the post-town of Dromore-West. The principal villages are Ballysadere, Ardnaree, Grange, and Riverstown.

Sligo, the county-town, is situated on the Garvogue or Garvoge river, which flows from Lough Gill into Sligo Bay, not half a mile above its outfal. It is in the barony of Carbury. This town appears to have owed its importance to a castle and monastery of Dominican friars, built here A.D. 1242 and 1252, by Maurice Fitzgerald, earl of Kildare, and at that time lord justice of Ireland. The town suffered repeated injuries from the hostilities between the English and the native Irish, and from fire. In the reign of James I. it received a grant of a market and two fairs, and was incorporated and made a parliamentary borough. In the civil war of Charles I. the town was occupied by the parliamentarians under Sir Charles Coote (A.D. 1645). They were however attacked by a strong force under the Roman Catholic archbishop of Tuam, but repulsed the assailants. The archbishop was killed in the retreat; and his papers, which were taken, afforded evidence of the king's private treaty (concluded on his behalf by the earl of Glamorgan) with the Catholics. Sir Charles Coote afterwards abandoned the town, which was occupied by the Catholics, and retained by them to the end of the war. In the civil war of James II. it was taken by the Enniskilleners, who, after repelling one attack, were driven out by the Jacobites under Sarsfield: it was again occupied by the Protestants under Lord Granard.

The river Garvogue makes a bend just at the town, its course changing from west to north and north-west. Part of the town is situated within the elbow thus formed, but the greater part is on the other side (the south and west side) of the stream. The town extends, in all, about a mile from north to south, and nearly as far from east to west. The streets are irregularly laid out; they are paved, but the pavement is in many parts very indifferent, and they are not lighted. The houses are generally respectable, and some of them very superior. There are two bridges; the old bridge below the bend, and the new bridge above it. The left bank of the river, below the old bridge, is lined with quays; these quays have been extended and some warehouses built within the last few years. That part of the town which is on the south and west side of the river is in the parish of St. John; the church is on the south-west side of the town, near the outskirts: it is an antient cross church, with a massive square tower at the west end. The other part of the town is in Calry parish: the church is at the eastern end of the town: it is a modern building, in the Gothic style, with a well-proportioned spire. There are in the town a Catholic chapel (for St. John's parish), and a small Dominican convent, with a chapel attached to it; and meeting-houses for Methodists (two), Presbyterians, and Independents. Just out of the town, on the east side, are the fever hospital, infirmary, and dispensary, all in one enclosure, and a charter-school; these are near Calry church, north of the river: on the opposite bank is the county gaol. The custom-house is on the new quay, just below the town, and not far from it are the police barracks and the government emigration-office. The town has every prospect of extension and improvement.

The population of the borough, in 1831, was 15,152; viz. 11,411 in St. John's, and 3741 in Calry: the outparts of the two parishes contain a considerable population in addition to the above, viz. St. John's, 2610, and Calry, 2679. There are a few linen and stocking weavers; but the linen manufacture, once very flourishing, is almost extinct, and the linen-hall is unoccupied. There is a large whiskey-distillery on the south bank of the river, above the new bridge, several breweries, with flour-mills, soap-houses, rope-walks, and manufactures of tobacco and snuff, hats, and candles. The trade of the port is very considerable. The exports are chiefly of corn, meal, flour, butter, provisions, and linen yarn; and the imports, West India produce, tobacco, refined sugar, tea, British spirits, wine, flax-seed, tallow, glass and earthenware, coals, iron, timber, and salt. The principal markets for corn and provisions are on Tuesdays and Saturdays, and are well attended: there is a corn and butter market every day: there are five yearly cattle-fairs, and a considerable salmon fishery is carried on in the river just above the town. The estimated value of the exports in 1835 was 359,490*l.*· of the imports, 124,692*l.* The amount of customs duty collected at the port in 1833 was 33,094*l.* 12*s.* 7*d.* gross, or 17,128*l.* 12*s.* 2*d.* net, after deducting repayment of trade vouchers, office expenses, and incidental charges: in 1839 the gross amount was 29,530*l.* 2*s.* 3*d.*; the net revenue, 13,743*l.* 11*s.* 7*d.*

The corporation, before the late Irish Municipal Reform Act, consisted of a provost, twelve free burgesses, and commonalty; under that act the borough has been divided into three wards, and has a mayor, six aldermen, and eighteen councillors; the commonalty are now termed the burgesses. The borough has a court of quarter-sessions, which is also a court of record. The municipal borough, as limited by the same act, is much smaller than the parliamentary (and previous municipal) borough, which is bounded by a circular line drawn with a radius of one mile Irish, and having the market-cross as a centre. Sligo returns one member to parliament: before the Union it sent two to the Irish Parliament. The assizes for the county, quarter-sessions for the division, and petty-sessions for the district, are held here. St. John's parish (a rectory) and Calry parish (a vicarage) are included, with the adjacent parishes of Killaspicbrone (rectory and vicarage) and Kilmacowen (rectory and vicarage), in the union of St. John's, Sligo, the gross revenue of which was returned (on the average of three years, ending with 1831) at 945*l.* 13*s.* 9*d.*, the net revenue at 718*l.* 6*s.* 4*d.* There are some ruins of the antient monastery, including three sides of the cloisters, and a portion of the church, the east window of which is of beautiful design and adorned with rich tracery.

Collooney is in that part of the parish of Ballysadere which is in the barony of Tirraghrill or Tirerrill, about seven miles south of Sligo, through Ballysadere. It is a small place, on the right or east bank of the Awinmore (or Owenmore, as it is often written), and consisted, in 1831, of a single street of 90 houses (89 inhabited and one empty), of which about 13 were slated, the rest thatched. The street runs northward to the Awinmore, over which there is a bridge. The population in 1831 was 553. At the southern end of the town are the church, a handsome Gothic building containing some good monuments, the police-barracks, and the market-house; and in other parts of the town a Roman Catholic chapel, a linen-hall, a dispensary, and two schools. Near the town are a large bleach-ground and an oatmeal-mill. The market is on Thursday, and there is one yearly fair. A short distance north-east of the town, at the junction of the Awinmore and Arrow, are the remains of an antient castle. There was a smart skirmish near Collooney (September 5, 1798), between a detachment of the Limerick militia, under Colonel Vereker, and the invading French force, under General Humbert.

Ballymote is in the parish of Emlyfadd or Emlaghfad, in the barony of Corran, about 14 miles south by west from Sligo, by Ballysadere and Collooney. It had formerly a strong castle, built by Richard de Burgo, A.D. 1300, seized by the native Irish in the great civil war of 1641, and retaken by the Parliamentarians, under Ireton and Sir C. Coote, in 1652. The ruins of this building occupy an area 150 feet square; and there are the remains of a Franciscan friary. The town had, in 1831, 140 houses, viz. 124 inhabited, and 16 empty, and a population of 875 It is at the junction of six considerable roads, and is irregularly built. The parish church of Emlyfadd, a good building in the early English style, with a handsome tower and spire, is in the town; and there are a Catholic chapel, a Methodist meeting, police-barracks, a bridewell, and a court-house in which quarter-sessions for the division and petty sessions are held. The linen manufacture, formerly carried on to some extent, is now nearly extinct: there is a weekly market, and there are six yearly fairs.

Coolaney is in Killoran parish, in the barony of Leney, about 10 miles south-west of Sligo, through Ballysadere. It stands on the right or south-east bank of the Awin, or Owen-beg, which joins the Awinmore about two miles above Collooney. There were, in 1831, 68 houses, viz. 58 inhabited, 8 uninhabited, and 2 building; the population was 326. The houses form one street, running nearly north and south, parallel to the river, over which, near the north end of the town, is a bridge. There are a dispensary, a court-house for petty sessions, a police barrack, and a small Baptist meeting-house. There is a weekly market, and there are two yearly fairs. There is a penny post, dependent on the post-office at Collooney.

Tubbercurry, or Tobercurry, is in the parish of Achonry and barony of Leney, about 21 miles south-south-west from Sligo, on the road to Swineford and Castlebar, and 10 or 11 miles from Ballymote. The town had, in 1831, 48 houses, viz. 40 inhabited, 6 uninhabited, and 2 building; the population was 210; there are in the place a neat Episcopal chapel, a Roman Catholic chapel, a police-barrack, and a market-house. The market is on Monday, and there are seven yearly fairs. There is a penny-post, dependent on Ballymote.

Easkey is in Easkey parish, in Tyreragh barony, 27 miles west of Sligo, on the old or coast road to Ballina. It is chiefly on the left bank of the river Easkey, about half a mile from its mouth: it is irregularly laid out, but most of the houses are on the Ballina road; there were, in 1831, 76 houses, viz. 61 inhabited, 14 uninhabited, and 1 building; the population was 289. The church is a neat building, and there are a Roman Catholic chapel and a Baptist meeting-house. There are the ruins of an old church, and in the neighbourhood are the remains of two antient castles, and some other antiquities. The market is on Wednesday, and there are two yearly fairs in the town, beside two others at Rosslee in the parish. Petty-sessions are held once a fortnight in a court-house in the town. Quarter-sessions for the division are also held here.

Dromore West is in the parish of Kilmacshalgan, in the barony of Tyreragh, about 22 or 23 miles west of Sligo, on the road through Ballysadere to Ballina. It stands on the little river Dunneill, which flows into the sea about a mile below the town, and consist of about 20 houses; it has a post-office: a short distance east of the village are the present parish church and the remains of the former one; and a short distance south-west is the Roman Catholic chapel.

Ballysadere is on the river of the same name, just above its outfal in Ballysadere Bay, five miles south of Sligo. It is in the parish of Ballysadere, and just on the boundary of the baronies of Tirraghrill and Leney, which are here separated from each other by the river. That part of the village which is on the right bank is in Terraghrill, the part on the left bank in Leney. The village consists of one main street on the right bank, running down to the bridge, and some houses, irregularly grouped, on the other bank; there were, in 1831, 100 houses, 95 inhabited and 5 empty; the population was 546. It a busy little place; on the river below the village are several mills, and in the immediate neighbourhood are a limestone-quarry and a bleach-green. Vessels of 100 tons can enter the river, and there is some export of corn and meal. There is a small pier, and at the mouth of the river a quay. There are seven yearly fairs, besides others at Tubberscanavin, Carricknagatt, and Collooney, all in this parish. At the mouth of the river on the left bank are the remains of an antient church, and near it the ruins of an abbey.

Ardnaree is in the parish of Kilmoremoy, in Tyreragh barony. It is on the right bank of the river Moy, and forms a suburb of the town of Ballina, which is on the opposite bank. It consists of one principal street running westward down to the bridge, which unites it with Ballina, and of some smaller streets or lanes leading from this; there were, in 1831, 512 houses, viz. 432 inhabited, 64 uninhabited, and 16 building: the population was 2482. The parish church is in the town, and the Roman Catholic chapel is very handsome; it is the cathedral of the Roman Catholic bishopric of Killala. There are the remains of an antient Augustinian abbey or monastery. There are a brewery in the town and a salmon-weir and a flour-mill just above it.

Grange is in the parish of Ahamlish and the barony of Carbury. It consisted, in 1831, of 40 houses, 34 inhabited, 4 uninhabited, and 2 building; the population was 221. It has a Catholic chapel, and near the village are a revenue police-barrack, and one for the county constabulary. There are seven yearly fairs.

Riverstown is partly in Drumcollum or Drumcolumb parish and partly in Kilmacallan, in the barony of Tirraghrill. It had, in 1831, 89 houses, viz. 87 inhabited and 2 building; the population was 421. The parish church of Kilmacallan is in the village, and the Catholic chapel; both are plain buildings: there are a Methodist meeting-house near the village and a police-barrack. There are two corn-mills and two kilns.

*Divisions for Ecclesiastical and Legal Purposes.*—The county was formed on the division of Connaught into counties by Sir Henry Sidney, lord-deputy of Ireland, under Queen Elizabeth, A.D. 1565. With the exception of two parishes, it is divided among the three dioceses of Elphin, Killala, and Achonry, the chief part belongs to the last. All the parishes of the barony of Carbery, except Rossinver, which is in the diocese of Kilmore and province of Armagh, and all those in the barony of Tirraghrill, except Ballysadere and Killery, the latter of which is in the diocese of Ardagh and province of Armagh, are in the diocese of Elphin; all those in the barony of Tyreragh, in the diocese of Killala; and all those in the baronies of Coolavin, Corran, and Leney, with the parish of Ballysadere, which is partly in Leney, partly in Tirraghrill, are in the diocese of Achonry. From the time of Charles I. the two sees of Killala and Achonry were united; and in 1833 they were, in pursuance of the act of 3 and 4 William IV., united to the see of Tuam. By the same act Elphin is, upon its next avoidance, to be added to Kilmore. All these are in the ecclesiastical province of Armagh. The Roman Catholic dioceses nearly coincide with those of the established church, but Killala and Achonry have continued separate. The Catholic bishop of the diocese of Killala has his seat at Ardnaree, a suburb of Ballina, in this county; and the bishop of the diocese of Elphin has his residence at Sligo. The county contains thirty-seven entire parishes and part of four or five others.

It is in the Connaught circuit: the assizes are held at Sligo, where is the county gaol. Quarter-sessions for their respective divisions are held at Sligo, Ballymote, and Easkey: at each of the last two places there is a court-house, and at Ballymote there is a bridewell. The Report of the Inspectors of Prisons as to the general management of the county gaol and the Ballymote bridewell (*Parl. Papers*, 1840) is favourable; but the county gaol has no adequate provision for the adoption of the system of separate confinement. The number of persons committed for trial in 1837 was 154, of whom 107 were convicted, 1 found to be insane, and 46 acquitted: of the convictions, only one was for a capital offence. In 1839, 578 persons were committed, of whom 151 were convicted, 1 found to be insane, and 426 acquitted or discharged without trial: of the convictions, not one was for a capital offence. In both years the number of offenders was below the average of the Irish counties, and in the year 1837 very far below it.

It returns two members to parliament for the county, and one for the borough of Sligo. Before the Union, Sligo borough returned two members to the Irish parliament. The county members are elected at Sligo. The number of voters for the county in 1834-5 was 804; for the borough of Sligo 694.

The county constabulary consisted, on the 1st Jan., 1840, of one county inspector, third-rate; five sub-inspectors, one first-rate and the other four third-rate; six head constables, one first-rate and five second-rate; twenty-three constables, and one hundred and forty-nine sub-constables, of whom one hundred and nineteen were first-rate and thirty second-rate: the whole expenditure for this force in the year ending 31st Dec., 1839, was 9598*l.* 18*s.* 3½*d.* The total amount of grand-jury presentments for the same year was 20,825*l.* 18*s.* 5½*d.*, consisting of the following items:—New roads, bridges, pipes, gullets, &c., 879*l.* 18*s.* 7*d.*; repairs of roads, bridges, pipes, gullets, &c., 6092*l.* 7*s.* 7½*d.*; erection or repair of court or sessions houses, 110*l.* 15*s.* 6*d.*; building or repairing gaols, bridewells, and houses of correction, 127*l.* 5*s.* 3*d.*; all other prison and bridewell expenses, 2943*l.* 3*s.* 4*d.*; police and police establishments, 4020*l.* 8*s.* 8½*d.*; salaries of all county officers, not included above, 2374*l.* 12*s.* 11*d.*; public charities, 3145*l.* 11*s.* 8*d.*; repayment of advances to government, 417*l.* 14*s.* 0*d.*; miscellaneous, not included above, 1413*l.* 1*s.* 3½*d.*; together, 21,524*l.* 18*s.* 10*d.*; from which the sum of 699*l.* 0*s.* 4½*d.* is to be deducted for re-presentments. The county is included in the district of the Connaught lunatic asylum at Ballinasloe, in which it had, in the year ending 31st Dec., 1839, 39 patients, at a charge of 623*l.* 4*s.* 0½*d.* The county infirmary and fever hospital are at Sligo; and there are dispensaries at Ballymote, Carney, Castleconnor and Kilglass, Collooney, Coolaney, Dromore West, Riverstown, Tubbercurry, and St. John's, Sligo.

The number of schools in connection with the National Board on the 31st March, 1835, was 18, with 18 teachers, namely, 13 males and 5 females; and 2663 children, namely, 1571 boys and 1092 girls, on the roll.

*History and Antiquities.*—In the most antient historical period, this part of Ireland is thought to have been inhabited by the people called by Ptolemy Ναγνάται, Μαγνάται, or Μαγνᾶτοι, Nagnatae, or Magnatae, or Magnati; whose chief town, Νάγνατα, Nagnata, or Μάγνατα, Magnata, called by Ptolemy πόλις ἐπίσημος, 'an eminent city,' is supposed by Sir James Ware to have been near Sligo, though Baxter places it at or near Galway. The Λίβνιος or Λίβοιος ποταμὸς, river Libnius or Liboeus of Ptolemy, is supposed to be the river on which Sligo stands; but the correctness of this opinion depends in a great degree on the identity of Nagnata with the town of Sligo. In the territorial arrangement of Ireland which prevailed both before and for long after the establishment of the English dominion in the island, this part of the country was divided as follows:—

| Antient Division. | Modern Division. |
|---|---|
| *Calruidhe*, or, more usually, *Calrigia*, apparently the modern parish of Calry, near Lough Gill. *Dartrigia*, also near Lough Gill. *Kinel Cairbré*, whence the modern name of the barony. *Siol Morey*, the neighbourhood of Sligo, more antiently called Crioch Carbury: it was the country of O'Connor Sligo. | Nearly coinciding with the barony of Carbury. |
| *Coranna*, whence the modern Corran. | Nearly coinciding with the baronies of Corran and Leney. |
| *Luigne* (whence the modern Leney), a subdivision of Coranna. | Nearly coinciding with the barony of Leney |
| *Gregraria*, in the neighbourhood of Lough Gara, the name of which appears to be an element of the designation Gre-grar-ia. | Nearly coinciding with the barony of Coolavin. |

This part of Connaught was made the scene of warfare between the descendants and family of Roderic O'Connor (the last monarch of Ireland), in their struggle for the principality of Connaught. Hugh O'Nial, chieftain of Tir-owen, or Tyrone, was defeated near Ballysadere (A.D. 1200) in the attempt to reinstate Cathal Croobhderg, or Cathal of the Bloody Hand, who had been dethroned by his brother or kinsman Carrach, who was supported by the Anglo-Normans under De Burgh or De Burgo. Some of the Anglo-Norman settlers were engaged on the side of Cathal. In 1245 the castle of Sligo was built, and, having been destroyed by the natives, was restored about the beginning of the next century.

The relics of antiquity are numerous. There are many cromlechs and other (supposed) Druidical monuments; and several remarkable caverns, the origin and purpose of which are unknown. Raths, or hill forts, are numerous in all parts of the county; and at Drumcliffe is one of the 'round towers' which have excited so much discussion: it is distinguished by its small dimensions and coarse construction. The ecclesiastical and castellated ruins of a somewhat later date are also numerous: several of the monastic churches have been converted to parochial use.

In the general rebellion near the close of Elizabeth's reign, the royal forces under Sir Conyers Clifford, president of Connaught, were surprised in this county by the natives under O'Ruarc, or O'Rourke, chieftain of Breffney (now Leitrim), and suffered considerable loss. In the rebellion of 1641 the county was occupied by the insurgents, and though Sligo was taken from them (A.D. 1645), and they were repulsed in an attack upon it by Sir C. Coote, they recovered it afterwards, and held it till nearly the close of the war. In the war of the Revolution the county was held by the Jacobites. A body of them were indeed repulsed on their first advance toward Sligo town by the Protestants of Enniskillen; but on their advance with a superior force, they obtained possession of that town. In the French invasion of 1798, a smart skirmish was fought at Colooney between the invading force, under General Humbert, and a body of the Limerick militia, under Col. Vereker.

(*Ordnance Survey of Sligo; Lewis's Topographical Dictionary of Ireland; The History and Antiquities of Ireland*, by Sir James Ware, translated and augmented by Harris; Moore's *History of Ireland;* Gordon's *History of Ireland; Parliamentary Papers.*)

SLING, an instrument with which stones or other missiles may be thrown to a great distance. In its simplest form the sling consists of a thong of leather, or a piece of cord or some woven fabric, both ends of which are held in the hand of the slinger. The stone or missile is placed in the fold or double of the thong, which is made wide at that part, and sometimes furnished with a slit or socket for the purpose of holding it; and the sling is then whirled round to gain an impetus. When a sufficient degree of centrifugal force is thus generated, the slinger allows one end of the thong to escape, and the stone, being thereby released, flies off with considerable velocity. In the hands of an expert slinger, this instrument may be made to project missiles to a great distance, and with surprising accuracy.

The simplicity and portability of the sling, and the facility with which supplies of ammunition for it might be obtained, led to its extensive use among the antients as a weapon of war, as well as for other purposes. Its common use among the Jews is intimated by several passages of Scripture. In the book of *Judges*, xx. 16, we read of 700 men of the tribe of Benjamin, of whom it is stated that 'every one could sling stones at an hair-breadth, and not miss.' At a later period the account of David's conflict with Goliath indicates his familiarity with this weapon; while the subsequent notices in 1 *Chron.*, xii., and 2 *Chron.*, xxvi., distinctly allude to its use as a weapon of offence. Several antient paintings represent the use of the sling at an early period by the Egyptians. Some of these are given by Wilkinson, who says (vol. i., p. 316, &c.),—'The sling was a thong of leather, or string plaited, broad in the middle, and having a loop at one end, by which it was fixed upon and firmly held with the hand; the other extremity terminating in a lash, which escaped from the fingers as the stone was thrown; and when used, the slinger whirled it two or three times over his head, to steady it and to increase the impetus.' In the Greek and Roman armies the light troops consisted in great part of slingers, who were called σφενδονῆται, or *funditores*, from σφενδόνη, and *funda*, the Greek and Latin names of the weapon. The Carduchi, according to Xenophon, annoyed the retreating army of the Ten Thousand by their powerful slings. (*Anab.*, iv. 1, &c.) There are no slingers mentioned in Homer; and the word which usually means sling (σφενδόνη) occurs only once (*Iliad*, book xiii., line 599), and then not in the sense of sling, but in the primary sense of the word, which means a broad band or bandage. This passage has sometimes been strangely misunderstood. The sling is not mentioned by Herodotus; and it is an error to assign the use of it to the Persians, for which there appears no evidence but a loose expression in Diodorus (xviii. 51), where he speaks of 'Persians, bowmen and slingers, five hundred.' The natives of the Balearic Islands attained the highest reputation for their skill in its management; which is attributed to their custom of teaching their children, while very young, to wield it, and forbidding them, it is said, to taste their food until they had dislodged it from a post or beam by means of a sling. Among the Greeks the sling was used with the greatest expertness by the Achæans and Acarnanians. Besides stones, leaden plummets, cast in moulds, were used as projectiles for the sling. These, which were called *glandes*, or μολυβδίδες, were of an elongated spheroidal form; somewhat resembling that of olives or acorns. They have been often discovered in various parts of Greece, and frequently bear on one side a figure of a thunderbolt, and on the other side either the word ΔΕΞΑΙ (take this), the name of their owner, or some other inscription or device. Some of these were of considerable size, weighing as much as an Attic pound, or 100 drachmæ. Fireballs also have been thrown by slings. Antient Egyptian representations show a small bag, attached to a belt worn over the shoulder of the slinger, for the purpose of holding a supply of stones; and a Roman bas-relief represents a slinger with a supply of stones laid in the folds of his *pallium*, or upper garment, hanging, like the Egyptian bag, upon his breast. Some of the slings used by the antients were managed by more than one cord; one, two, or three being used, according to the size of the missiles to be thrown.

The sling was long used, both as an offensive weapon and otherwise, in England. Strutt observes, 'that it is altogether uncertain whether the antient inhabitants of Britain were acquainted with the use of the sling or not;' but that our Saxon ancestors certainly used it, and seem to have been skilful in its management. Besides the ordinary sling, they used one attached to a staff or truncheon three or four feet long, wielded with both hands. This kind of sling, with which large stones were thrown, appears to have been used principally in sieges and in naval warfare. It is represented in an old drawing, supposed to be by Matthew Paris. Slingers formed a part also of the Anglo-Norman soldiery; and the following lines, quoted by Strutt, show that the sling had not fallen into disuse as a military weapon at the commencement of the fifteenth century. They occur in a MS. poem of that date, entitled 'Knyghthode and Batayle,' which professes to treat upon the duties and exercises necessary for a good soldier. The object of the poet in this passage is to express the destructive effect of stones projected from a sling, even to men cased in armour; and the advantages of the weapon, in being readily carried, and easily supplied with ammunition in any place:

> 'Uso eek the cast of stone, with slynge or honde;
> It falleth ofte, yf other shot there none is,
> Men harneysed in steel may not withstonde
> The multitude and mighty cast of stonys·
> And stonys in effecte are every where,
> And slynges are not noyous for to beare.'

In alluding to the more recent use of slings for amusement, Strutt mentions a substitute for the ordinary sling, consisting of a stick of ash or hazel, cleft at one end to receive the stone; which was thus held with sufficient force to keep it from falling out, yet not so firmly as to resist the impulse of the slinger. It required, he states, much practice to make the stone fly out at exactly the right time, so as to strike the mark with precision. The use of the sling may now be considered obsolete in this country, not only as an offensive weapon, but even as a means of amusement.

(*Dictionary of Greek and Roman Antiquities*, art. 'Funda;' Wilkinson's *Manners and Customs of the Ancient Egyptians*, first series, vol. i.; Strutt's *Sports and Pastimes*.)

SLINGELANDT, PETER VAN, was born at Leyden in 1640, and became a pupil of Gerard Douw. He imitated very successfully the highly finished style of his master, whom in this respect he frequently equalled. His colouring is perfectly true to nature, and his chiar'oscuro admirable. Various instances are recorded of his extreme patience in finishing his works. It is related by Houbraken, that he was employed three years, without intermission, on a small picture containing portraits of the family of Meerman, and that he devoted a whole month to the finishing of a ruff. When he introduced a dog, a cat, or a mouse, which he often did, he seemed to have made a point of representing every single hair. It was to be regretted that with all this labour his design and composition are in general indifferent, and far inferior in correctness and expression to his master. His works are however highly valued, as among the best of the Flemish school, and are often mistaken for those of Mieris and Gerard Douw. Dr. Waagen, in his account of the galleries in England, mentions very few of this artist's performances: one in Sir Robert Peel's collection; one in the Bridgewater gallery, distinguished, he says, by the incredible minuteness of detail in the execution, in which it even exceeds Gerard Douw, though far inferior to him in other respects; two in the private collection of George IV., which he highly commends, and which have both been ascribed to G. Douw, and sold as his; and one in the collection of the Marquis of Bute, at Luton House, which he says is far more powerful and warm in the tone, and more spirited in the execution, than is usual with him. Slingelandt died in 1691, aged 51.

SLIP, or BUILDING-SLIP, a piece of ground cut in a direction perpendicular to the bank of a river or harbour, so as to form an inclined plane, descending from the general surface of the land at one end, towards the water at the other end. It is frequently paved with stone, and it is entirely covered by a roof, which is supported on lofty pillars of wood. On this plane ships are built, and therefore its length and breadth must exceed those of the largest vessel for which it is intended. Its slope has about 1 foot in height to every 19 feet in length, so that its surface is inclined to the horizon at an angle of about three degrees. Its lower extremity is considerably below the level of high water, and strong gates keep the slip dry till the vessel is about to be launched.

It has been stated in the article SHIP-BUILDING, that during the construction of a vessel, the keel rests upon blocks of wood placed at intervals in line on the slip. Now when the vessel is to be launched, timbers placed side by side, having their upper surfaces worked to a plane, or to a gentle curve with its convexity upwards, and made very smooth, are disposed on blocks which are also laid on the slip, in a line on each side of the keel, parallel to it, and at the distance of a few feet (usually about one-sixth of the vessel's breadth) from it. These two inclined planes are called the *ways*; each extends through the whole length of the slip, and its breadth is about three feet: its slope is rather greater than that of the slip, having 1 foot in height to about 14 feet in length, so that its inclination to the horizon is above 4 degrees. Previously to the ship being launched, a frame of timbers called a *cradle* is constructed for its support; and this, carrying the vessel with it, is allowed to slide upon the ways till the ship floats upon the water; then the cradle, whose parts are kept together and are attached to the ship only by treenails, either falls to pieces of itself or is removed by the workmen. Along the exterior side of each of the *ways* is a riband or ledge of timber raised above 4 inches above the surface, in order to prevent the frame-work which forms the cradle from being, by any lateral pressure, forced off from the plane.

The cradle is formed by laying upon each of the *ways* one long timber called a *bilge-way*, about 12 inches in breadth, and as much in depth, having its lower surface made quite smooth, and upon this another timber, which is capable of being raised a little from the former by means of numerous wedges placed between them at intervals in its whole length. Above these timbers, about the middle of the ship's length, are laid others longitudinally; and near the two extremities are placed stout props of timber in vertical positions, the upper sides of the former and the upper ends of the latter being in contact with the bottom of the hull. Previously to the completion of the cradle the surfaces of the two inclined planes or ways are covered with a thick coating of soap, tallow, and oil; and when, by driving in all the wedges simultaneously, the upper part of the cradle is made to press against the bottom of the ship, so that the weight of the latter is in a great measure taken off from the blocks under the keel, on cutting away those blocks the ship is ready to descend in its cradle to the water. In fact, the ship is then only prevented from sliding on the ways by two short timbers called the *dog-shoars*, which are placed, one on each of the ways, near the head of the vessel at a small angle of inclination to the plane of the ways. Each of these shoars is kept in its inclined position by a short prop called a *poppet* placed under its extremity (that which is nearest to the head of the vessel), and that extremity, which is covered with iron, abuts against a projection on one side of the cradle, while the lower extremity abuts on a *cleet*, which is spiked down to the surface of the way. When the ship is to be launched, the gates of the slip having been opened, and the water suffered to flow in by the rising of the tide, the poppets of the two dog-shoars are knocked away at the same moment, which is nearly that of the highest water: and should the shoars not drop down, on cutting a slender string at the ship's head a heavy mass of lead on each side becomes disengaged, and descending upon each shoar at the same instant, causes both of them to fall. Then the weight of the ship on the inclined planes, aided by a small elevation of her hull, produced by the water which has entered the slip, causes her to descend gradually into the river or harbour.

SLOANE, SIR HANS, Bart., was born at Killileagh, in county Down, on the 16th of April, 1660. Though a native of Ireland, he was of Scotch extraction, his father Alexander Sloane having been the head of a colony of Scots whom James I. settled in Ulster.

While young his health was delicate, and from his sixteenth to his nineteenth year he suffered from spitting of blood. It was however in his youth, and while living at home, that he imbibed a taste for those pursuits in the cultivation of which he afterwards attained such celebrity. As soon as his health would permit, he repaired to London, and during four years which he spent in the metropolis devoted himself to the study of medicine and the collateral sciences. Strafforth, a pupil of the celebrated Stahl, was his instructor in chemistry, and his fondness for botany brought him acquainted with Ray and Robert Boyle. In 1683 he set out for Paris, and during his stay there attended the anatomical lectures of Duverney and those on botany by Tournefort. On his departure for Montpellier he was furnished by Tournefort with introductions to all the celebrated men at that university. Here he passed a year, spending much of his time in collecting plants, and, after having travelled through

Languedoc with the same purpose, returned to London late in the year 1684.

He gave many of the plants and seeds which he had collected to Ray, who described them, and acknowledged his obligations to the donor in his 'Historia Plantarum.' He now settled in London, and the young physician found in the great Sydenham a most valuable friend, who did all in his power to introduce him to practice. In 1685 he was elected a fellow of the Royal Society; and a fellow of the College of Physicians, in April, 1687. His attention had been excited when young by the descriptions of the wonderful productions of tropical climates, and the offer of the appointment of physician to the duke of Albemarle, who was going out as governor to Jamaica, afforded him an opportunity of gratifying his curiosity. He accordingly set sail with the duke on September 12, 1687, and after touching at many of the Caribbee islands, reached Port Royal on the 19th of December in the same year. The death of the duke soon after his arrival diminished Sloane's resources, and compelled him to hasten his return, though he did not leave Jamaica till he had formed in that and the neighbouring islands an immense collection of plants. He arrived in England on the 29th of May, 1689, after a residence in Jamaica of only fifteen months.

The plants which he brought with him amounted to 800 species. Of these he gave his friend Mr. Courten whatever he wanted to complete his collection, and the remainder, with other objects of natural history, formed the nucleus of his museum. Success too attended him in practice. He was appointed physician to Christ's Hospital in 1694, and held the office for thirty years; and in 1695 he married a lady of considerable wealth, Elizabeth, daughter of Alderman Langley, by whom he had four children, two of whom died young, while two daughters survived their parents, and carried their wealth to the noble families of Stanley and Cadogan.

In 1693 he was chosen secretary to the Royal Society; and in 1712 was elected one of the vice-presidents. The Academy of Sciences in Paris had conferred on him the title of a foreign associate in 1708. George I. created him a baronet in 1716, and appointed him physician-general to the forces; he was elected president of the College of Physicians in 1719, and held the office till 1735. In 1727 he was appointed physician to the king; and in the same year had the honour of succeeding Newton in the president's chair of the Royal Society. He had purchased an estate at Chelsea in 1720, and retired thither in 1740, when eighty years old. His time was now passed in entertaining scientific men, and in examining the treasures he had collected. He died, after a short illness, on January 11, 1753, in the ninety-third year of his age.

Sir Hans Sloane was a man of a benevolent and generous disposition, and active in all schemes for doing good. During the thirty years that he held the appointment of physician to Christ's Hospital he never kept his salary, but always devoted it to charitable purposes. He was very active in establishing the dispensary set on foot by the College of Physicians for providing the poor with medical attendance and medicines gratuitously, the opposition to which on the part of the apothecaries called forth Garth's talent for satire; but he was so ready to banish the memory of a quarrel, that when he purchased his Chelsea estate in 1720, he presented the Apothecaries' Company with the freehold of their botanic garden. He did all in his power to promote the formation of the colony in Georgia in 1732, and was one of the founders of the Foundling Hospital, and drew up the plans for the management of the children.

Sir Hans Sloane directed that at his death his museum should be offered to the nation for 20,000*l.*, a sum which he says, in a codicil to his will, dated July 20, 1749, did not amount to a fourth part of its real value. This collection, in the purchase of which by government the British Museum originated, was not altogether accumulated by Sir H. Sloane, but had been greatly increased by the bequest, in 1702, of the museum of his friend Mr. Courten. At the time of his death, Sir H. Sloane's cabinet contained 200 volumes of dried plants, and 30,600 other specimens of objects of natural history, besides a library of 50,000 volumes and 3566 manuscripts. [British Museum.] His fame however does not rest merely on his collection: he contributed many papers to the 'Philosophical Transactions.' Before he was appointed secretary to the Royal Society, the publication of these Transactions had been suspended for six years; he resumed their publication, and continued to superintend it till 1712. He likewise wrote a pamphlet on sore eyes, which had considerable repute for many years. But his great work was the 'Natural History of Jamaica,' which appeared in two volumes, folio, with many plates, of which the first volume was published in 1707, and the second twenty years after. The first volume contains an introduction comprising a description of the island, its climate, products, and the diseases of its inhabitants, followed by an account of the plants indigenous there and in other of the West India Islands: the trees and animals are described in the second volume. He mentions in his preface that the whole undertaking had been submitted to Ray, and met with his approval, though it did not receive any emendations from him. A small Latin catalogue of the plants of Jamaica had been published by him in 1696, and serves as a sort of index to the large work. Notwithstanding his diligence in studying natural history, Sir H. Sloane appears not to have fully appreciated the benefits of scientific arrangement, and he contents himself in his writings with referring plants to genera and species already known, and made no attempt to improve the very defective classification of that day.

**SLO'ANEA**, a genus of fine trees of the natural family of Tiliaceæ, named by Plumier in honour of Sir Hans Sloane, a former president of the Royal Society, and well entitled to the compliment from his investigation of the Flora of Jamaica, and from his being the founder of the Chelsea Botanic Garden, as well as a patron in general of science. The genus Sloanea is divided into five sections, each of which may probably form a genus. The leaves are large and alternate, the flowers are large, and the fruit as big as chesnuts. The trees are not known to be applied to much use, with the exception of *S. dentata*, of which the wood is sometimes employed for making canoes of a single piece. The inner bark is astringent, and prescribed in dysentery; the fruit is eaten.

**SLOBODE UKRAINE**, or the government of the Slobodâs of Ukraine, in European Russia, is one of the provinces of southern Russia, which, after successive invasions from Lithuanians and Mongols, came into the possession of the Czars about the beginning of the seventeenth century. It appears to have been originally tributary to the grand-duchy of Kieff: it formed part of the government of Bielgorod, which was constituted in 1726, and did not obtain its present appellation until 1765. It bore the name of Kharkof in the interval between 1780 and 1796, in which year Paul I. declared that it should be called the government of the Slobodâs of Ukraine. The term *Slobodâ* belongs in Malo-Russia to the villages inhabited by Cossacks, who were formerly organised into regiments, free from all taxes, and had no master but their own will. The tract of land of which we are speaking being almost uninhabited in 1651, the emperor Alexey Michaelowich allowed the Cossacks of western Ukraine to settle in it, and to enjoy the privileges guaranteed to them by Stephen Battory, king of Poland. They then founded five large villages or 'Slobodâs;' and from this circumstance the name is derived.

The government of the Slobodâs of Ukraine is bounded on the north by that of Kursk, on the east by the country of the Don Cossacks, on the south it has the government of Yekaterinoslaf, and on the west that of Poltâva. It contains about 19,000 square miles, 6930 of which are arable land and 2000 forests. The country is generally flat, and the soil fertile, yielding frequently more than five millions chetwerts (3,750,000 quarters) of corn, two millions of which are surplus produce, and may be exported. The forests in this government belong chiefly to the crown; game is scarce, but the forests abound in wolves and foxes.

The population consists of Malo-Russians, Cossacks, Great Russians, German colonists, converted Calmucks, Jews, and Gypsies, and amounts to 1,350,000 (according to an estimate taken in 1835), of whom 35,000 are Cossacks. Besides the military population of the Cossacks, there are five colonised regiments of cavalry, who occupy the districts of Chuguyef, Volchansk, Izyum, Kupyansk, and Starobyelsk; the number of districts belonging to this government is eleven, viz. Kharkof, Akhtyrka, Lyebedin, Sumy, Valki, Zmiyef, and the above-mentioned military colonies.

The chief occupation of the inhabitants of Slobode Ukraine is agriculture, although various means have been used by the government and the nobles to draw their attention to manufactures and commerce. The cultivation of mulberry-trees for the production of silk was introduced in the reign of Alexander I., but it does not seem to have been successful. It is probable however that the depressed state of commerce in this government is owing to the badness of the roads and the want of navigable rivers. The only stream which could have been made use of for the purpose of transporting goods is obstructed by corn-mills and hide and tallow factories. This is the Syevernoy Donyetz, the principal river of the government, which, after receiving the Oskol in the neighbourhood of Izyum, falls into the Don. The other rivers are the Vorskla and the Psiol, both falling into the Dnieper, the former of which belongs to the southern districts, and the latter to the northern.

The inhabitants are all of the Græco-Russian church, with the exception of a few Lutherans and some Jews; they belong to the eparchy of the Slobodâs of Ukraine and Kharkof, which was erected towards the end of the last century. This diocese contains 628 churches, seventeen of which are cathedrals, and one monastery and one nunnery.

There were in 1832 thirty schools with 200 masters and 1938 pupils, 133 of whom were girls. These establishments for public instruction are all under the control of the university of Kharkof, which was established in 1805, and has authority over a district comprising the governments of Sloboda Ukraine, Poltâva, Kursk, Orël, and Vorônetz.

The chief town is Kharkof, founded in 1652. [CHARKOW.]

The other towns of this government are the following: Akhtyrka, the chief place of the district which bears its name, situated on a small river which falls into the Vorskla; it contains eight churches, one of which attracts a great number of pilgrims from possessing a miraculous image of the Holy Virgin. Sumy, remarkable for its extensive traffic in horses. Chuguyef, on the Psiol, containing 9000 inhabitants, of whom many are converted Calmucks. Izyum, which is a fortified town containing four churches and about 4000 inhabitants; it is situated between the Oskol and the Donyetz, in the extreme south of the government. Slavyansk, in the neighbourhood of which city there are four saline lakes. Besides these towns there are Lyebedin, Volchansk, Zmiyef, Miropoloye, Nyedrigaylof, Krasnokutsk, Zolochef, Kupyansk, and Valki.

SLOE. [PRUNUS.]

SLOTH. [AI; UNAU.]

SLOW LEMUR. [STENOPS.]

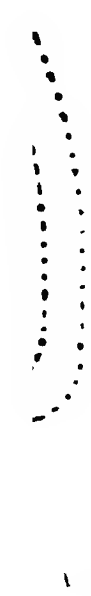
SLOW WORM, one of the English names for the BLIND WORM. And see also ORVET; SAURIANS; SCINCOÏDIANS.

SLUGS. [LIMAX.]

SLUICE. (In Dutch, *Sluis*, in which language it is defined to be 'a mass of masonry and closing doors, to keep water in, or to stop the flow of water. The word *Sluis* occurs in the names of various places in Holland, as Hellevoetsluis.) In a limited sense this name is almost confined to the sliding gates commonly used in mill-streams, ponds, sewers, &c., to retain the water when necessary, or to allow it to escape in any required quantity; such gates being usually raised and lowered by means of a rack and pinion attached to the upper part of the frame in which they slide. In a more extended application of the term, it embraces all kinds of floodgates, flaps, and other apparatus used to stop, collect, or retain water, and to let it off as occasion requires. According to this use of the word, a canal lock may be considered as a double sluice.

Sluices are extensively used in most hydraulic works, and vary much in their construction, according to the purposes for which they are required. In mill-streams they serve to keep back the water when the mill is at rest, and to regulate the supply when it is going. They also act as *wasters*, to allow the surplus water of a reservoir to escape. For these purposes many self-acting sluices have been contrived, to avoid the inconvenience and even danger which might arise from neglect, as well as to save the expense of a sluice-keeper. In Brewster's *Edin. Journal of Science*, vols. ii., iii., and iv., several ingenious arrangements of this sort are described and illustrated; most of which have been successfully used by their inventor, a Scotch gentleman named Thom. Some of these are regulated by floats; and others by the weight of iron cans, so situated as to fill with water when it rises in the reservoir to a certain height, while they are made to empty themselves when it is necessary to close the sluice. In one of the plans for a waster-sluice, the sluice-gate is balanced by a weight, capable of sliding freely up and down in a cylindrical vessel which communicates with the water at the highest required level, and has a small pipe from its lower extremity to allow the water to run out as soon as the water in the reservoir sinks below that level. The weight is so adjusted as to hold the sluice-gate closed so long as the cylinder is empty, while it is insufficient to do so when the cylinder is full of water: the useful effect being produced by the difference between the gravity of the balance-weight when suspended in air and in water.

The construction of an ordinary canal-lock has been described in the article CANAL, vol. vi., p. 220. It is necessary to make the large gates meet in an angle in the middle of the stream, in order that they may be able to resist the pressure of the water; and as this pressure would render it impossible to open them against any considerable head of water, small sluices are provided, either in the gates or in the masonry of the lock, by which the water may be let in or out at pleasure. In locks exposed to the sea or to a tide river, a double set of gates are sometimes used; one set pointing outwards, to exclude the high tide, and the other inwards, to bear the pressure of the water in the canal when the tide is below it. An admirable contrivance for meeting all the contingencies of such a situation is the *fan-gate* sluice or lock; of which a full description, with engravings, is given in Brewster's *Edin. Journal of Science*, vol. iii. It was invented by Mr. Blanken, of the Netherlands, and has been found completely successful. The subjoined cut will explain the principle of the apparatus, applied merely as a sluice capable of bearing a head of water in either direction; of being opened against a head of water; or of being closed while the current is rushing through. In this diagram *a*, *b*, and *b*, *a*, are the sluice-gates, meeting in the centre of the stream, and capable of resisting the pressure of a head of water at A. These gates are pivoted at *a*, *a*, and are connected, by very strong framing, with the tail-gates *a*, *c*, which move with them, and fit closely to curved recesses of masonry, *d*, *d*. The tail-gates are, as shown in the plan, about one-fifth wider than the sluice-gates: *e*, *e*, are small tunnels in the masonry, com-



municating between the head of water at A and the spaces *d*, *d*; these being provided with small sluices by which they may be opened or closed at pleasure: *f*, *f* are similar tunnels, also provided with sluices, communicating between the water at B and the side spaces *d*, *d*. If the gates be required to exclude a head of water at A, the tunnels *e*, *e* are opened, and the water, rushing through them, fills the side spaces to the level of A; the gates being thereby held close. If the head of water to be sustained be at B, the tunnels *e*, *e* are closed, and those marked *f*, *f* opened; and then, although the pressure of the water tends to open the sluice-gates, the water rising to the same level in *d*, *d*, and there acting upon the larger superficies of the tail-gates *a c* keeps them closed. By reversing the use of the tunnels *e*, *e*, and *f*, *f*, the gates may be released from pressure in either direction, and therefore be easily opened; while by using them in the order first described the gates may be closed when the stream is rushing through. The illustration iven by Brewster is a lock at Gorinchem in Holland, forming a communication between the tidal river Linge and the canal of Steenenbock. The arrangement resembles that of the above diagram, the chamber of the lock being in the place of B, and its other end being closed by a pair of common gates opening towards the river.

SLUR, in Music, a curved line (⁀) more or less extended, as may be required, drawn over two or many notes. If placed over two notes on the same line or space, it signifies that the second is not to be repeated, though to be held out its due time. When drawn over notes on different degrees, it signifies that they are to be *legato*, *i.e.* tied—played in a smooth blending manner. This character is sometimes called a *bind*, and also a *tie*.

SLUYS (in French, *L'Ecluse*), is a very strongly fortified town in the province of Zealand, in the kingdom of the Netherlands. It is situated in 53° 18′ 30″ N. lat. and 3° 20′ E. long., on a small bay of the German Ocean called the Zwin, at the mouth of the Schelde, and is connected by a canal with the city of Bruges, which is about 15 miles distant. The harbour, which was formerly deep and clean, is not now capable of admitting any but small vessels. It is furnished with sluices (whence its name), by which, in case of a siege, all the surrounding country can be laid under water. It has about 1400 inhabitants. It was taken by the French in 1794.

SMÄLAND. [SWEDEN.]

SMALL-POX (*Variola*). It is a subject of dispute whether this disease was known to the antients, or whether it has originated at a comparatively recent date. Those who contend for its antiquity refer us to the account of the plague of Athens by Thucydides (ii. 46, &c.), which, they say, is as accurate a description of the leading symptoms of Variola as could possibly be expected from any historian who is not a physician. Those who hold the opposite opinion call in etymology to their aid; the word *pock* or *pox*, they say, is of Saxon origin, and signifies a bag or pouch; the epithet *small* in England, and *petite* in France, were added in the fifteenth century. The term variola is derived from the Latin word *varus*, a pimple, or *varius*, spotted; and, according to Moore, the first authentic passage in which it occurs is to be found in the 'Bertinian Chronicle' of the date 961. The first author however who treats expressly of small-pox is Rhazes, an Arabian physician [RHAZES], but even he confounded it with measles, and these two diseases continued to be considered as modifications of the same disorder till the time of Sydenham. Small-pox, when it occurs naturally, is preceded by the usual premonitory symptoms of eruptive fevers, such as rigors, pains in the back and loins, prostration of strength, loss of appetite, nausea, and sometimes vomiting, and, in young children, frequently convulsions. About forty-eight hours after the commencement of these symptoms an eruption of small, hard, red-coloured pimples makes its appearance about the face and neck, and gradually extends downwards over the trunk and extremities. The primary fever, as it is called, now lessens; but the pimples increase in size, and become converted into whey-coloured pustules with a depression in their centre. On the eighth day they are at their height, and on the eleventh the matter oozes from them and concretes into crusts, which fall off about the fourteenth day, leaving the skin of a brownish-red colour, and studded with slight depressions or pits. As the eruption travels from above downwards, the parts of the body successively attacked by it become affected with swelling, the mouth waters, and the voice is hoarse; when the incrustation has taken place, these symptoms subside, but a secondary fever commences, which is sometimes more severe than that which preceded the outbreak of the eruption. Small-pox, according to its severity, is distinguished by authors into two varieties, the *distinct* and the *confluent*, *variola discreta* and *confluens*. In the former, the pustules are few in number, well formed, and do not touch each other, and the fever is inflammatory, but mild; in the latter, the disease altogether is more violent, the eruption more general, and the pustules, small and unhealthy, run one into another. The fever likewise is greater, and rather of the typhoid character, is not mitigated on the appearance of the eruption, and is much aggravated at its termination; there is delirium, considerable prostration of the vital powers, ptyalism, inflammation of the fauces, and frequently diarrhœa. Petechiæ and an unhealthy exudation from the body often accompany this form of the disease. Among the mucous membranes, the larynx and trachea suffer much, and children often die of suffocation from this cause; the extent of mucous and of cutaneous inflammation however are not always necessarily proportioned to each other Small-pox rarely attacks the same individual more than once, and, like measles and scarlatina, its consequences are sometimes more to be dreaded than the disease itself. During the secondary fever, an intense form of ophthalmia frequently sets in, which rapidly involves all the structures of the eye, and in the course of a few days destroys its entire organization. Although it is not common to have both eyes thus affected, still a large proportion of the blind at our public institutions owe their misfortune to this disease. Pleurisy, consumption, scrofula, obstinate diarrhœa, and a fetid discharge from the ears attended with more or less deafness, are the principal diseases liable to result from a severe attack of small-pox. The immediate cause of this disease is a peculiar miasm or poison received into the system from an individual labouring under the same affection, and it is said to make its appearance in from twelve to fourteen days after exposure to the contagion; when however it is communicated by inoculation, it appears on the seventh or eighth day. Instances are recorded of mothers who were exposed to the infection of small-pox, communicating the disease to the fœtus in utero, without being themselves affected by it; and, what is equally remarkable, women suffering from small-pox during pregnancy, have brought forth healthy children, who did not take the disease till they were inoculated. Small-pox is frequently epidemic, especially in the spring, and, like all other epidemics, those who are first attacked by it suffer the most severely: it is observed also to be greatly influenced by certain conditions of the atmosphere.

Small-pox can be communicated by inoculation with the matter of its pustules, and the resulting disease being rendered milder by this operation, it was formerly much practised to guard the individual against a spontaneous attack; since however the introduction of vaccination by Dr. Jenner, the practice has been deservedly abandoned. Vaccination was supposed by its discoverer to secure the individual permanently and effectually from the contagion of the small-pox; more extended experience has proved, that although it does not always prevent it, yet it so shortens its duration and moderates its violence, that a death from small-pox after vaccination is a rare occurrence. A difference of opinion prevails respecting the character of the eruption which occasionally appears after exposure to variolous infection in persons previously vaccinated. According to many, it is nothing more than chicken-pox; while others affirm that it is really small-pox, although modified by the controlling influence of the cow-pox. The truth appears to be, that 'modified small-pox' resembles the chicken-pox in its mildness and duration, but differs from it in its originating from the 'variolous germ,' and in its power of communicating the true small-pox to others, as well by inoculation as by infection.

The history of the different epidemics of small-pox shows the mortality to be one in four of those attacked who had not been vaccinated; whilst of those who had undergone vaccination the proportion was not one in 450. From the register kept at the Small-pox Hospital in London, it appears that the mortality at this institution is considerably greater than one in four, having averaged during the last fifty years 30 per cent., the extremes being 18 and 41. From the same source we learn that the greatest number of deaths occurs on the eighth day. Of 168 fatal cases, there died in the first week 32; in the second, 99; in the third, 21; and in the fourth and after, 16. The causes of death at these different periods are the following:—1st week, malignant fever; 2nd week, affections of the throat, and consequent suffocation; 3rd week, or during the secondary fever, febrile excitement, mortification of large portions of the integuments, pneumonia, pleurisy, or laryngitis; 4th and following weeks, exhaustion, erysipelas, or some of the diseases before enumerated as liable to result from small-pox. It was formerly supposed that the eruption of variola was not confined to the skin, but invaded also the internal parts; this is not the case, the internal affections are simply inflammatory, and do not partake of the specific character of the cutaneous disease.

No peculiar plan of treatment is required for small-pox; it is that of ordinary fever: cleanliness, free ventilation, an attention to the strength of the patient, and a watchfulness against accidental complications, are the principal points to be kept in view. During the eruptive stage of the disorder, the bowels should be kept moderately open by saline aperients, and the occasional exhibition of a mild mercurial. The temperature of the skin may be regulated by cool air, or by sponging it with tepid vinegar and water; if there should be much unpleasant effluvium from the surface of the body, washing it with a weak solution of one of the chlorides will be found to correct this. It has been recommended by some writers, and has been long a practice in Eastern countries, to pierce the pustules with a fine needle; this procedure, it is said, lessens the violence of the secondary fever, and prevents pitting. M. Serres, with the same object, directs the application of lunar caustic to the pustules on the fourth day. As a general rule, we should say that venesection is not admissible at any period of small-pox; indeed we have no hesitation in affirming that some of the severest consequences of the disease may be averted by a judicious employment of measures of an opposite tendency to blood-letting. The sloughing of the integuments, and the intense ophthalmia, rapidly terminating in entire loss of vision, are eminently connected with an enfeebled and cachectic state of body; and the best mode of averting these evils is to have recourse early to those remedies which are most efficacious in arresting their progress. Hence bark or its preparations, combined with the mineral acids, sarsaparilla, wine, brandy, if the powers are much reduced, and animal food, if the patient can eat it, must be perseveringly administered. It may not be out of place here to mention that the character of the ophthalmia termed *variolous* has only lately been pointed out to the profession by Mr. Marson of the Small-pox Hospital. It had been supposed that the eye was lost in small-pox from one or more of the pustules of this disease forming on the cornea. Mr. Marson has shown not only that this never takes place, but that the loss of vision is attributable to ulceration or sloughing of the cornea, which comes on generally about the eleventh or twelfth day of the disease. The patient is nearly always in a state of great debility, and requires tonic medicines and nutritious diet to give him a chance of escaping from the destructive effects of this ophthalmia.

**SMALT** is a glass coloured of a fine blue, by means of oxide of cobalt. [COBALT.] When reduced to an impalpable powder, it is employed to give a blue tint to writing-paper and linen.

**SMART, CHRISTOPHER,** was born at Shepburne in Kent, April 11, 1722. He was educated at Durham and Maidstone schools, and at Pembroke Hall, Cambridge, where he was sent October 30, 1739. Here he distinguished himself by his classical attainments; he was elected a fellow of Pembroke Hall, July 3, 1745. He gained the Seatonian prize for five successive years: the subjects of the prize poems were respectively the Eternity, the Immensity, the Omniscience, the Power, and the Goodness of the Supreme Being. In 1753 he quitted Cambridge on his marriage with Miss Ann Maria Carman, and afterwards resided in London, endeavouring to make a livelihood by trifling literary undertakings. He became engaged in an altercation with Sir John Hill, who criticised his poems, and Smart in revenge published a satire called the 'Hilliad.'

In 1754, in consequence of pecuniary embarrassment and other mortifications, he became deranged, and continued in this condition, with intervals more or less lasting of sanity, till his death, May 18, 1770, in the rules of the King's Bench, where he had been confined in his latter years. Smart translated the Psalms, Phædrus, and Horace into prose; and in 1752 published a small collection of poems, to which he made subsequent additions. His productions have sunk into deserved oblivion. He seems to have been a weak improvident man, not destitute of good qualities, such as gained the favour of several of the nobility, and the friendship of Garrick and Johnson, the latter of whom has written an account of him. His poems were printed in 1791.

**SMEATHMA'NNIA,** a small but beautiful genus of plants belonging to the natural order Passifloraceæ. It was named by Solander in honour of Smeathmann, a German botanist, who travelled in many parts of Western Africa, and collected plants, especially at Sierra Leone, of which place this genus is exclusively a native. The genus possesses a one-leaved nectarium, which is urceolate and surrounding the base of the stamens. The stamens are numerous, distinct, and seated on a short column with incumbent anthers; the stigmas are peltate and five in number; the capsule is inflated, and four- or five-valved; the seeds are dotted. All the species are upright shrubs, with white, showy, axillary flowers. Three species are recorded, *S. pubescens*, *S. lævigata*, and *S. media*. In cultivation they succeed best in a mixture of loam, peat, and sand. They may be easily propagated by sticking cuttings in the same soil under a bell-glass.

**SMEATON, JOHN,** was born, according to most authorities, on the 28th of May,* 1724, as Austhorpe, near Leeds, in a house built by his grandfather, and long afterwards inhabited by his family. His father was an attorney, and brought him up with a view to the legal profession. Our information respecting the domestic history of Smeaton is exceedingly scanty; it amounts to little more than that he very early displayed a taste for mechanical pursuits; delighting, it is said, even when a child in petticoats, to observe mechanics at work, and to question them respecting their employments. One of his biographers states that his toys were the tools of men; and that, while yet little more than an infant, he was discovered one day on the top of his father's barn, fixing something like a windmill. But passing over such symptoms of precocity, the evidence of which must always be received with caution, we find him, at the age of fourteen or fifteen, constructing a machine for rose-engine turning, and producing neat ornamental boxes, &c. for his friends. He appears to have been but little older when he cut, in a lathe of his own manufacture, a perpetual screw in brass, according to the design of his intimate friend Mr. Henry Hindley of York, with whom he joined enthusiastically in mechanical pursuits. By the age of eighteen years he had attained much practical skill in mechanical operations, and had furnished himself with many tools for performing them.

About this time, in the year 1742, in pursuance of his father's design, young Smeaton came to London, and attended the courts of law at Westminster Hall; but finding the bent of his mind averse to the law, his father yielded to his wishes, and allowed him to devote his energies to more congenial matters. The next circumstance in his history related by his very brief biographers is his taking up the business of a mathematical-instrument maker, about the year 1750, when he was residing in lodgings in Great Turnstile, Holborn. In 1751 he tried experiments with a machine that he had invented for measuring a ship's way at sea; and in 1752 and 1753 was engaged in a course of experiments 'concerning the natural powers of water and wind to turn mills and other machines depending on circular motion.' From the latter investigation resulted the most valuable improvements in hydraulic machinery. In the construction of mill-work, Smeaton, during the whole of his useful career as a civil engineer, stood deservedly high: and, by his judicious application of scientific principles, he increased the power of machinery impelled by wind and water as much as one-third. The results of these experiments were published in 1759, after he had been able to give them a practical trial; and their value obtained for him the Copley gold medal of the Royal Society in that year. Smeaton had previously, in the year 1753, been made a member of the Royal Society; and he had made some communications to the 'Transactions' even before that date. In 1754 he visited Holland and the Netherlands; and the acquaintance he thus obtained with the construction of embankments, artificial navigations, and similar works, probably formed an important part of his engineering education.

In 1766 Smeaton commenced the great work which, more than any other, may be looked upon as a lasting monument of his skill—the EDDYSTONE LIGHTHOUSE [ix., pp. 268, 269]. Two lighthouses had been erected on the Eddystone or Edystone rock, before the admirable structure of Smeaton; of which the first was swept away in a storm, and the second, which was formed of timber, was destroyed by fire in December, 1755. The immediate re-erection of the beacon being highly important, Mr. Weston, the chief proprietor, lost no time in applying to the earl of Macclesfield, then president of the Royal Society, for advice as to the person who should be entrusted with the difficult task. The previous structures had been designed by non-professional men; and it was felt now, to adopt the language of Smeaton's narrative, that to erect another 'would not so much require a person who had merely been bred or had even rendered himself eminent in this or th[illegible]

* June 18th is the date given in the 'Encyclopædia Britann[illegible] but no [illegible] planation is offered of this deviation from, as far as the wri[illegible]n ascertain, all other authorities.

given profession; but rather one who from natural genius had a turn for contrivance in the mechanical branches of science.' The earl immediately perceived that Smeaton was the man required, and therefore recommended him. Although a great portion of the lease under the provisions of which the lighthouse had been erected was expired, and their interest in the undertaking was consequently limited to a comparatively short time, the proprietors liberally entered into Smeaton's views respecting the superior advantages of a more durable material than timber; and determined on the adoption of his plans for a stone structure of the greatest possible strength. The cutting of the rock for the foundation of the building was commenced on the 5th of August, 1756; the first stone was landed upon the rock June 12th, 1757; the building was finished on the 9th of October, 1759, and the lantern lighted for the first time on the 16th. During this time there were 421 days' work done upon the rock.

Smeaton appears to have been by no means fully employed as an engineer for several years after the completion of the Eddystone lighthouse; for in 1764 he became a candidate for the office of a receiver of the Derwentwater estate, the funds of which were, after its forfeiture in 1715, appropriated to Greenwich Hospital. On the last day of that year, chiefly, as he states in his account of the Eddystone lighthouse, through the friendship of the earl of Egmont and earl Howe, lords of the admiralty, he was appointed to this office. In this engagement he was happy in being associated with Mr. Walton, the other receiver, who took upon himself the management of the accounts, leaving Smeaton at leisure to devote his attention to improvements and to professional engagements. While he held the receivership he greatly improved the estate, the mines and mills of which required the superintendence of such a man to make them of their full value. Increasing business induced him, in 1775, to desire to relinquish this engagement, but he was prevailed on to retain it about two years longer.

Of the many useful works executed by Smeaton, Ramsgate harbour perhaps holds, next to the Eddystone lighthouse, the most prominent place. This work was commenced in 1749, but was carried on with very imperfect success until it was placed under his superintendence in 1774. This harbour, being enclosed by two piers, of about 2000 and 1500 feet long respectively, affords a safe refuge for ships where it was much needed, vessels in the Downs having been exposed to imminent risk during bad weather before it was constructed. Smeaton laid out the line of the great canal connecting the western and eastern shores of Scotland, from the Forth to the Clyde, and superintended the execution of great part of it. To his skill, in all probability, the preservation of old London bridge for many years was attributable. In 1761, in consequence of alterations made for the improvement of the navigation, one of the piers was undermined by the stream to a fearful extent. The bridge was considered in such danger that no one would venture to pass over it; and the engineers were perplexed. An express was therefore sent to Yorkshire for Smeaton, who immediately sunk a great quantity of stones about the endangered pier, and thereby preserved it. The Calder navigation was one of the great works which he successfully accomplished; and he provided with much skill for the effect of the impetuous floods to which that river is subject. The Spurn lighthouse at the mouth of the Humber, some important bridges in Scotland, and many other works of like character might also be mentioned.

About 1783 Smeaton's declining health rendered it necessary for him to avoid entering upon many new undertakings. He then devoted much attention to the publication of an account of the Eddystone lighthouse, which was to have been followed by a 'Treatise on Mills,' and other works embodying his valuable experience as an engineer. The former of these was the only work he lived to complete; and it is a volume of great and permanent interest, detailing in the most minute and simple manner every circumstance worthy of record concerning the history or the construction of the lighthouse. It is dedicated to George III., who had taken much interest in the structure; and in the dedication, in explaining the circumstances which had delayed the appearance of the narrative so long after the completion of the building, the author observes, 'I can with truth say, I have ever since been employed in works tending to the immediate benefit of your majesty's subjects; and indeed so unremittingly, that it is not without the greatest exertion that I am enabled even now to complete the publication.' He had made some progress in this work before 1763; but it appears to have been laid aside for about twenty years, and was not published until 1791. On the 16th of September, 1792, while walking in his garden at Austhorpe, Smeaton was seized with an attack of paralysis; and on the 28th of October he died.

About the year 1771 several friends of Smeaton, engaged in kindred pursuits, formed themselves into a society, which may perhaps be looked upon as the first public recognition of the useful body of men who have since, under the name of Civil Engineers, done so much in developing the resources of this country. Untoward circumstances led to the dissolution of this society previous to Smeaton's death but steps were taken to re-organize it before that event took place. The new Society shortly took steps for the publication in a collected form of Smeaton's numerous professional reports; but the work was not completed until 1812. It is in three quarto volumes, to which a fourth was subsequently added, consisting of his miscellaneous papers communicated to the Royal Society, &c. The Society alluded to is mentioned in the first volume of the 'Transactions of the Institution of Civil Engineers' as still existing. The introduction to this volume contains a high eulogium on the talent of Smeaton as an engineer. Alluding to the Eddystone lighthouse, it observes, 'This, Smeaton's first work, was also his greatest; probably, the time and all things considered, it was the most arduous undertaking that has fallen to any engineer, and none was ever more successfully executed. And now, having been buffeted by the storms of nearly (now more than) eighty years, the Eddystone stands unmoved as the rock it is built on—a proud monument to its great author. Buildings of the same kind have been executed since, but it should always be borne in mind who taught the first great lesson, and recorded the progressive steps with a modesty and simplicity that may well be held up as models for similar writings. His Reports are entitled to equal praise; they are a mine of wealth for the sound principles which they unfold and the able practice they exemplify, both alike based on close observation of the operations of nature, and affording many fine examples of cautious sagacity in applying the instructions she gives to the means within the reach of art.' The deliberation and caution always exercised in the works of Smeaton are well worthy of imitation; and to this may be attributed the almost unexampled success of his undertakings. So highly was his judgment appreciated, that he has been called the 'standing counsel' of his profession, and he was constantly appealed to by parliament on difficult engineering questions.

His improvements of wind and water mills have been mentioned already. The atmospheric steam-engine of Newcomen was the subject of similar experiments, attended with the like results; although the more important improvements of Watt threw Smeaton's efforts in this way comparatively into the shade. His improvements consisted chiefly in the proportions of the component parts of the machine; yet they effected so great a saving of fuel, that Boulton and Watt excluded them from their ordinary agreement—which was, to receive for the use of their patent right one-third of the coal saved by their machine in comparison with those previously used. The low state of the mechanic arts in England led Smeaton, during the early part of Watt's career, to doubt the possibility of his machines being made with the required accuracy.

Smeaton also introduced many improvements in mathematical apparatus, and had an ardent love for science. He was particularly attached to astronomy, and had an observatory at Austhorpe, where, even during the most active part of his career, he occasionally resided.

In person he was of middle stature, broad and strong made, and of good constitution. His manners were simple and unassuming. His temper was warm, but not overbearing; and his social character unimpeachable. Very little is recorded of his private history; but his daughter, Mary Dixon, in a letter prefixed to his 'Reports,' gives a pleasing account of his character as a husband, parent, and friend He was by no means grasping or avaricious, as many anecdotes related of him seem to show. The empress Catharine of Russia was at one time very desirous of engaging his services, and offered him his own terms: but the princess Daschkaw, by whom the request was communicated, found him to be, as she said, a man who had no price.

The principal authorities consulted for this article are a short memoir by Smeaton's intimate friend Mr. Holmes, a watchmaker, then residing in the Strand, which was published separately in 1793, and appeared also in the 'European Magazine' and the 'Annual Register' for that year; and the memoir prefixed to his 'Reports.' Some particulars have been gleaned also from his own 'Narrative' respecting the Eddystone lighthouse.

SMELL. The essential part of the organ of smell consists of the expansion of the olfactory nerves, the first or most anterior of the nerves from the brain, whose minutest branches are distributed just beneath the mucous membrane of part of the nose.

In man the framework of the nose is formed in part of bone and in part of cartilage. Of that part which is prominent on the face, the upper portion only is formed of bone, consisting of the nasal bones in the middle, and the nasal processes of the superior maxillary bones on each side. The lower and lateral portions, termed the Alæ, which bound the nostrils, are formed chiefly of cartilage. The nasal cavities, to which the nostrils lead, extend to the forehead above and to the pharynx behind; they are separated from each other by a middle partition. They are bounded on each side, in front, by the nasal bone and the meeting of the septum and alæ; above, by the cribriform plate of the ethmoid bone; below, by the palatine processes of the upper jaw and palate bones; behind, by the body of the sphenoid bone; on the inner side by the septum; and on the outer by the ala, by the ascending plates of the upper jaw and palate bones, the lacrymal, and the orbital plate of the ethmoid bone, and the internal pterygoid processes of the sphenoid, between which is the aperture from the nose into the pharynx. Within these cavities there hang, on each side, the three turbinated bones, the spaces above and within which are occupied by the fine cells and laminæ of bone forming the ethmoidal cells, which communicate with the frontal, maxillary, and sphenoidal sinuses.

Of these complicated cavities, the several parts of which are described in the article SKELETON, a small portion only is devoted to the sense of smell. The rest is subservient either to respiration, the passage through the nose being that by which in most animals the air passes to the lungs, or to the voice, of which the cells and the several sinuses near the nose seem destined to increase the resonance. All the surfaces within the nose are covered by a layer of thin, tough, and very vascular mucous membrane, the Schneiderian membrane, whose structure is simple, possessing neither papillæ, villi, nor glands, and which secretes in every part a small quantity of clear viscid mucus.

The olfactory nerves descend from the under surfaces of the olfactory bulbs [BRAIN] through the foramina of the cribriform plate of the ethmoid bone. They are very numerous, and are densely distributed in bundles and tufts in the mucous membrane covering the upper part of the septum, the under surface of the cribriform plate, and the inner surfaces of the superior and middle turbinated bones, and of the cells immediately adjacent to them.

The human organ of smell is less developed than that of other mammalia, in most of whom the turbinated bones, and all the parts to which the olfactory nerves are distributed, are much larger and more complicated in their form. In birds also the extent of the surfaces of these parts is proportionally much greater than in man, in correspondence with the greater acuteness with which they smell. In fish the nose is merely a depression, without any aperture into the pharynx; the olfactory membrane lining it has its surface extended by being developed in numerous folds and tufts. The closure of the nasal passage behind is one of the most constant of the characters distinguishing fish from amphibia, in the majority of which also there are not mere tufts of membrane, but well-developed turbinated bones, with the mucous membrane spread out upon them. In invertebrata the organs of smell are not clearly known, though there is little doubt that some of them exercise the sense.

All that is necessary for the perception of an odour is that the scented particles (without undergoing any such changes as light does in arriving at the retina, or sound on its way to the auditory nerve) should come in contact with the surface under which the olfactory nerves lie, with the force of rather more than an ordinary inspiration. If the medium containing the odour be at rest, or be only gently forced against the membrane, no impression is produced.

In different animals the sense of smell is adapted chiefly to that class of substances on which they feed. The carnivora, for example, have an acute sense of the odour of animal substances, but, so far as we can discern, none for that of vegetables; and, on the other hand, herbivora are as clear in their perception of the latter, and as nearly insensible to the former. Man, as his food is mixed, so also is his sense of smell adapted to both classes of substances, though for each less acute than that of the animals that feed exclusively on the one or the other. In the choice of food, which is the main object of the sense of smell, man generally, though almost unconsciously, and animals always, exercise the precaution of smelling, and they instinctively form a judgment according to the impression received. In eating also, much of that which is commonly attributed to the sense of taste depends on the odour of the food carried from the mouth to the nose. In eating cinnamon, for example, or any similar aromatic substance, if we close the nostrils, we perceive no flavour, and, except for the stinging of the tongue, might imagine ourselves eating a tasteless wood. And, in like manner, we often mistake for those of odour the impressions made by substances on the nerves of common sensation with which the lining membrane of the nose is abundantly supplied; for example, in smelling ammonia, vinegar, and other acrid substances, the impression which we regard as their odour is compounded of that and of the irritation of the nerves of common sensation; and the nose of an animal whose olfactory nerves are destroyed is hardly less sensible to this latter irritation than that of one in which the nerves are entire. Facts of this kind have led to the error of supposing that the olfactory are not the only nerves of smell; they only prove that the sense of smell has a more limited range than is commonly supposed. The same substances, ammonia and the like, which irritate the common sensitive nerves of the nose, act in the same manner on the eye or any equally delicate part; but in the nose alone is this irritation accompanied by any peculiar sensation of odour by which one such substance can be distinguished from another. This perception of odour, independently of irritation, is the proper function of the olfactory nerves, which are thus strictly nerves of peculiar sensation, of the same class with the optic, auditory, and gustatory. [NERVE; SENSES.]

SMELTING. [IRON—*Manufacture and Trade.*]

SMERDIS. [CAMBYSES; DARIUS.]

SMILA'CEÆ, a small natural order of plants belonging to Lindley's Retose group of Monocotyledons. There has been much difference of opinion amongst botanists with regard to the position of Smilax in the natural system, as well as the number of genera that ought to be admitted into the order Smilaceæ. Lindley has placed two genera, Smilax and Ripogonum, in this order, which possesses the following characters:—Flowers hermaphrodite or diœcious; calyx and corolla confounded, inferior six-parted; stamens six, inserted into the perianth near the base, seldom hypogynous; ovary three-celled, the cells one- or many-seeded; style usually trifid; stigmas three; fruit a roundish berry; albumen between fleshy and cartilaginous; embryo usually distant from the hilum. They are mostly herbaceous plants, with a woody stem, and a tendency to climb. Their leaves are reticulated. This last character separates the order from Liliaceæ and its allied orders, with which it otherwise closely agrees.

Smilax is found in most parts of the world, especially in Asia and America. For the principal properties of the order see SMILAX.

SMILAX, a genus of plants which gives its name to the natural family of Smilaceæ. The name occurs in Greek authors, as Theophrastus and Dioscorides, and is applied to several different kinds of plants, as the yew-tree; a species of Phaseolus or Convolvulus (σμίλαξ τραχεῖα), is Smilax aspera, which belongs to the present genus. Smilax is characterised by having a six-leaved corol-like perianth, with six stamens inserted into their base; the anthers are linear and fixed by the base; ovary three-celled; ovules solitary, in each cell affixed to the apex; style very short; stigmas three, spreading; berry one- to three-celled, one- to three-seeded; seeds globular; testa membranaceous, whitish; hilum large and coloured; albumen cartilaginous; embryo very small, remote from the hilum. The species form evergreen climbing shrubs, of which a few are found in temperate, but the majority in warm and tropical regions of both hemispheres, extending south to New Holland, and north to Japan, North America, and the south of Europe. The species have fibrous or tuberous roots; stems often prickly; leaves alternate petiolate; cordate or hastate, nerved, reticulate, venose, conchiferous stipules between the petioles; flowers sessile on a globular receptacle; subcapital pediculate and umbellate.

Though the original species (S. aspera) of this genus is an inhabitant of the south of Europe, those now most celebrated for yielding the different kinds of Sarza or Sarsaparilla are natives of South America. But S. aspera still continues to be employed for medicinal purposes in the south of Europe, where it is called Sarsaparilla Italica, but there is no truth in the statement of its being the plant yielding Indian Sarsaparilla, which is Hemidesmus indicus. Another celebrated species is the *Smilax China*, which has a tuberous root abounding in fecula, and therefore probably useful as a demulcent, though the Chinese esteem it invigorating, and ascribe to it other virtues. It is remarkable that two Indian species, which, like the Chinese species, have tuberous roots, should be called in Silhet *hurina-shook-China* and *gootea-shook-China*. These are *Smilax glabra* and *S. Lanceæfolia*, and their roots cannot be distinguished from the China root, or *Chob. chænea*, as it is called in India. A similar species is common in the southern parts of North America, and has been called *Smilax pseudo-China*, though there is reason to believe that more than one species may be confounded under this name. *S. glycyphylla* is a New Holland species, which has received its specific name from the sweetish taste of its leaves, and has been called Sweet Tea from its employment in the form of infusion, and is probably alterative and diaphoretic, as well as slightly tonic. Though the genus Smilax contains about one hundred species, few others require notice except those yielding the medicinal Sarsaparilla. It is probable that some of the species found in the Old World will be discovered to be possessed of virtues equal to the American species. Some of the Indian species have been sent by Dr. Gibson, superintendent of the East India Company's botanic garden near Poonah, to the Medical Board of Bombay, for trial in the hospitals of that presidency.

SMILAX (*Medical Properties of*). Though, according to Dr. Hancock, but one species of this rather extensive genus yields the genuine sarsaparilla, it is quite certain that the roots of many are collected, and pass under that name in commerce. The species which, according to him, furnishes the true root is a native of Guayana, growing on the elevated lands of the Rio Juniquen at Unturana and Caraburi. Most species of smilax are provided with spines, which has given origin to the first half of the name in the Spanish language, *zarza*, a bramble, and *parilla*, a vine, from its climbing or turning habit. The former is adopted as its familiar name in the London Pharmacopœia. The same work indicates S. officinalis (Humbt., *Nova Genera et Species*, i, 271) as the source of the officinal article. The different kinds of sarsaparilla are better known by the course they follow in their progress towards European consumption, than by their botanical history. In describing them it seems best therefore to adopt their commercial names.

1. Jamaica or Red Sarsaparilla. This occurs in bundles formed of the root alone, folded in a roundish mass, about a foot or more in length, and four or five inches broad. Each bundle is formed by the roots and rootlets (fibrillæ, or beards, as they are technically termed), without any portion of the rhizoma (or chump) or of the aerial stem. The roots are long, slender, about the thickness of a small quill, with a dark-brown furrowed or wrinkled bark. The bark is thick, easily separable from the ligneous part beneath. The ligneous part is of a light red, which assumes a deeper hue when moistened. It is easily split longitudinally, and has a whitish centre or medulla, containing more or less starch. But for the absence of medullary rays and of nodi, this root might be taken for the twigs of an Exogenous plant, to which the structure of the Smilaceæ approximates in several other points. A transverse section exhibits the cuticle and epidermis, which are separated from the inner or ligneous circle by a zone of cellular tissue; then the duramen, which presents the cut or open extremities of numerous ducts; and lastly, the medulla, or pith, in the centre. The duramen, though porous, is of a denser texture than that of the Honduras sarza. The taste is at first sweetish or slightly mucilaginous, then nauseous, resembling ipecacuanha, but not very acrid or bitter. No variety of sarza has any odour, but dirty or unwashed specimens have a faintly earthy smell.

The powder is a light reddish-brown, which, when triturated with water and tincture of iodine, changes to a blue, but of a less intense depth than the Honduras sarza, indicative of a smaller proportion of starch in the former.

According to Mr. Pope (*Trans. Medico-Chir. Society*, xii., p. 349), 'the whole medical efficacy resides in the bark; and the root, deprived of its cortical part, contains only pith and tasteless woody-fibre.' The tasteless character of the wood renders this statement very probable. He further says: 'The cortical part gives out nearly the whole of its virtues by cold infusion in distilled water, very readily to lime-water or water slightly impregnated with caustic alkali; and that boiling distilled water extracts all its virtues.' He deems the quantity of extract yielded by any specimen the criterion of its excellence. Judged by this standard, the Jamaica sarza is manifestly the best. His experiments have been confirmed by those of Mr. Battley, and by Thubeuf, the latest inquirer, who from six pounds of Jamaica sarza obtained 22½ ounces of extract, while a similar quantity of Lisbon sarza yielded only 13½ ounces, and of Honduras sarza 14 ounces.

Jamaica sarsaparilla is the produce of the Spanish Main, and thence sent to Jamaica, to be forwarded to Europe. Some has been recently cultivated in that island, but it is of inferior quality. The smilax officinalis (Humbt.), which is conjectured to be the parent plant of the wild root, grows in New Granada, on the banks of the Magdalen river, near Bojorque.

2. Lisbon, Para, or Brazilian Sarza.—The term Lisbon sarza was also bestowed on the sort just described, for as Lisbon sarza was till lately most esteemed, the former on its first introduction was vended under that name. The true Lisbon sarza is the produce of smilax siphilitica, which grows both in New Granada, on the river Cassiquiare, between Mandacava and San Francisco Solano, and in Brazil, on the Yupura and Rio Negro, by which last name it is sometimes designated. (Martius, *Reise*, iii., pp. 1213, 1280.) The Indians collect it all the year round, dry it over a moderate fire, and tie it into bundles with the flexible stem of a plant called Timbotitica. To prevent its being attacked by insects, they hang it up at the gables of the houses, and sometimes gently smoke it.

It is shipped from the Brazils, mostly from Maranham, in large bundles, weighing each about one hundred pounds, which are generally remodelled in Europe, especially in Holland, and reduced to small parcels of from one and a half to two pounds weight, the roots being cut clean off at each end, and made fast with paper and string. These bundles have a neat appearance externally, but the interior is filled up with the chumps and other rubbish. The fibres vary in thickness from that of a straw to that of a crow-quill, with little beard, and fewer longitudinal wrinkles than the Jamaica sarza; the colour, a light, sometimes a dirty greyish yellow, or reddish-brown colour, internally white; the cortical part mealy, including a thin cellular layer, which, with the duramen, is also white. Taste at first insipid, but on prolonged mastication a sort of acrid guttural taste, without bitterness, is experienced. This kind contains more starch than the Jamaica variety, and yields a paler infusion.

3. Honduras Sarza was the kind first introduced into medical practice, a circumstance which still leads many persons to prefer it. It generally comes over in very large bundles, weighing from one hundred to one hundred and fifty pounds, but sometimes in small round bundles. Each piece has the chump and the numerous roots proceeding from it. The chump is often two inches thick, woody, hard, and insipid. The roots are from two to four feet long, mostly thicker than those of the Jamaica or Lisbon kinds. The outer part is a dirty greyish yellow, sometimes verging to brown or reddish. The cortical part is very easily separable from the ligneous; between the epidermis and the duramen is a thick white amylaceous layer, whence a large quantity of flour or starch falls when the piece is broken across; hence the term *mealy*, applied to this variety. A transverse section exhibits a great many cut extremities of ducts, which run parallel, and are so continuous, that air can be blown from one end to the opposite of a considerable piece. This kind has no odour, and the taste is at first merely starchy and insipid, but at last acrid and guttural. The rhizoma (or chump) is altogether tasteless. The fibres and the bark are rendered black by iodine; while the rhizoma is not affected by this re-agent. The

decoction of the roots is changed to an intense blue by a solution of iodine.

4. Vera Cruz Sarza is not common in the English market, but is occasionally sold under the name of Lisbon sarza. It is the produce of smilax medica (Schlecht), which grows abundantly on the eastern slope of the Mexican mountains. Externally the fibres are more furrowed than the Jamaica. The transverse section is denser in the young roots, and it is not mealy; there is little beard. The chump is always attached. It yields a deep-coloured decoction, which is unchanged by a solution of iodine. The sarsaparilla of the Caracas of French writers is deemed to be the Vera Cruz sort.

5. A kind called Lima Sarza is brought in considerable quantity to this country, and greatly resembles Jamaica sarza, for which it is said by Dr. Pereira to be extensively sold, and from which it differs chiefly in yielding a less quantity of extract.

It is manifest that the S. Sarsaparilla (Linn.), which is a native of the southern states of the American Union, yields none of the article used at present in Europe, though it may yield a portion of what is used in the United States.

It is difficult to distinguish these different kinds of sarza by mere physical characters, but chemical tests furnish a ready and certain criterion.

| Kinds. | Iodine, action of, on substance. | Infusion. | | | Decoction. | |
|---|---|---|---|---|---|---|
| | | Colour. | Sesquichloride of Iron. | Tincture of Galls. | Colour. | Iodine. |
| Jamaica . | Turns it black, but the powder, rubbed with water and tincture of iodine, becomes blue. | Brownish-red. | Is rendered turbid but not deepened in colour. | No effect. | Clear deep reddish-brown. | Colour deepened, but not rendered blue. |
| Honduras | Tincture of iodine turns the roots, but not the chump, black. The powder, with water and iodine, is intense bluish-black. | Deep reddish-brown. | Scarcely affected. | No effect. | Deep brown, but not clear when cold. | Turned intensely blue. |
| Lisbon . | As the foregoing. | As the above. | As the above. | No effect. | Light brown. | Rendered blue. |
| Vera Cruz | Turns it brown, the thicker pieces rather blackish-blue. | Light brown. | More deepened. | No effect. | Deep coloured. | Scarcely affected. |

'A strong decoction of Honduras sarza forms a copious precipitate (starch) on the addition of alcohol.' (Pereira.)

Besides the above-described varieties, the produce of different species of smilax, there are numerous spurious or false sarsaparillas, some from known, others from unknown sources. Italian sarza is the root of Smilax aspera, the only species native of Europe. It is a very worthless kind, and owes its reputation to a mistake by which it was considered to be the source of the Indian sarza, a truly valuable root, but which is the produce of an asclepiadeous plant, Hemidesmus indicus. German sarsaparilla consists of the rhizoma of one or more species of Carex, C. hirta and C. arenaria. It may easily be distinguished from the genuine by the numerous nodi, which are absent from the smilax. The chemical analyses of sarsaparilla furnish little practical guidance, from its not being recorded what kind was submitted to examination. The investigation, in 1834, by Thubeuf (*Journal de Pharmacie*, xx., p. 682), gave as its composition,—a crystalline substance (*Salseparine*, supposed to be identical with *pariglin* of Palotta, *smilacin* of Folchi, and *parallinic acid* of Batka), a colouring matter, a resinous matter, ligneous matter, starch, chloride of potassium, nitrate of potash, fixed aromatic thick oil, and waxy substance. A volatile oil is mentioned in some of the analyses; it probably exists only in young roots, and in the older is converted into resin. Berzelius procured only one ounce from 100 pounds of the root.

The active properties are mostly due to the salseparine the resin, and, when present, to the volatile oil. The more acrid and bitter any specimen of sarza is, the better.

The virtues of sarsaparilla are the subject of much diversity of opinion; many practical men deeming it very useful, while others consider it nearly worthless. This difference seems owing partly to its being employed in different diseases by the one set, from those in which it is used by the other, and still more to inherent differences in the particular root used. It is collected at all seasons of the year, and in all stages of its growth, circumstances which cannot fail to influence its qualities; as young roots gathered before the flower appears must differ greatly from old roots gathered after flowering. But a more important cause of difference exists in the mode of preparing it for administration. The long period enjoined in the 'London and Edinburgh Pharmacopœias' for boiling the root is most injurious, and in reality the order is never obeyed by any of the chemists or druggists who have obtained a reputation for their preparations. They either use water of a temperature far below that of boiling, or perfectly cold water, as ordered by the Dublin Pharmacopœia, and recommended by all the most eminent Continental pharmaceutists. The powder is not thus injured, but its bulk and taste are obstacles to its full employment. The compound syrup of the latest edition of the American Pharmacopœia is a most excellent form as an addition to some of the watery preparations.

The curative powers of sarsaparilla are often very much heightened by combination either with alkalis, especially lime-water, or in other cases with acids, particularly the nitric. When properly prepared, and administered in suitable cases, no one can doubt the efficacy of sarsaparilla. From the high price of it, and the great consumption of it, attempts have been made in many of the great hospitals to dispense with it or discover a cheaper substitute, but without success. In the worn-out or debilitated systems so common in the patients by whom these establishments are crowded, its utility is daily manifested. This is partly owing to the care taken to procure the best kinds, and partly to the appropriate use made of it, for the sake of economy. It is chiefly used in chronic, syphilitic, rheumatic, gouty, and cutaneous diseases. Its most obvious action is diaphoretic, but if the patient be kept cool, diuretic. In cases where an acid is indicated, the Hemidesmus indicus, which is possessed of a natural acid (hemidesmic acid), will be found a useful substitute for the artificial preparations.

If any European plant ever prove a proper substitute for sarsaparilla, it will be the Tamus communis, or black bryony of our hedges, the root of which, when scraped and applied externally as a poultice, rapidly promotes absorption of effused blood. This is well known to bruisers, gypsies, and others, who to remove ecchymoses of the eye apply a poultice of this root, and generally remove the blackness in twelve or twenty hours. (Tyrrell *On the Eye*, vol. i., p. 200.)

SMILIS. [SCULPTURE.]

SMI'LIUM, Dr. Leach's name for a genus of pedunculated *Cirripeds*, distinguished from *Pentelasmis* by the number of its valves, and from *Scalpellum* by its hairy pedicle. Pieces thirteen, all smooth; ten in pairs, lateral and subtriangular; two anterior dorsal and ventral incurved and triangular; one posterior dorsal and linear; pedicle hairy.

Example, *Smilium Peronii*.

SMITH, SIR THOMAS, was the eldest of the three sons of John Smith, of Saffron-Waldon, who appears to have been a gentleman of some distinction in the county, since he served the office of high-sheriff for Essex and Hertford in 1538. His son Thomas was born at Saffron-Walden, on the 28th of March, 1514, or 1515, most probably in the latter year.

In 1526 he was entered of Queen's College, Cambridge, of which he became a fellow in 1531. It is said to have been after this that, incited by the example of Dr. John Redman, who had just returned from the Continent an accomplished Greek scholar, he made himself master of that language in about two years; and the story is commonly told so as to imply that the study of Greek was till now unknown at Cambridge. But this is incredible; and indeed Smith's own relation of the methods he took to reform the prevalent mode of reading Greek at the University shows that some acquaintance with the language, though perhaps not a very exact or profound acquaintance, was previously general among the students. In 1535 he was appointed to read the public Greek lecture; and it was while holding this office that, in conjunction with his friend Cheke, he introduced the improved mode of pronouncing the Greek letters, of which he has given an account and defence in his tract entitled 'De Recta et Emendata Linguæ Graecæ Pronuntiatione,' first printed in 4to., at Paris, in 1568, and afterwards, along with the 'Disputationes' of Cheke, the 'VII. Epistolæ' of Bishop Gardener (who espoused the cause of the old pronunciation), and other writings on the same subject, in Henry Stephen's collection entitled 'De Linguæ Graecæ ac Latinæ Vera Pronuntiatione Commentarii Doctissimorum Virorum,' 8vo., 1587.

In 1536 Smith, now one of the most distinguished members of the University, was chosen public orator, and for some years he discharged the duties of that office with great applause. But in 1539 he left England, and remained abroad for two or three years, during which time he visited France and Italy, and took his degree of doctor of the civil law at Padua. After his return home, having taken the same degree at Cambridge in 1542, he was appointed king's professor of law in that University, and he seems to have continued to reside at Cambridge during the remainder of the reign of Henry VIII., although he is stated to have taken at least deacon's orders, and to have held in the church both the rectory of Leverington in Cambridgeshire and the deanery of Carlisle. His father had been long attached to the new doctrines in religion, and he had himself been brought up in the reformed faith from his childhood.

The accession of Edward VI. however was the great turning point in the history of this learned and able man. He was immediately taken into the family of the lord-protector Somerset; and, besides being made one of his masters of requests, was appointed to the two lucrative places of Provost of Eton and Steward of the Stannaries. In addition to his classical erudition, Smith had distinguished himself by his acquirements both in the pure mathematics and in such physical and experimental philosophy as was then known. We have already seen him figuring as a professor of law and as a clergyman: in 1548 he appears in a new professional character, having been that year made secretary of state and knighted. The same year he was sent to Brussels on an embassy to the emperor Charles V. There is some reason to suppose that on the fall of his patron Somerset he lost his place of secretary; but if so, he was soon restored to it; for in April, 1551, he was sent in that capacity on the embassy to Henry II. of France, to treat of a marriage between King Edward and that king's daughter.

When the crown passed to Mary, Sir Thomas Smith was deprived of all his employments and preferments; but having conducted himself with prudence, he was not further molested, and was even allowed a pension of 100*l.* a year. On the accession of Elizabeth, he was immediately restored to his deanery, and he was soon also recalled to public employment. In 1559 he was one of the commissioners sent to France by whom a peace was concluded between the two countries; and being again sent thither in 1562, he continued to reside abroad till 1566. He was also employed on another mission to France in 1567. Then he resided for some years at his seat in the country, till he was recalled to court in 1571; and being admitted of the privy council, was soon after appointed assistant secretary of state under Burleigh. In 1572 he once more went over in a diplomatic capacity to France; and while he was abroad he was nominated by the queen Chancellor of the Order of the Garter. In June that same year, on Burleigh's promotion to the place of lord treasurer, Smith succeeded him as secretary of state; and this office he held till his death on the 12th of August, 1577. He died possessed of considerable landed property, which, as he left no issue, though he was twice married, descended to the family of one of his younger brothers. A natural son whom he had was killed in Ireland in 1573.

Besides his Latin treatise on the pronunciation of Greek, already mentioned, Sir Thomas Smith is the author of another tract, entitled 'De Recta et Emendata Linguæ Anglicæ Scriptione,' printed along with that in 1568. But his most remarkable work is that entitled 'The English Commonwealth,' in three books, first published in 1584, and several times reprinted since; and in a Latin translation executed by himself, forming one of the small volumes of the collection of the 'Respublicæ.' Some shorter performances of his are given in the appendix to his Life by Strype, which also contains accounts of his unprinted writings. [STRYPE, JOHN.]

SMITH, ROBERT, D.D., an English mathematician, who was born in the year 1689: the place of his birth and the manner in which he was educated are not known; but it appears that from his youth he applied himself diligently to the study both of pure mathematics and of the physical sciences. In the early part of his life he was appointed tutor to the duke of Cumberland, and he subsequently received the title of master of mechanics to the king. He was a cousin by his mother's side of the celebrated Roger Cotes, and the two young men were intimately connected by friendship as well as by blood; they pursued their studies in each other's society, and their united labours were directed to the advancement of the Newtonian philosophy in this country. Mr. Cotes, who was Plumian professor of astronomy at Cambridge, dying in 1716, Mr. Smith, then M.A., was immediately afterwards appointed to succeed him: in 1723 he was made LL.D.; and in 1742, on the death of Dr. Bentley, he was appointed master of Trinity College. In 1722 he published, under the title of 'Harmonia Mensurarum,' and with a valuable commentary, several tracts on philosophical subjects which had been written by his relative and friend; and in 1738 he brought out, in two vols. 4to., his great work, entitled 'A Complete System of Optics,' which he dedicated to the Right Hon. Ed. Walpole. Such a work was then much wanted: it contains, besides a full development of the several different branches of the science, a considerable number of applications of the subjects to astronomy and navigation; but it is considered as rather deficient in perspicuity and arrangement. It was translated into French in 1767.

Dr. Smith undertook to correct and publish Cotes's 'Lectures on Hydrostatics and Pneumatics;' and this work, which came out in the year 1737, was enriched with a great number of notes, explanatory and illustrative of the subjects. A second edition of it was published in 1747. In the following year he published in one volume, 8vo., a treatise entitled 'Harmonics, or the Philosophy of Musical Sounds;' and of this work a second edition appeared in 1758. This learned man, of whose life so little is known, was in 1718 admitted a fellow of the Royal Society, and was intimately acquainted with most of the scientific men of his time. He died at Cambridge in 1768, and in the seventy-ninth year of his age, having been a liberal benefactor both to the University and to Trinity College; and having bequeathed two annual prizes, each of 25*l.*, for students who, being bachelors of arts, should have made the greatest progress in mathematics and natural philosophy. The two bachelors who gain these prizes are designated by the name of Smith's prizemen.

SMITH, ADAM, the only child of his parents, was born at Kirkaldy, June 5th, 1723, a few months after the death of his father, who was comptroller of the customs at that place. He was brought up with great tenderness by his surviving parent, and sent to the grammar-school of his native town. From 1737 to 1740 he pursued his studies at the university of Glasgow. Being designed for the Church of England, he left Glasgow, and proceeded as an exhibitioner on Snell's foundation to Balliol College, Oxford, where he spent seven years. Mathematics and natural philosophy, with antient and modern languages, were his favourite studies at this University. Having abandoned the idea of taking orders, he returned to Scotland: and in 1748 went to reside at Edinburgh, where, for the next three years, he read lectures on rhetoric and belles-lettres, under the patronage of Lord Kames. In 1751 he was elected professor of logic in the university of Glasgow; and in the following year was appointed to the chair of moral philosophy, which he filled for the next thirteen years. The third division of his lectures included various subjects, which he subsequently so ably treated in the 'Wealth of Nations.' His talents in the chair have been highly praised, and his lectures were generally delivered extempore. During his residence at Glasgow, he published his 'Theory of Moral Sentiments:' the first edition appeared in 1759; and the sixth, which contains considerable additions, shortly before the author's death. The fundamental principle of this work is, that sympathy forms the foundation of morals; that 'the primary objects of our moral perceptions are the actions of other men; and that our moral judgments with respect to our own conduct are only applications to ourselves of decisions which we have already passed on the conduct of our neighbours.' (Dugald Stewart.) This theory being now little thought of, it is unnecessary to enter into further details. To the second edition of the above work was prefixed a dissertation on the origin of languages, which was afterwards published separately, under the title of 'Considerations concerning the First Formation of Languages, and the Different Genius of Original and Compounded Languages.' It is praised rather for its ingenuity than the soundness of its conclusions. In 1763 Mr. Smith resigned his professorship, in consequence of an invitation to accompany the Duke of Buccleugh on his travels. The university of Glasgow conferred upon him the honorary degree of LL.D., a title which he never assumed in private life. He left London with his noble pupil in January, 1764, and proceeded to Toulouse, where they resided eighteen months. They next visited various parts of the South of France, spent two months at Geneva, and came to Paris at the end of 1765, where they remained ten months; and after an absence of nearly three years, returned to England. At Paris Mr. Smith became intimately acquainted with Turgot, Quesnay, Necker, D'Alembert, Helvetius, Marmontel, and other distinguished persons. Had Quesnay lived, it is said that the 'Wealth of Nations' would have been dedicated to him. Soon after his return to England, Smith proceeded to Kirkaldy, where, with the exception of occasional visits to Edinburgh and London, he resided until 1766, engaged in his great work. He mixed with the best literary society of both capitals, and was on terms of intimate friendship with Hume. When Johnson visited Scotland, he and Smith met, and Johnson rudely attacked the latter on account of his intimacy with the great historian. The interview between them is described in the *Edinburgh Review*, No. 145, p. 51. The 'Wealth of Nations' appeared early in 1766. To the third edition (1784) the author made several additions; but the fourth edition (1789) contained no alterations of any kind. The two following years after the first appearance of the work were spent in London. In 1788, through the influence of the Duke of Buccleugh, Mr. Smith was appointed one of the commissioners of customs for Scotland, on which he removed to Edinburgh, where he spent the remaining thirteen years of his life. When this appointment took place, he was in his fifty-fifth year; and it has frequently been regretted that his time was not devoted to more profitable labours, for though the duties of his office were not onerous, they were sufficient to distract his attention. He had collected materials for publication, which, with the exception of some detached essays published by his executors, were destroyed by his orders a few days before his death, as he had never found time to arrange them for the press. The closing years of his life were spent tranquilly in the society of a small circle of friends, who generally supped with him every Sunday. His mother resided with him until her death in 1784, a loss which he severely felt; and a maiden cousin, who had always superintended his domestic concerns, died four years afterwards. In 1787 he was elected rector of the university of Glasgow. He did not linger long after his domestic bereavements, but died in July, 1790, aged 67. He was never married.

The private character of Adam Smith has been fully given by his friend Dugald Stewart, in the account of his 'Life and Writings,' which is prefixed to more than one edition of the 'Wealth of Nations.' His disposition was amiable and benevolent; his manners artless and simple; and in society he not unfrequently exhibited instances of absence of mind. Dugald Stewart says:—'He was certainly not fitted for the general commerce of the world, or for the business of active life.' His acts of private charity were on a scale much beyond what might have been expected from his fortune. The medallion by Tassie gives an exact idea of his profile and the general expression of his countenance.

The 'Wealth of Nations,' or, to give the title correctly, the 'Inquiry into the Nature and Causes of the Wealth of Nations,' is the work on which the fame of Adam Smith will permanently rest. It overthrew the errors of the mercantile theory, that money was wealth; those of the agricultural theory, that land was the only source of wealth; and established the principle that the true source of wealth was labour. Hobbes, in 1651 ('Leviathan,' chap. 24), had briefly glanced at the importance of labour in conferring value upon things; Locke, in 1689 ('Essay on Civil Government'), went further, but was evidently not fully aware of the importance of the principle which he elucidated. Mr. McCulloch, in his 'History of the Rise and Progress of the Science of Political Economy up to the publication of the Wealth of Nations,' thus sums up what Adam Smith has done for this science:—'In the "Wealth of Nations" (he says) the science was, for the first time, treated in its fullest extent; and the fundamental principles on which the production of wealth depends, were established beyond the reach of cavil and dispute. In opposition to the French economists, Dr. Smith has shown that *labour* is the only source of wealth, and that the wish to augment our fortunes and to rise in the world is the cause of wealth being saved and accumulated. He has shown that labour is productive of wealth when employed in manufactures and commerce, as well as when it is employed in the cultivation of the land. He has traced the various means by which labour may be rendered more effective; and has given a most admirable analysis and exposition of the prodigious addition made to its powers by its division among different individuals, and by the employment of accumulated wealth, or capital, in industrious undertakings. Dr. Smith has also shown, in opposition to the commonly received opinions of the merchants, politicians, and statesmen of his time, that wealth does not consist in the abundance of gold and silver, but in the abundance of the various necessaries, conveniences, and enjoyments of life. He has shown that it is in every case sound policy to leave individuals to pursue their own interest in their own way; and that, in prosecuting branches of industry advantageous to themselves, they necessarily prosecute such as are at the same time advantageous to the public. He has shown at great length, and with a force of reasoning and amplitude of illustration that leaves nothing to be desired, that the principles of the mercantile or exclusive system are at once inconsistent and absurd; and that every regulation intended to force industry into particular channels, or to determine the species of commercial intercourse to be carried on between different parts of the same country, or between distant and independent countries, is impolitic and pernicious—injurious to the rights of individuals—and adverse to the progress of real opulence and lasting prosperity.'

Adam Smith's errors lean towards the theories of the French economists. Some principles he overlooked; others he did not duly appreciate. Many of the theories which he controverted have now become obsolete, yet the manner in which he has investigated them will always please and instruct. Still it is not safe for the student to read him without a guide. The best edition of the 'Wealth of Nations' is that by Mr. McCulloch, either in 4 vols. 8vo. or 1 vol. 8vo.: it contains useful foot-notes, and at the end several original dissertations on subjects which were not so well understood half a century ago.

The 'Wealth of Nations' is divided into five books; but the arrangement of the subject is not on the whole considered judicious. In the first and second books the circumstances which determine the price of commodities, the rate of wages and profits, and the rent of land are discussed. The third book treats of the probable progress of a country in which individual and national industry were unimpeded by restrictions, and shows the 'natural progress of opulence.' The causes which had produced the then existing policy of different European countries are pointed out. In the fourth book the mercantile and agricultural systems are examined. The fifth book relates to revenues of the state, the principles of taxation, and the effect of national debts. There are several long digressions on various branches of the subject.

SMITH, JOHN STAFFORD, a composer of great eminence, was born about the year 1750, in Gloucester, of which cathedral his father was organist, and by whom he was prepared for his final instructions in music under Dr. Boyce. At an early age he was appointed one of the Gentlemen of the Chapel-Royal; and on the decease of Dr. Arnold, in 1802, became organist of the same. In 1805 Dr. Ayrton resigned to him the mastership of the Children of the Chapel, an office which he relinquished in 1817, when he withdrew from all his professional engagements, and enjoyed a moderate but well-earned independence till his death, which took place in 1836.

At the age of twenty-three Mr. Smith gained a prize-medal from the Catch-Club, for a composition which had nothing to recommend it but that kind of grossness so much admired in 'the good old times;' but the following year produced his fine glee for four voices, 'Let happy lovers fly where pleasures call,' on which a similar medal was much more properly bestowed. The same honour was with equal discrimination conferred, in the three succeeding years, on his glees, 'Blest pair of Syrens,' 'While fools their time in stormy strife employ,' and 'Return, blest days.' He obtained in the whole eight of these honourable distinctions; but his very delightful glees, 'Let us, my Lesbia, live and love,' and, 'As on a Summer's day,' missed the reward due to their merits. Mr. Smith was also author of a madrigal, 'Flora now calleth forth each flower,' a work which may compete with anything of the kind extant. He published, between the years 1777 and 1785, five collections of glees, a volume of anthems, *Musica Antiqua*, and *Antient Songs of the Fifteenth Century*, the two last of which bear indisputable evidence of his industry and research, and now form a part of every good musical library.

SMITH, JOHN RAPHAEL, son of a respectable landscape-painter, who, from the place of his residence, is commonly known as Smith of Derby, was born about the middle of the last century. His father, Thomas Smith, has been stated to be one of the first artists 'who explored and displayed the charming scenery of his native country.' Several of his pictures were engraved by Vivares. Bryan states that he died in 1769. He intended to make an artist of his eldest son Thomas, who had given early indications of inclination towards painting, and apprenticed the subject of this notice to a linen-draper. Time however proved that he was mistaken in his selection, for Thomas never advanced beyond mediocrity, while John Raphael forsook the counter, and became eminent as a mezzotinto engraver and also as a painter. Very little is recorded of his history, and the few circumstances which are narrated are conflicting. It appears however that he was in full practice as an artist in London about 1778. He executed many beautiful engravings from pictures by Sir Joshua Reynolds, and several from his own. Among the latter are whole-length portraits of Charles James Fox and Earl Stanhope. Latterly Smith devoted himself chiefly to the production of slight crayon portraits, which he executed with great facility. Dayes, a contemporary artist, observes, 'The number of slight heads he has painted at a guinea are incalculable; one of the family told me he had done as many in one week as brought him forty pounds, and each of them I know he could finish in an hour.' While residing in London, he became a publisher and printseller; but during the latter years of his life he travelled about the country a good deal as a portrait-painter. He died in March, 1812, in his sixtieth year, according to a brief notice of his life and works in vol. iv. of the 'Library of the Fine Arts,' or in 1811, according to Bryan, and was buried at Doncaster. Unhappily his habits and character were not such as to excite respect. He was much given to low sports and practices; even pugilism has been mentioned among the debasing amusements to which he was addicted. With a taste for such pursuits, it is not surprising to find him on intimate terms with Morland, whom he assisted in bringing into notice.

SMITH, SIR JAMES EDWARD, celebrated as the purchaser of the collections and library of Linnæus, and founder of the Linnean Society, was born at Norwich, on the 2nd December, 1759. He is described as having extreme mental susceptibility, and a delicate constitution, whence he was much under the care of his mother, from whom he imbibed his taste for flowers. His father was a man of cultivated mind, and had no doubt considerable influence in forming his son's mind, especially as his education was domestic, with the assistance of masters from Norwich. This town has long been remarkable for the fondness of its inhabitants for flowers, introduced, it is believed, by the Flemish weavers, who took refuge in England from the tyranny of the Spaniards in their own country. Hence it has probably happened that botany has been a favourite pursuit in Norwich, and that so many botanists have been produced there, as may be seen in Smith's 'Biographical Notice of Norwich Botanists,' as well as in some of our living botanists. Mr. Smith was intended for some mercantile calling, but from his love of science was induced to study medicine, for which purpose he proceeded to Edinburgh in 1781, and obtained in 1782 Dr. Hope's gold medal for the best botanical collection. After his arrival in London, he happened to be breakfasting with Sir Joseph Banks, from whom he learnt that the whole of the collection of books, manuscripts, and natural history of Linnæus had been offered him for one thousand guineas, but that he intended to decline it. The young student of medicine determined upon becoming himself the purchaser, though without funds for the purpose. His father, though at first refusing, afterwards consented to the purchase. The collection arrived here in twenty-six cases, in 1784, and cost 1088*l.* 5*s.* The ship conveying it had just sailed when the king of Sweden, Gustavus III., who had been absent in France, returned home, and sent a vessel to the Sound to intercept its voyage, but happily it was too late. On the death of Sir James, this celebrated collection was purchased by the Linnean Society, and forms a part of their valuable stores of natural history.

A number of circumstances appear thus to have determined the future course of Sir James's life. Though he took up his residence in London, with the intention of practising his profession, it seems never to have seriously occupied his attention. Two years after he became possessed of the collections of Linnæus, he made a tour through Holland, France, Italy, and Switzerland, of which he published an account. He obtained his medical degree at Leyden. In the year 1788, with the assistance of Sir Joseph Banks, Dr. Goodenough (Bishop of Carlisle), and some others, the Linnean Society was founded, and Dr. Smith elected its first president. In 1792 he was employed to teach botany to Queen Charlotte and to the princesses. He continued to reside in London until 1796, when he removed to Norwich, but paid a yearly visit of two months to London, when he gave a course of lectures on botany at the Royal Institution. On the 28th July, 1814, Dr. Smith was knighted by the prince regent at a levee, when he presented a copy of the 'Transactions' of the Linnean Society. The honour was conferred on him as institutor and president of the Society. In the year 1818 Sir James became a candidate for the chair of botany at Cambridge, but not being a member of the University, nor of the Church of England, he was not considered eligible by the authorities of the University. His health began to decline five or six years previous to his death, which took place on the 17th March, 1828.

The public will be chiefly interested in his works. Of these a full list is given in the Memoir of his Life and Correspondence, published by his widow. These are numerous, but those by which he will be principally known and remembered are, 'English Botany,' in thirty-six volumes, with 2592 coloured figures by Mr. Sowerby; 'The Latin Flora Britannica,' three volumes, and especially 'The English Flora,' in four volumes; also 'Flora Græca,' from Dr. Sibthorp's materials, and the 'Prodromus Floræ Græcæ.' He was also author of the botanical articles and of the botanical biography in Rees's 'Cyclopædia,' from the letter C, which have always been much valued, and of numerous papers in the 'Transactions' of the Linnean Society.

Sir James Smith was moreover esteemed as a man of a kind heart, amiable dispositions, and pure moral habits. His correspondence displays great warmth of friendship towards him on the part of numerous distinguished individuals. His purchase of the Linnean collections, and his devotion to the science of botany for so many years, had considerable influence in spreading a taste for and in extending the cultivation of that science. In his exclusive attachment to the artificial classification of Linnæus in preference to the natural method, in favour of which Linnæus has expressed himself in the strongest terms, he preferred that which was valuable for a time, to that which, as perfected, becomes fitted for all times.

SMITH, ANKER, who received his unusual name by way of fanciful allusion to his being an only son, the *hope* of his parents (*anker* being an old way of spelling anchor), was born in London in 1759. He was educated in the Merchant Taylors' School, and was articled, in 1777, to his uncle, Mr. John Hoole, a solicitor. The unusual neatness of his writing led Mr. Hoole to try his skill at drawing with a pen. He therefore copied two line engravings in pen and ink; and so admirably was the second executed, that James Heath is said to have mistaken it for a print. In consequence of this indication of talent, young Smith was articled to an engraver named Taylor, in the year 1779, but he quitted him in 1782, by which time he had surpassed his instructor. He then became an assistant of James Heath, in whose name he executed many works, among others, the Apotheosis of Handel, which is said to be entirely his own. About the year 1787 Smith received his first independent employment as an engraver, being then engaged upon the plates to illustrate Bell's edition of the 'British Poets.' About the same time he was introduced by Hoole, the translator of Tasso (who was brother to the gentleman of that name before alluded to), to Alderman Boydell, by whom he was commissioned to engrave Northcote's picture of the Death of Wat Tyler. For this engraving he was, in 1797, elected an associate of the Royal Academy.

The engravings of Anker Smith are much esteemed for their beautiful execution and correct drawing; although, from the circumstance of his working much for book publishers, his name is less known than it deserves to be. His private character was unimpeachable; and his modesty, piety, and correct judgment secured him many friends. In 1791 he married. He died of apoplexy, in June, 1819, leaving his widow, four sons, and a daughter. Of his sons, the second, named Frederick William, who became a pupil of Chantrey, gave great promise of eminence in the art of sculpture, but died in 1835, at the age of thirty-eight years; and the two younger, who still survive, have embraced that of painting. Mr. Smith had several sisters, one of whom was mother to W. C. Ross, Esq., miniature-painter to her present majesty.

SMITH, JOHN THOMAS, for many years keeper of the prints and drawings in the British Museum, was the son of Nathaniel Smith, formerly a sculptor, and afterwards a well-known printseller in Great May's Buildings, St. Martin's Lane. Nathaniel Smith had been when young the playfellow of Nollekens; and they had learned drawing together. In August, 1755, Smith was placed with Roubiliac, the sculptor; and about 1759 and 1760 he and Nollekens, who had become a pupil of Scheemakers in 1750, obtained some of the best prizes of the Society of Arts. Nathaniel Smith, who gained many prizes from the Society, carved three of the heads of the river-gods which adorn the arches of Somerset House, from designs by Cipriani. The friendship existing between him and Nollekens occasioned the subject of this article, who was born on the 23rd of June, 1766, to be very early noticed by the eccentric sculptor, who, while he was yet a boy, used to take him to see various parts of London, pointing out curious vestiges of antiquity, and thus probably exciting that peculiar taste by which Smith was subsequently rendered eminent. His mother dying in 1779, young Smith was invited to the studio of Nollekens, to whom his father was then chief assistant. After enjoying this privilege for three years, during which time he had much practice in drawing, he became a student at the Royal Academy. About this time he made pen-drawings in imitation of the etchings of Rembrandt and Ostade, and these, through the introduction of Dr. Hinchliffe, then bishop of Peterborough, obtained a liberal offer from Sherwin, in consequence of which Smith became a pupil of that skilful engraver. For some years after being with him, Smith was chiefly engaged as a drawing-master.

He married at the age of twenty-two years, and soon afterwards commenced the publication, in numbers, of his first work, the 'Antiquities of London and its Environs,' a collection of representations of houses, monuments, statues, and other interesting remnants of antiquity; unaccompanied by letter-press descriptions, but having short accounts, with references to Pennant and other writers, engraved under each subject. This work was commenced in January, 1791, and completed in 1800; the whole series consisting of ninety-six plates of a quarto size. A complete list of the subjects is given in Upcott's 'Bibliographical Account of the Principal Works relating to English Topography,' vol. ii., p. 886. While this was in course of publication, Smith brought out his 'Remarks on Rural Scenery,' a thin quarto volume, illustrated with twenty etchings of cottages, some of which are very prettily executed.

Smith's next work for the illustration of the early architecture of the metropolis was his 'Antiquities of Westminster,' comprising the old Palace, St. Stephen's Chapel, &c., and containing engravings of 246 topographical objects, of which, at the time of its publication (1807), 122 were no longer in existence. This series of engravings is comprised in 38 plates and six wood-cuts, of which a particular account is given by Upcott, vol. ii., p. 835, *et seq.* 'This task,' it is observed by Mr. Smith's biographer, in the 'Gentleman's Magazine,' 'appears to have been determined on in the year 1800; when, on occasion of the Union with Ireland, it becoming necessary to remove the wainscoting for the enlargement of the House of Commons, some very curious paintings were discovered, on the 11th of August.' 'The next day,' the narrative proceeds to inform us, 'Dr. Charles Gower and Mr. Smith visited the paintings. Mr. Smith immediately determined to publish engravings from them; and, permission being obtained, on the 14th he commenced his drawings. It was his custom to go there as soon as it was light, and to work till nine o'clock in the morning, when he was obliged to give way to the workmen, who often followed him so close in their operations as to remove in the course of the same day on which he had made his drawing, the painting which he had been employed in copying that very morning.' Antiquaries will long esteem the name of John Thomas Smith, were it only for the service he rendered in snatching these curious paintings from complete oblivion. The plates of the 'Antiquities of Westminster,' which comprise coloured copies of several of these paintings, are accompanied by descriptions of considerable length, a great part of which were written by J. Sidney Hawkins, F.S.A.; although, owing to a misunderstanding which led to the publication of much angry correspondence, portions of which are often bound up with the work, it was completed by Smith alone. A disastrous fire at Bensley's printing-office destroyed 400 copies of this work, and 5600 prints, occasioning a loss to Mr. Smith which he estimated at 3000*l.* In 1809 appeared sixty-two additional plates to the above work, forming a second volume, but without any description, or even a list of subjects. The latter however has been supplied by Mr. Upcott, in the work above alluded to, vol. ii., p. 839, &c.

These works were followed by another, in imperial 4to., entitled 'Ancient Topography of London,' the publication of which was commenced in October, 1810, although it was not completed until 1815. This, which is considered Smith's best work, contains 32 plates, very boldly etched, in a style somewhat resembling that of Piranesi, and accompanied by descriptions of the buildings represented. The author intended to extend it somewhat further, but never did so. In 1816 Mr. Smith received his appointment as keeper of the prints in the British Museum; and in the next year published his 'Vagabondiana, or Anecdotes of Mendicant Wanderers through the Streets of London,' illustrated with about thirty portraits, and with an introduction by Mr. Douce.

The last literary production of Mr. Smith was the amusing but not very honourable or trustworthy book entitled 'Nollekens and his Times,' which appeared in 1828, and soon ran through three editions. Smith was an executor to Nollekens, and was disappointed in not being a legatee. He therefore wrote under the influence of excited feelings, and made a discreditable use of the free access he had for so many years enjoyed to the home and studio of Nollekens. Still, although the work contains much that should not have been published, and is distinguished by a degree of high colouring which greatly impairs its veracity, it contains many curious anecdotes of artists and other distinguished men with whom Smith had come in contact in the course of a long and rather eventful life. He left in manuscript materials for a history of his own life and times, which has not yet been published. He had also collected much matter towards an account of the parish of St. Paul, Covent Garden, and for a work which he intended to call 'Walks through London;' but he did not live to complete any of these works, having died of inflammation of the lungs, after only a week's illness, March 8th, 1833, in his 67th year. His wife, a son, and two daughters survived him. Mr. Smith is stated to have been of kind disposition, and inclined to encourage young artists. In his attention to the duties of his office he was exemplary; and his fund of anecdote rendered him a very amusing companion. There is a portrait of him engraved by Skelton, from a drawing by Jackson. (*Gent. Mag.*, vol. 103, part i., p. 641, &c.)

SMITH, WILLIAM, LL.D., author of the first geological map of England and Wales, born 23rd March, 1769, at Churchill, in Oxfordshire, died 28th August, 1839, at Northampton, where a tablet is intended to be erected by subscription to his memory.

The life of this distinguished ornament of English geology is full of events which illustrate the power of a vigorous intellect and patient disposition in conquering the difficulties which sometimes impede the prosecution of science; but we propose in this brief notice merely to state a few of the circumstances which justify his admitted claim to be entitled 'father of English geology.'

Previous to the year 1791, Mr. Smith had made observations on the various sorts of land, as depending on different kinds of rocks: had compared, for example, the red marls and lias of Warwickshire with the oolitic soils and strata of Gloucestershire; but in 1791, being employed to make careful surveys of collieries and mines in Somersetshire, he found, on descending the pits and comparing the underground sections with the surface features, evidence of a 'constancy in the order of superposition' of strata, much more extensive and practically and analytically demonstrated than was ever stated or admitted before. Reflecting on this circumstance, he resolved to examine if the strata thus regularly superposed were equally or approximately coextensive in the limited district of Somersetshire and the bordering counties, in which his labours were then confined. He found by abundant investigation and levellings in separate valleys, that generally the edges of the strata above the coal were continuous on the surface, their plane surfaces declining into the earth in one direction, viz. toward the east or south-east; but that the strata of coal lying beneath the red marl were not 'conformed' in their inclination to the rocks above. This 'unconformity' he represented by a large working section of Pucklechurch colliery in Gloucestershire.

In his investigations, which, as engineer to the Somerset Coal Canal, he made for the purpose of setting out the line and letting the works, it became difficult always to recognise and discriminate the rocks which were to be cut through, on account of the great mineral resemblance between some of these and their accidentally displaced positions. Searching for marks to aid these distinctions, Mr. Smith was quickly led to perceive the constancy with which certain classes of organic remains accompanied only particular layers or strata. By collecting these fossils, and placing them in relative order, as they were found lying in the earth, he was soon able by their aid to 'identify' the strata near Bath; to declare, regarding all these stratified rocks; that they had each formed 'successively the bed of the sea,' and contained each the remains of the creatures which then lived and died. These remains were different in different strata, because at successive times the forms of life had changed, and because of the influence on life of the different mineral constitution of the sea's bed; but they were generally identical in distant parts of the same strata.

With these ideas clearly established, Mr. Smith, in 1794, was enabled, by one long journey through great part of England and Wales, to generalise the propositions, and to commence, as an obvious consequence of such views, a 'Geological Map of England and Wales,' and a 'Table of Superposition of the Strata.' This table was drawn up in 1799; a map on a small scale was coloured in 1801; and the author promised in that year a valuable volume to accompany documents so new and important. The originals of these documents are fortunately preserved. It would be painful to speak of the discouragements and difficulties which Mr. Smith had to overcome before, in 1815, on a large and handsome scale, appeared the 'Delineation of the Strata of England and Wales,' with an interesting memoir. These difficulties were often generated by his own unmeasured zeal in prosecuting his favourite science. To it all the considerable profits of a successful profession were freely devoted; and not even in later years, when he had to suffer the consequences of such devotion, was he ever known to regret this inconvenient profusion.

After giving to the world 21 geologically-coloured maps of English counties, many valuable sections, and two unfinished volumes on Organic Remains, Mr. Smith was for many years lost to science till drawn from his retirement by the Geological Society of London, which, in 1831, awarded to him the first medal placed at their disposal by the bequest of Wollaston, 'in consideration of his being a great original discoverer in English geology; and especially for his being the first, in this country, to discover and to teach the identification of strata, and to determine their succession by means of their imbedded fossils.'

In 1835 he received the degree of LL.D. in Trinity College, Dublin, and during a few years he enjoyed a pension of 100*l*. At his death, a vast mass of unpublished papers, many of which are of uncommon merit and bear on practical applications of geology, constituted his whole property. (Fitton, in *Edinb. Review* for 1817: Sedgwick, *Address to Geol. Soc.*, 1831; *Magaz. of Nat. History*, 1839.)

SMITH. Several English artists of this name may be briefly mentioned. JOHN SMITH, a contemporary of Kneller, after whom he engraved many portraits, was by far the best mezzotinto engraver of his time. His works are very numerous, and comprise not only portraits, but historical and miscellaneous subjects also. The 'Biog Univ.,' without referring to any English authority, gives 1654 as the date of his birth, and 1719 as that of his death; and several other works state that he died in 1720. The writer has however seen a print with his name, bearing the date 1721. From Dallaway's edition of Vertue's 'Catalogue of Engravers,' it would appear that there were two engravers of this name, father and son; but this statement rests, as far as we know, on no other authority. A note in the work referred to mentions a collection of 574 engravings by these artists. Of the more eminent John Smith (if there were really two) there is a portrait by Kneller. Strutt mentions an indifferent portrait engraver named JACOB SMITH, who was living in 1730, and executed portraits of Sir Isaac Newton and Sir Hans Sloane, each of which consisted of a single spiral line; and GABRIEL SMITH, who died in 1783, and excelled in the chalk style of engraving. He lived for some time in Paris, but was a native of London, where, according to the 'Biog. Univ.,' he was born in 1724. SAMUEL SMITH, a landscape engraver, surpassed by few, if by any, lived in the latter half of the eighteenth century. He engraved a beautiful plate of Wilson's 'Niobe,' which is now in the National Gallery; the figures were put in by Sharpe. He also did the landscape to Sharpe's 'Holy Family,' after Sir Joshua Reynolds, and some engravings from Loutherbourg. As he worked much for other engravers, his name is comparatively unknown. We have been unable to find the date of his birth or death, and know nothing of his history excepting that he never married. WILLIAM SMITH, born 1707, died 1764; GEORGE SMITH, born 1714, died 1776; and JOHN SMITH, born 1717, died 1764, were three brothers, natives, it is commonly stated, of Chichester, although Pilkington mentions Guildford instead of that place. The first painted chiefly portraits, and the others principally landscape. Although apparently self-taught, they attained a respectable standing in their profession.

SMITH, JOHN. [VIRGINIA.]

SMI'THIA, a genus of plants of the natural family of Leguminosæ, named in memory of Sir James Smith, founder and long president of the Linnean Society.

The genus Smithia consists of small plants with inconspicuous flowers, but the leaves are remarkable for their apparent sensibility on being touched, in which they resemble the sensitive plant. The genus is nearly allied to Æschynomene and to Lourea. The calyx is bipartite, the corol papilionaceous, the stamens in two equal bundles, the legume transversely articulated, plicate, and enclosed within the calyx. The species are found in warm parts of the world, as in New Holland and the plains of India, in the rainy season. As the periodical rains extend also to the Himalayan Mountains, and produce considerable uniformity of temperature and moisture, so a delicate Smithia is found at considerable elevations, as S. ciliata, figured by Dr. Royle in his 'Illustr. of Himalayan Botany,' from the lofty Mountain of Kedarkanta.

SMITHFIELD. [LONDON.]

SMOKE, the vapour arising from substances in a state of combustion. In its more extended sense the word smoke is applied to all the volatile products of combustion, which consist of gaseous exhalations charged with minute portions of carbonaceous matter, or soot; but, as often used in reference to what are called smoke-consuming furnaces, the term is frequently employed to express merely the carbonaceous matter which is held in suspension by the gases. It is important to bear this distinction in mind, as it involves a fact which appears to have been sometimes overlooked, namely, that however completely the soot may be destroyed, and the smoke be thereby rendered invisible, it still remains necessary to provide means of free exit for the deleterious gaseous matter which is evolved from the burning fuel.

The matters to be noticed under this head resolve themselves into two classes—such as effect the removal of smoke, especially from open fire-places; and such as bear upon the purification of smoke, either by consuming the carbonaceous matter, or by separating it from the more volatile gases.

*Removal of Smoke; Cure of Smoky Chimneys.*—The action of an ordinary chimney in conveying the smoke from a fire situated at its lower extremity is very simple. The air in the chimney, being rarefied by the heat, becomes lighter in proportion to its bulk than the surrounding atmosphere, and therefore rises, its place being supplied by fresh air forced in at the lower end by the pressure of the comparatively heavy cold air outside the chimney. A constant rising current is thus created, the force of which is sufficient to carry up with it any light bodies, such as the particles of soot which escape from the fire. The intensity of this current, or in ordinary language, the strength of the draught, depends much upon the height of the chimney; for it is evident that the higher a chimney is, within reasonable limits, the greater must be the difference between the weight of the column of hot air which it contains, and that of a column of cold air of equal elevation; and that the force with which the cold air enters the bottom of the chimney will be proportionate to the amount of such difference. It is also evident that the hotter the air in the chimney is kept, the more rapidly it will rise, and that it is therefore advisable to build chimneys in warm and sheltered situations, and to construct them of materials which will not readily part with the heat they may acquire. Hence chimneys act better when built in stacks, or when in the interior of a house, than when single, or when outside the walls, and it is especially desirable to avoid erecting them in situations exposed to cold north winds.

The circumstances which impede the proper action of chimneys, and occasion the annoyance of smoke in houses warmed by common open stoves, have excited the attention of many individuals, and form the subject of several treatises. Franklin analysed the subject very judiciously, and published a pamphlet, entitled 'Observations on the Causes and Cure of Smoky Chimneys,' in which he enumerated nine different causes, and suggested means for the cure of each. This little work, from which most of the following remarks are condensed, was originally printed in Philadelphia, but has been republished in England. The causes, with the remedies recommended by Dr. Franklin, are as follow:—

1. The want of a free supply of air to the bottom of the chimney. It is of little consequence how spacious the room may be into which the chimney opens, if the access of fresh air to the room be cut off. As the hot air escapes from the top of the chimney, its place must be filled by fresh air taken from the room. But if the entrance of the external atmosphere be prevented, every chimney-full of air abstracted from the room lessens the density of what remains, so that the draught will decrease until the air in the chimney and that in the room are of equal density, when it will cease altogether, and the smoke will no longer ascend. The case here supposed—that of the *entire* exclusion of fresh air from the room, never occurs in practice; but the same results are produced in a less degree wherever the means of access for the external air are insufficient for the supply of the chimney—a circumstance of frequent occurrence in new houses, where the carpenter's work is true and close. This inconvenience can only be remedied by providing openings for air commensurate to the demands of the fire. The area of the openings required for this purpose may be ascertained by opening a door or window just so far as to enable the smoke to pass off freely; and their situation should be chosen with reference to the comfort of the inmates, so as to avoid as far as possible any current of cold air passing through the room. Whenever it is practicable, the best situation for them is near the top of the room, and over the fire-place; because the entering air is then warmed by the warm air which rises to the top of the room, and becomes pretty generally diffused. In building new houses such an arrangement may be readily effected, and the air-passages may be conducted by the sides and back of the fire-place, so as to warm the air previous to entering the room. In other cases the object may be attained by leaving a window a little open at the top, or by long narrow openings above the window or immediately beneath the cornice. In either case Franklin recommends the fixing of a little inclined shelf just below the opening, to conceal it from view, and to direct the air towards the ceiling. Another plan occasionally resorted to is the use of a pane of glass in the window, hinged to the frame at its lower edge, and capable of being opened more or less as required; wings or side-pieces of glass being added to prevent the air from entering sideways. Sometimes, in lieu of one pane of glass, a number of strips of plate-glass, so arranged as to resemble a Venetian blind, are used; these being so placed as to throw the air upwards, by which means also the risk of rain beating in is avoided. The common ventilator, or *whirligig*, answers the same purpose, and diffuses the air in some degree by its rapid revolution, which is occasioned by the action of the current upon its inclined vanes; but it has the disadvantage of being unsightly, and also that of making a noise. It has been proposed to supply a chimney with air by passages opening immediately into its lower extremity; but any such arrangement, by diminishing the rush of air from the apartment, destroys the best safeguard against the entrance of smoke into the room.

2. Many chimneys smoke because the opening at the lower end is too large. The size of the opening should be proportioned to the height of the chimney; for while a small opening to a tall chimney increases the draught to an improper degree, and causes a wasteful consumption of fuel, a large opening to a short funnel will allow the smoke to escape into the room; because all the air required by the chimney may enter at one side of the opening, leaving the other side free from current, and therefore allowing the smoke to puff out. In such a case the draught is weakened by the coldness of the air which enters the chimney at such a distance from the fire as to be very little affected by it. This defect must be remedied by contracting the opening; and the necessary degree of contraction may be ascertained by covering the top or sides of the opening with boards until the smoke ceases to enter the room. Stoves are now made in such a form that a contracted opening is not necessarily mean in its appearance; the marble top and sides of the fire-place being of handsome dimensions, while the opening is contracted by ornamental iron-work. This fault in construction is still very common.

3. The third cause of defective action mentioned by Dr. Franklin is the funnel or chimney being too short. The same effect is produced when, as in some ill-contrived houses, the flue from an upper story is turned into one from a lower room; for in such a case, when a fire is burnt in the upper stove, the only available length of chimney, as far as draught is concerned, is that between the point of junction and the top of the funnel, because there is free access for air at the point of junction, from the lower part of the main flue. In like manner the length of the main flue can only be counted from the bottom to the point where the collateral chimney joins it, and brings in a supply of air. The inconvenience of such an arrangement may be somewhat diminished by a contrivance for closing the collateral flue when not in use. The shortness of a chimney may sometimes be rendered harmless by contracting the entrance, so that all the air entering it shall be highly heated, by passing immediately over the fire; but for kitchen chimneys, where large openings are indispensable, our author recommends the erection of two additional funnels, one on each side of the original one; each funnel having a distinct opening of moderate size, and those at the sides being provided with slides, so that one or both might be closed when not in use. One advantage claimed for this plan is, that the stack of three chimneys may be safely carried up to a greater height than a single funnel could be.

4. Different chimneys in the same house occasionally overpower each other. If we suppose two stoves, each having a distinct chimney, in a room without a sufficient supply of air from without, we may conceive that one fire

becoming stronger than the other, may overpower it, and obtain a supply of air down the chimney of weakest draught; the descending current of course blowing the smoke of the weaker flue into the room. Precisely the same effect will take place if the stoves are in different rooms, provided their be, owing to the opening of the doors, a communication between them. This will account for the common case of a parlour chimney smoking whenever the room-door is opened, although it may act properly when the room is closed, and thereby cut off from the effect of the kitchen chimney. The proper cure for this is the same as for the first-mentioned cause of smoking. If every room have a free supply of air from without, there will cease to be any probability of the chimney of one apartment overpowering that of another.

5. The next cause of failure in the action of a chimney arises from the situation of the house. If a house stand under the brow of a hill, or in the vicinity of a much higher building, the wind, passing over the higher obstacle, appears to beat down into the chimneys of the sheltered house, and so to prevent the exit of smoke. This may sometimes be remedied by raising the chimney, and in other cases by means of a cowl, or turning-cap, the opening of which always turns from the wind. The ordinary cowl is turned by means of a vane attached to its upper part; but one patented in 1831 by Mr Pollard is turned by wheels set in motion by the action of the wind upon the oblique vanes of a rotatory flyer; the apparatus resembling that used on a large scale for turning the upper part of a tower windmill. In the 'Mechanic's Magazine,' vol. xxiv., p. 121, is a description of a cowl in which the end opposed to the wind is not solid, but concave or funnel-shaped, and terminating in a small pipe. By this arrangement the wind passes through the centre of the cowl, and is supposed to assist in carrying away the smoke. The plan is stated to have proved successful in some cases that had been deemed incurable. Many other contrivances for the same purpose have been used, but only one other will be adverted to here. It consists of a square box placed on the top of the chimney, each side of which consists of a door, hinged at one edge, and connected, by means of an iron rod, with the door on the opposite side of the box or cowl, in such a way that when one door is closed by the force of the wind, the opposite one opens, and allows the smoke to escape. This simple apparatus, which is stated to be in common use at Glasgow, is described and represented in Hebert's 'Engineer's and Mechanic's Encyclopædia,' vol. i., p. 367. Franklin recommends, when a house is built in the immediate vicinity of a hill that is likely to produce the effect above described, that the doors should be made in the side nearest the hill, in order that the wind entering them may counterbalance the pressure in the chimneys, and so lessen its injurious effect.

6. Chimneys occasionally smoke from a cause just the reverse of that last described. This occurs when the chimneys are low, and stand between the wind and a high building, or neighbouring edifice, so that the air is dammed up, as it were, round about them. This case appears to be a very difficult one to deal with; for, owing to the pressure of the atmosphere resisting the escape of the smoke in every direction, cowls are of very little use. Raising the chimneys appears to be almost the only alternative.

7. Another cause of smoking is the injudicious arrangement of the door or doors of a room. If the door be on the same side as the fire-place, and occasion it to smoke by sending a current across the front of the stove, either it must be altered so as to open in the opposite direction, or a screen must be used between it and the stove.

8. Smoke is sometimes blown down a chimney which is out of use. This arises from the circumstance that a stack of chimneys usually maintains a more uniform temperature than the surrounding air. So long as their temperature exceeds that of the external atmosphere, though it may be in a very trifling degree, there is an *upward* current through them: but when, as in the middle of the day, the air generally becomes warmer than that in the chimneys, the current moves *downward*, carrying with it smoke that may happen to be passing over, or escaping from a neighbouring flue. A plate or register, closing the bottom of the chimney when out of use, obviates this inconvenience. It is also very useful in affording ready means of regulating the draught of the chimney, and thereby economising fuel, and avoiding unnecessary currents of air through the room.

9. Lastly, chimneys which under ordinary circumstances perform very well, occasionally smoke in consequence of the passage of a strong wind over them, which the force of the rising vapour is insufficient to cope with. Franklin states that in Venice it was customary to make the top of the flue funnel-shaped, with a view to facilitate the escape of the smoke under such circumstances; but that where he lived a different practice prevailed,—that of reducing the opening at the top to a long narrow slit. Probably a cowl might be of use in such a case.

Although Franklin states that he found smoke generally tractable, when dealt with in a proper way, and that he could make it escape in almost any direction he chose, he met with some very puzzling cases. In one instance where a chimney resisted all appliances, it was discovered that, owing to the irregular settlement of the brickwork, it had a large fissure which admitted the cold air. In another case a chimney on which several experiments had been tried, proved to be choked up by the building of birds' nests. Similar instances still occasionally baffle the *smoke-doctor;* but most smoky chimneys may be accounted for by one of the above causes, and remedied by the means suggested.

*Consumption or Purification of Smoke.*—The nuisance occasioned by the smoke of coal-fires has formed a subject of complaint from the earliest times in which mineral fuel was extensively used; and the great increase of steam-engine and other furnaces, consequent on the extension of manufactures, has afforded, of late years, additional ground for attempts to abate the nuisance. Such attempts are important, not only for the purification of the air, but also for the economy of fuel; since the matter which gives smoke objectionable density and colour is unconsumed fuel in a finely divided state. It appears therefore that if a supply of air could be thrown into a fire in such a way as to occasion the combustion of the carbonaceous matter, the result would be that a greater amount of heat would be obtained from a given quantity of fuel, at the same time that the nuisance of smoke would be abated. But while this is true in theory, and almost every scheme brought forward for the, so-called, consumption of smoke lays claim to great advantages on the score of economy, it seems that no important saving has yet been effected in practice. Even an act of parliament, passed in consequence of the Report of a Select Committee appointed in 1819 and 1820, 'to inquire how far it may be practicable to compel persons using steam-engines and furnaces in their different works, to erect them in a manner less prejudicial to public health and public comfort,' though it has afforded the means of removing the nuisance in some instances, has failed to relieve our manufacturing towns generally from the murky exhalations of furnace-chimneys, notwithstanding the recorded opinion of the committee that the object sought after—an efficient means of destroying smoke—had 'been satisfactorily and effectually obtained.'

It may be observed that the quantity of smoke emitted from furnace-chimneys varies much with the state of the fire; being greatest when a mass of fresh fuel is thrown on, and least when the fire has burned clear, or the fuel is fully ignited. Attention to this circumstance, on the part of the stoker, will greatly diminish the nuisance; because if he throw on the fresh fuel in a thin layer, it will the sooner become perfectly ignited; and, by laying it in the fore part of the furnace, the dense smoke arising from it has to pass over that part of the fire which is in a state of more perfect combustion, and is thereby in a great measure consumed. Many of the contrivances introduced or suggested as smoke-consuming furnaces act on these principles; arrangements being adopted to insure the right feeding of the fire without much attention on the part of the firemen. In the apparatus of Mr. Steel, for instance, which is fully described and represented in the Report of the Parliamentary Committee of 1819, the fuel is supplied in a constant stream, by means of an inclined hopper; the quantity of coal supplied in a given time, and the size of the pieces, being regulated by means of a grooved roller; while it is distributed all over the furnace by the motion of the grate itself, which is of a circular form, and turns on a central pivot. A similar method of feeding the fire is adopted in Brunton's patent apparatus, of which an account will be found in the same Report. In some furnaces of the more usual form a similar object is aimed at by inclining the grates, or making portions of them moveable.

It is usually stated that the first important attempt made in this country for the combustion of smoke was that of Watt, who obtained a patent in 1785 for a method of constructing furnaces in such a way as to cause 'the smoke or flame of the fresh fuel, in its way to the flues, or chimney, to pass, together with a current of fresh air, through, over, or among fuel which has already ceased to smoke, or which is converted into coke, charcoal, or cinders, and which is intensely hot; by which means the smoke and grosser parts of the flame, by coming into close contact with, or by being brought near unto, the said intensely hot fuel, and by being mixed with the current of fresh or unburned air, are consumed or converted into heat, or into pure flame, free from smoke.' Since that time innumerable plans have been brought forward for introducing the necessary supply of air to the furnace: but while many of them accomplish the purification of the smoke as completely as could be desired, they are generally found either to increase the consumption of fuel, or to weaken the draught of the furnace. If the air admitted to the furnace be cold, it diminishes the heat of the fire; and if hot, expense is incurred in heating it, whether this be effected by a separate fire or by passing the air in pipes through the chimney. Without pretending to enumerate the plans that have been tried, even within the last few years, allusion may be made to the experiments of Mr. Chanter, especially as applied to the use of coal in locomotive engines. Most railway companies are required, by their acts of incorporation, to avoid the emission of smoke from their engines; and this is usually done, at great expense, by the use of coke. The plain of Mr. Chanter, which has been tried with great promise of success, consists in the introduction of a *deflector* dipping into the burning fuel, which compels the smoke from the crude coal to pass through a mass of burning coke, which is supplied through a small door, and conducted at once to the back of the furnace. By this means three parts of coal may be used to one of coke, with very little risk of much smoke.

Another mode of destroying smoke, which appears to answer the purpose very completely, is by injecting steam into the furnace. The plan has been tried by several individuals; but the apparatus which has attracted most notice is that of Mr. Iveson, in which the steam is thrown into the fire in several minute jets, from a fan-shaped distributor in the fore part of the furnace. The steam not only destroys the smoke, but also greatly increases the intensity of the fire; so much so, indeed, as to sanction the supposition tnat the steam is decomposed, and that its component gases are consumed. Thus the necessity for a large chimney is obviated, it being only necessary to provide a small passage for the escape of the gaseous products of combustion. Experiments on the same furnace, with and without the injection of steam, indicate a saving of fuel to the amount of thirty-three per cent.; the consumption in five hours being respectively 558 and 812 lbs. As a drawback from this saving, the plan requires, in a steam-engine furnace, about one-tenth of the steam generated, and in other furnaces renders necessary the erection of a small boiler. It is proposed, in high-pressure engines, to make use of the waste steam for the purpose of injection. A patent was obtained in 1838, by Mr. Chappé, for the use of a stream or shower of hot water thrown into the furnace in the same way.

Besides the numerous plans for the combustion of smoke, various methods have been tried on a limited scale for conducting it to a distance from the buildings in which it is formed, by means of subterraneous channels; and for condensing it by means of a shower of water, so that the sooty matter might be conveyed away by the sewers. Some interesting experiments on the purification of the noxious smoke emitted from copper-smelting furnaces, are detailed in Gill's 'Technical Repository,' vol. iv., p. 1, &c. Without offering any opinion as to the means best adapted for the purpose, it may be observed that some simple and economical method of destroying the nuisance of smoke, from private houses as well as from factories and steam-vessels, would tend greatly to the salubrity and cleanliness of large towns, and will probably soon be introduced.

SMOKE-JACK, an apparatus believed to be of German origin, by which the rising current in a chimney, acting upon the inclined vanes of a wheel fixed in the funnel, gives motion, through a train of wheels, to any matter which is hung before the fire to roast. This contrivance is now almost superseded by jacks impelled by the descent of a weight or the uncoiling of a spring. The smoke-jack appears to be of early origin; for it is stated in the fourth edition of the 'Encyclopædia Britannica,' on the authority of Messinger, that it is represented in a painting at Nürnberg, which is known to be older than 1350.

SMOLENSK, a government of the Russian empire, was acquired by Russia from Lithuania in 1654. It is situated between 53° 12′ and 56° 30′ N. lat., and between 30° 20′ and 35° 20′ E. long., and is bounded on the north-west by Pskow, on the north-east by Twer, on the east by Moscow, on the south-east by Kaluga and Orel, on the south by Czernigow, on the south-west by Mohilew, and on the west by Witepsk. The area is 20,000 square miles, and the population 1,200,000.

The country is an undulating plain, broken only by low hills. The soil is clay, mixed with sand and black mould. Some parts are very fertile, and all well repay the expense of cultivation. The country forms an elevated table-land, and a part of the Alauman Hills extends into it from the north-west, and contains the sources of several considerable rivers. There are many marshes. The principal rivers, are: 1, the Dnieper, which rises in the marshes, but though swelled by the junction of several other rivers, is shallow and not navigable in this government; 2, the Obscha; 3, the Mischa; 4, the Kaspla, which run in a westerly direction to the Düna; 5, the Ugra, which flows eastward to the Oka; 6, the Gshat, and 7, the Wasuga, both which run into the Volga. There are, it is said, 150 lakes, but none of considerable extent, and many morasses. As the country lies so high, the climate is colder than that of other provinces in the same latitude. The frost in winter is very severe, and the ice does not break up till April; on the other hand, the heat of the summer months is very great, vegetation luxuriant, the weather not changeable, and the air healthy.

*Natural Productions; Agriculture; Manufactures; Trade.*—The government produces corn (especially rye), about four million chetwerts in a year, hemp, flax, tobacco and hops, culinary vegetables, and some fruit, but the wealth of the country consists chiefly in the immense forests, which supply timber for the use of the province itself, and also for the navy, particularly fine masts, which are sent to Riga. These forests abound in game of all kinds; elks, deer, wild boars, wolves, bears, and lynxes are found in them, and prodigious quantities of wild birds. Much attention is paid to the breed of horses, which are of a good Lithuanian race. Oxen are used in agriculture as well as horses; and great numbers are fattened for exportation. Swine are very numerous, but sheep do not appear to thrive. The fishery is of no importance; the quantity of sturgeon, shad-fish, &c. does not exceed four thousand poods in a year, and the profit is not above seven thousand rubles. The country-people have great numbers of bees. The minerals are copper, salt in abundance, and bog-iron. Though Smolensk is not among the manufacturing provinces of the empire, the inhabitants being chiefly engaged in agriculture and rural occupations in general, the country-people manufacture linen and woollen cloths. The Smolensk carpets are in great repute, and employ a large number of looms, which are mostly worked by the women. There are numerous saw-mills, brandy distilleries, tanneries, soap and candle manufactories, and some glasshouses.

The exports of this government are corn, flour, groats, peas, hemp, and flax of superior quality, some hemp-seed and linseed and oil, horse-hair, hides, hogs' bristles, wool, honey, wax, masts to Riga, timber and firewood to the Dnieper, boats made for the navigation of the Oka, the Volga, and the Düna; horses, oxen, swine, salt pork, tallow, and lard. Most of the articles are conveyed by land to Riga, Wilna, and Moscow; a great part of the cattle are driven to Poland, and thence to Germany, and the timber is floated down the rivers which fall into the Düna, the Oka, and the Volga. The imports are colonial produce, wines, fine manufactured goods, and various articles, which, if they cannot be called necessaries, nor yet designated as luxuries, are however nearly indispensable to the comfort and convenience of civilized life. The principal commercial towns are Wiäsma and Gshatsk. Smolensk, situated on the main road to Moscow, likewise takes an active share in the foreign commerce, but is chiefly engaged with inland and retail trade.

*Religion and Education.*—The great majority of the inhabitants are of the Russian-Greek church, under the bishop of Smolensk, whose diocese is co-extensive with the government, and has 608 parishes. The Poles, Jews, and Germans are few in number. For public instruction Smolensk is under the University of Moscow, but education is very backward. In 1832 there were only 18 civil schools, with 45 teachers and 1097 scholars; 8 ecclesiastical schools, with 27 teachers and 1534 scholars;—total, 26 schools, 72 teachers, 2631 scholars; so that there was only one scholar out of 450 inhabitants. Many schools have been since founded, but we have not the specific official accounts. The government is divided into twelve circles.

SMOLENSK, the chief town of the government, is in 54° 50′ N. lat. and 32° E. long., on the right bank of the Dnieper, which is there navigable, and over which there is a wooden bridge. It is the key to the interior of the Russian empire, on the road to Moscow, and is strongly fortified; it is surrounded with a wall 30 feet high and 15 feet thick, nearly two miles in circuit, and has a strong citadel. Smolensk is one of the most antient towns in Russia, and the date of its origin is not known. Its name occurs in the Russian Annals as far back as 879. It was subsequently an independent principality, and from the beginning of the thirteenth century suffered by the attacks of the Russians of Kieff, of the Tartars, and the Lithuanians. The Lithuanians obtained possession of it in 1413. In the next two hundred and fifty years it was repeatedly taken and retaken by the Poles and Russians, till it was finally taken by the latter in 1654, and formally ceded to them by Poland by the treaties of 1667 and 1686. It was then strongly fortified. In 1812 the first serious conflict between the army of Napoleon, and the Russians, under Barclay de Tolly, took place on the 16th and 17th of August, under the walls of Smolensk, when it was bombarded and set on fire. Two-thirds of the town were reduced to ruins. The Russians stated their loss at 4000 men; that of the French was 8000, and that of the Poles 5000. The Russians could not pardon Barclay de Tolly for giving up this holy city, as they call it, without a pitched battle. On the disastrous retreat of the French in November, they blew up part of the works. In 1813 there remained only 459 habitable houses, and 317 capable of being repaired. The number of the inhabitants was reduced to 4000. Smolensk, though not a handsome city, is now much superior to what it was before 1812, when it was almost entirely built of wood. The part rebuilt since that time is more regular; the houses generally of stone, and many of them handsome. The public buildings are numerous; there are sixteen Greek churches, three convents, one Roman Catholic and one Lutheran chapel, numerous charitable institutions, a gymnasium, a seminary for priests, a military school, &c. The manufactures are linen, leather, silks, hats, and soap; and the inhabitants carry on a brisk trade in their own manufactures and in the natural productions of the country. The population at the lowest estimate is now 12,000; some late writers state it at 20,000.

WIASMA, about 110 miles from Smolensk, on the road to Moscow, is a considerable town, with 12,000 inhabitants. It is situated on the river of the same name, and is built on a hill, and surrounded with a wall. There being large vacant spaces, it covers a great extent of ground, so that viewed at a distance it looks much more considerable than it really is, an illusion which is aided by the steeples and domes of nearly thirty churches.

PORETSCHJE on the Kaspla, which is here navigable, is a town with 6000 inhabitants, 50 miles from Smolensk. It has a considerable transit trade, and is the staple place for the commerce between Smolensk and Riga.

DOROGOBUSCH, on the Dnieper, is a pretty and well-built town, with 4000 inhabitants, who have some manufactures and considerable trade.

SMOLLETT, TOBIAS, was born in the parish of Cardross, in 1721, of good family; his grandfather, Sir James Smollett of Bonhill, upon whom he was left dependent, being a member of the Scottish parliament. The lovely scenes among which he was bred had no doubt considerable influence on his tastes and feelings; and he describes them in 'Humphrey Clinker' with great relish. He was sent to school at Dumbarton, where, under Mr. Love, he made great proficiency in the classics. His tendency to ridicule was manifested very early, and he wrote abundant satirical verses on his schoolfellows; and he also, with a boyish patriotism, wrote a poem on 'Wallace,' which has been lost. He left Dumbarton for Glasgow, where he chose the profession of medicine, and was apprenticed to Mr. Gordon, surgeon, whom Smollett is supposed to have ridiculed as Potion, in 'Roderick Random.'

His medical studies were but indifferently pursued: the more attractive pursuit of literature and history—the passion for miscellaneous reading which so often besets men of genius, unable to confine themselves to any one branch of study—and which so materially assisted him in his subsequent literary career—diverted his attention. Satirical verses; practical jokes, prompted by a wild reckless spirit of enjoyment; poetical and literary studies; fruitless endeavours to give the proper direction to his energies; these occupied, not quite unprofitably, his early years. Before completing his eighteenth year he finished a tragedy called 'The Regicide;' the preface to which, written ten years after, is perhaps the most amusing portion. It would be unjust to require in such a production any of the requisites of tragedy; it would be unjust to object to so prosaic a man as Smollett, that it is only stilted prose; and it would be still more unjust to criticise it otherwise than as the production of a boy; but when we find him in his preface railing at the managers, and looking on himself as a very ill-used man because it was not produced; and when we look at this tragedy, which he brought with him to London in the hopes of making his fortune, we cannot wonder at the tricks of managers, nor at his being reduced to 'print it, and shame the rogues.'

In 1741 Smollett was appointed surgeon's mate on board a ship of the line, and he sailed on the expedition to Carthagena. He describes this expedition in 'Roderick Random,' and also with historical accuracy in the 'Compendium of Voyages and Travels' which he published in 1756. He quitted the service in disgust whilst in the West Indies, and resided for some time in Jamaica, in what capacity is not known. It was here that he met and fell in love with Anne Lascelles, whom he subsequently married. On his return to London, 1746, his imagination was inflamed at the exaggerated descriptions of the severities practised in the suppression of the Scottish rebellion, and accordingly vented itself in some stanzas of prosaic fustian, entitled the 'Tears of Scotland.' 'His friends wished him to suppress this piece, as having a tendency to offend the Whigs, on whose patronage he had some reliance; and although his enthusiasm was at present too warm for advice, and he had from this time declared war against the Whig ministers under George II., yet it does not appear that it was published with his name for many years after.'

'Advice,' a satire, was his first appearance in public, in 1746. It has all the dirt and vehemence of Juvenal, with none of the power; it alarmed and disgusted his friends, increased his enemies, and enraged the persons attacked. He wrote also an opera for Covent-garden, called 'Alceste.' But his ungovernable temper was perpetually provoked at the delays and hindrances of a theatre, and a quarrel with the manager prevented its being acted. The next year he again disgraced himself by a satire, the 'Reproof,' a sequel to the 'Advice,' and of the same stamp, with some bitter lines on Rich, the manager of Covent-garden. It is curious to see how he quarrelled with all the managers, and thus for ever shut the theatres against him; and not content with quarrelling, he abused and ridiculed all who did not agree with him on the merit of his pieces. Garrick, Lacy, Rich, Quin, Akenside, Lord Lyttleton, were all introduced by him into his novels and satires, and made to pay the penalty of having offended an author's vanity. In this year, 1747, he married Miss Lascelles, who was to have had three thousand pounds, but owing to a suit he obtained only a small portion of this dowry. This disappointment, together with sundry extravagances he had been led into, placed him in a very unpleasant pecuniary position, to relieve which he published, 1748, 'Roderick Random,' the first and best of his novels. It is an admirable novel, and one which must ever be a favourite. The style is easy and unaffected: the incidents rapid, varied, but loosely connected and often purposeless. The humour is broad, palpable, and coarse—mostly of a physical nature, and deriving its force from external circumstances; for instance, Roderick's 'carrotty locks, which hung down over his shoulders like a pound of candles'—the adventure of Strap and Mrs. Weazle (which bears some resemblance to Chaucer's 'Reve's Tale')—Strap's ignorance of London, and the adventures and blunders which arise therefrom. Smollett's humour is essentially vulgar, but hearty. He exhibits, as Hazlitt said, the ridiculous accidents and reverses to which human life is liable, not the 'stuff' of which it is composed. Smollett does not probe to the quick, as Fielding does, nor penetrate beyond the surface. He has great knowledge of 'life,' especially in its worst shades, but little of 'character.' He knows the peculiarities of men better than their motives; their eccentricities better than their natures. In a word, he has a ready eye to seize the superficial distinctions of manner and appearance, but little insight into the passions and character. Here lies Fielding's superiority. On the other hand, he has a 'rude conception of generosity in some of his characters, of which Fielding seems incapable, his amiable persons being merely good-natured. It is owing to this that Strap is superior to Partridge; as there is a heartiness and warmth of feeling in some of the scenes between Lieutenant Bowling and his nephew, which is beyond Fielding's power of impassioned writing.' (Hazlitt's *Comic Writers*, p. 238.)

In 1750 Smollett went to Paris, but his prejudices against the French and his ignorance of their language rendered his stay there a short one. The year after he published 'Peregrine Pickle,' which was greatly read and applauded. He received 'a handsome reward' for inserting the prurient and profligate memoirs of Lady Vane, and they form such a mere episode, we wonder they have not been expunged. It might suit the morbid vanity of the 'lady' to pay a large sum for the insertion of her memoirs in a popular novel; but what are we to say to the author who received the money for such a purpose?—one too who described himself as—

> 'Too coy to flatter and too proud to serve,
> Thine be the joyless dignity to starve.'

Having done it, we are not to be surprised at his 'flattering himself that he had expunged every adventure, phrase, an' insinuation that could be construed by the most delicate readers into a trespass upon the rules of decorum:'—the one was a consequence of the other. After 'Peregrine Pickle' was published, he resumed his medical profession, and announced himself as Dr. Smollett; but from what university he obtained his degree was a secret, and remains one. With this character however he endeavoured to set up in Bath, and published a pamphlet on the 'External Use of Water.' Nobody however seemed inclined to trust their healths with the 'popular author'—reputation, unless exclusively professional, being a greater drawback to success than the most profound stupidity. Disappointed therefore in this design, he again took up the pen as a profession, and fixed himself in Chelsea, where he wrote the 'Adventures of Ferdinand Count Fathom.' This novel has not been relished so much as the others, and with reason; the subject and characters are disgusting, and the story is tedious and spun out. There is however some biting satire on the follies and vices of the world, and some powerful writing in it. The robber-scene in the forest is a masterpiece of effect.

In 1755 he published by subscription his translation of 'Don Quixote;' this translation, which has been so often praised, is worthless. Let any one compare it with the original, and he will be struck with its inefficiency. All the difficult passages are slurred over; Sancho's dry proverbial humour is lost, by having a sort of conscious slang mixed with it; the exquisite gravity of the Don is lost—his use of antique heroic words, such as 'insula' for 'isla,' 'las fazañas que han fecho' for 'las hazañas que han hecho,' &c., is not represented; the melancholy and poetical shades of his character are not seized, and the whole becomes vulgarized. Lord Woodhouslee was the first to detect, in his 'Essay on Translation,' that Smollett had founded his translation on the forgotten one of Jarvis. He is said to have excelled Jarvis, but we think without justice. Jarvis had a greater knowledge of Spanish; and if his translation be dull, it is at least free from the vulgarity and Smollettism (so to speak) of Smollett, which the latter has contrived to infuse into his translation.

Smollett then visited his relations in Scotland, and on his return to London undertook the management of the 'Critical Review,' which was to oppose the 'Monthly Review.' His taste was vitiated and capricious, and his temper irritable: his jealousy bitter and watchful, and his vanity enormous. These were not the qualities desirable in an editor, and in consequence his power to offend, coupled with his delight in offending, disgraced the 'Review' with unseemly personalities. Among the many he attacked was Admiral Knowles, who brought an action against the printer of the 'Review' for a libel. Smollett, by applying to persons acquainted with Knowles, endeavoured to stop the action, but without avail, and when judgment was about to be pronounced on the printer, he stepped forward and declared himself the author, and was sentenced to pay 100*l.* and be imprisoned for three months. In 1757 he wrote the 'Reprisals, or the Tars of Old England,' a comedy, which Garrick, in spite of their old quarrel, produced on the stage, where however it had only small success. In 1758 he brought out his 'Complete History of England from the earliest times to the treaty of Aix-la-Chapelle in 1748. This was written in the space of fourteen months—a specimen, as it has been observed, of 'literary industry,' a specimen also of literary presumption. Neither his temper of mind nor his pursuits had qualified him to be an historical writer. But the work was written in a clear and easy style, and it was very popular, and was immediately reprinted in 8vo. weekly numbers, of which an edition of ten thousand was rapidly sold.

During his imprisonment he wrote the 'Adventures of Sir Launcelot Greaves,' a stupid and tedious imitation of 'Don Quixote.' But the characters of Crowe, Ferret, and Clarke are amusing. This novel was printed in detached parts in the 'British Magazine.' The success of his 'Complete History' induced him to continue it from 1748 to 1764. The volume for 1765 was written by Guthrie during Smollett's absence on the Continent. Smollett is also supposed to have written the accounts of France, Italy, and Germany for the 'Universal History.'

On Lord Bute's promotion to the administration, Smollett defended him against Wilkes in a paper called the 'Briton,' which Wilkes answered by his celebrated 'North Briton.' Smollett's paper was however soon discontinued and his services unpaid. About 1764 also, having mastered the French language, he was engaged in a translation of the works of Voltaire and a compilation entitled 'The Present State of all Nations.' In June, 1763, 'traduced,' as he sentimentally informs us, 'by malice, persecuted by faction, and overwhelmed by the sense of domestic calamity,' he went to France and Italy, and on his return published the result of his observations, 'Travels through France and Italy.' Splenetic and prejudiced, this work has long been forgotten. His increasing ill-health made travelling necessary, and accordingly he went to Scotland, and from Scotland to Bath, and in 1767 found himself considerably restored. His renewed vigour was shown in the 'Adventures of an Atom,' a violent political satire, wherein, under fictitious names, he abused ministers. But his health again requiring a milder climate, this 'independent writer,' this man too 'coy to flatter,' got his friends to solicit the very ministers whom he had satirized, for a consulship. It can occasion no surprise that this application did not succeed.

In 1770 however he left England again for Italy, writing on the way 'The Expedition of Humphrey Clinker,' a pleasant gossiping work, which has remained a favourite. 'It is quite as amusing as going the journey could have been; and we have just as good an idea of what happened on the road as if we had been of the party. Humphry Clinker himself is exquisite; and his sweetheart Winifrid Jenkins not much behind him. Matthew Bramble, though not altogether original, is excellently supported, and seems to have been the prototype of Sir Anthony Absolute in the "Rivals." But Lismahago is the flower of the flock. His tenaciousness in argument is not so delightful as the relaxation of his logical severity when he finds his fortune mellowing in the wintry smiles of Mrs. Tabitha Bramble. This is the best preserved and most severe of all Smollett's characters. The indecency and filth in this novel are what must be allowed to all Smollett's writings.' (Hazlitt's 'Comic Writers,' p. 239.)

In the neighbourhood of Leghorn he lingered through the summer of 1771, and died on the 21st of October, in the fifty-first year of his age. Stout, well-proportioned, and engaging in person; cold in his manners; impetuous, irritable, and unforgiving in temper; contemptuous and bitter towards all differences; hearty and loving in all sympathies; proud and yet mean; vain, yet generous; of quick, versatile intellect; considerable information; broad exuberant humour, and shrewd observation—such appears to have been Tobias Smollett. As a novelist he stands next to Fielding—as a poet he is not to be named—and in reference to his other works he must be looked upon as a mere bookseller's hack, writing for bread, with no other object than dispatch.

SMUGGLING is the clandestine introduction of prohibited goods; or the illicit introduction of goods by the evasion of the legal duties. Excessive duties present an overwhelming temptation to men to evade them; and the law loses a great part of its moral influence when it first tempts to violation of it and then punishes the offence. In parts of a country where a 'free trade' is extensively carried on, the smuggler is rather a popular person than otherwise; in some countries, as in Spain, still more than in England. His neighbours do not usually regard his mode of acquiring a livelihood disgraceful, but rather look upon him as a benefactor who supplies them with necessaries and luxuries at a cheap rate. 'To pretend,' says Adam Smith, 'to have any scruple about buying smuggled goods would in most countries be regarded as one of those pedantic pieces of hypocrisy, which, instead of gaining credit with anybody, serve only to expose the person who pretends to practise them to the suspicion of being a greater knave than the rest of his neighbours.' This is probably rather too strongly expressed; but many persons even attach a fictitious value to goods which have been smuggled, on account of their cheapness and supposed excellence; so much so, that articles which have duly passed through all the forms of the custom-house are frequently offered for sale as contraband. It is the crimes and the moral evils which are the offspring of smuggling that are to be dreaded rather than smuggling itself. The true remedy is a wise tariff. It annihilates at once a traffic which no ingenuity can ever put down; for all experience proves that so long as a profit can be made by smuggling sufficiently high to counterbalance the necessary risk, it will not fail to flourish. The decrees of Berlin and Milan, instead of annihilating commerce, only forced it into extraordinary channels. Silk from Italy, for example, instead of being received in England by the most direct means, often arrived by way of Archangel and Smyrna; in the former instance being two years, and in the latter twelve months on its passage. Sugar, coffee, tobacco, and cotton-twist were dispatched from England to Salonica, and thence conveyed by horses and mules through Servia and Hungary to Vienna, from which place they were distributed over the Continent, in defiance of the rigorous decrees of Napoleon: it might happen that coffee was consumed at Calais which, instead of being sent direct from London, arrived by the above circuitous route. The risks of this illicit traffic, and the enormous expense under which it was carried on, raised the price of sugar on the Continent to 5*s.* and 6*s.* per lb. The refined sugar was packed in small boxes made in England, and capable of containing about two cwts., so as to admit of one box being slung on each side of a horse or mule for the overland journey. (Tooke's *Hist. Prices*, i. 310.) The slave-trade may be mentioned as another instance of the impossibility of putting a stop to any traffic which is a source of great profit. The slave-traders of the Havanna gave from 35 to 40 per cent. as a premium of insurance on their African risks; but at this rate the assurance companies did not realise a profit, though they sustained no serious loss. This proves that nearly two out of every three adventures are successful; and as one out of three would at least have covered all loss, the difference makes a profit of at least cent. per cent. to the slave-dealer. Until this profit be reduced, the slave-trade cannot be effectually suppressed. (Turnbull's *Cuba*, 1840.) Whenever duties exceed 30 per cent. ad valorem, it is impossible to prevent a contraband trade.

We have only to examine the tariff of any country to know if smuggling is practised; and if a bad system of commercial policy has been long pursued, there the smuggler will be found. The *contrabandista* of Spain figures in novels and tales of adventure. In no country is the illicit trade so general and extensive. The exports to Gibraltar from England considerably exceed a million sterling per annum, and a very large proportion of British goods is introduced by smugglers into the interior. Mr. Porter states (*Progress of the Nation*, ii. 111) that nearly the whole of the tobacco imported into Gibraltar, amounting to from 6 to 8 million lbs. per annum, is subsequently smuggled into Spain, where the article is one of the royal monopolies. On the French frontier the illicit trade is equally active.

The vicinity of France and England, and the injudicious character of their respective tariffs, have encouraged smuggling to a large extent on both sides of the Channel. 1. Smuggling of French goods into England. Spirits, tea, tobacco and silk goods, and more particularly brandy, from the high duties imposed on it in this country, constitute the most important articles of the illicit trade. The total amount of duties evaded in 1831 by the smuggling of French goods into the United Kingdom was estimated to exceed 800,000*l.*, exclusive of tobacco, 'whole cargoes of which are sometimes introduced from the French bonding warehouses into Ireland.' (*Report on the Commercial Relations between France and England*, by Mr. Poulett Thomson (late Lord Sydenham) and Dr. Bowring.) The duty on tobacco in England is above 900 per cent.; and Lord Congleton states (*Financial Reform*) that three-fourths of the tobacco consumed in Ireland is believed to be supplied by smugglers. Mr. Porter, of the Board of Trade, proved before the Imports Duty Committee, in 1840, that 48 per cent. of French silks imported into England paid no duty whatever; and that the loss to the revenue in twelve years, from 1827 to 1838, amounted to 1,792,439*l.* In the Report just quoted, the loss to the revenue on smuggled French brandy was estimated, in 1831, as considerably exceeding 500,000*l.* a year. The duty is 22*s.* 6*d.* per gallon, and the smuggled brandy is usually 33 per cent. above proof, the proof being 22. Dunkirk, Calais, Boulogne, Fécamp, and Cherbourg are the head-quarters of the French smugglers, who in the northern parts of France are chiefly Flemings, and in the Channel ports Normans. The landing is usually effected during dark nights on the coasts of Kent and Sussex, or farther to the west, as may best suit their purpose. The premium on the illicit introduction of French goods into England was, in 1831, for gold trinkets, from 6 to 10 per cent.; silver, 10 to 12; silk goods and ribands, 22 to 25 per cent.; tea, 50 per cent.; and spirits 80 per cent. 2. Smuggling English goods into France. The extensive land frontier of France, and the offices for collecting the *octroi* duties in inland towns, give rise to some peculiarities in the smuggling-trade in France. It is not sufficient to land merchandise on the coast, as in England, but it has to pass the local custom-houses at the barriers of the large towns. This adds greatly to the difficulty and expenses of smuggling. It is stated that in 1831 the premium on landing English woollens on the French coast was 55 per cent.; at the barriers of Paris 63 per cent.; and within the walls 10 per cent. additional; making in all 73 per cent.; the premium on cotton goods being 65 per cent. English goods are chiefly introducted by the Belgian frontier, and the smugglers have their depôts at Cambray, St. Quentin, Ypres, Tournay, Mons, and other towns in the adjacent departments. In the Report of 1831, already quoted, it is stated that in that year the amount of British goods smuggled into France by this frontier exceeded 2,000,000*l.* in value; but if the ports on the Channel were included (of which no estimate is given), this amount would be greatly increased. Cotton-twist is the most important article in the illicit trade. Cotton-yarns, when once lodged in the manufacturer's warehouse, cannot be seized, and in consequence of the article being essential to the progress of manufacturing industry in France, the government, instead of reducing the duty, in some degree connives at its illicit introduction. Bobbin-net is extensively smuggled, also quiltings, cambric, and muslins; and tobacco is clandestinely introduced both by sea and land, the price of the inferior article produced under the royal monopoly being from 300 to 400 per cent. above the English and Dutch bonded prices. The smuggled tobacco finds its way to a great distance in the interior: at two or three leagues distance from the frontier it is 80 or 90 per cent. above the foreign prices, while at Amiens and in the inland towns it is 150 per cent. above the foreign price. A considerable quantity of fine cutlery is also smuggled. Smuggled sugar, coffee, and other bulky articles are consumed in the districts adjacent to the frontier. The agents of the smuggling companies regularly attend 'Change. They effect insurances to cover the risk of seizure, and make arrangements for the conveyance of smuggled goods into the interior. The houses importing these goods usually run from one-half to two-thirds of the risk; the rate of insurance varies considerably in the different custom house districts; and the goods are valued at from one-half to two-thirds of the cost price. On the Belgian north-eastern and eastern frontier dogs are trained to convey smuggled goods into France. They are of a large size, and carry from 22 to 26 lbs. each of tobacco and colonial produce, and sometimes cotton-twist and manufactured goods. A single dog has been seized conveying goods worth from 20*l.* to nearly 50*l.* These dogs are conducted across the frontier in packs, are kept without food many hours, then beaten, and at night-fall their load is fixed upon them, when they start for their destination, which is usually two or three leagues on the other side of the frontier. On their arrival they are well fed. From

1820 to 1830 not fewer than 40,278 of the smuggling dogs were destroyed, a reward of three francs being offered for each.

The nature of the frontier by which a country is bounded necessarily exercises considerable influence on the character of its tariff. It would, for example, be nearly impossible to prevent the smuggling of British goods into the United States on the Canadian frontier, if the duties on importation were excessive. This consideration has induced the legislature of Texas to raise the public revenue by direct taxation, and the importation of merchandize is charged with very trifling duties.

In 1822 the cost of preventing smuggling in England was enormous. The Preventive Service and the Coast Blockade were organized for this purpose, and were aided by a fleet of fifty-two revenue cruisers. In 1822 and 1823 there were captured on the English coast 52 vessels and 385 boats engaged in smuggling. For the half-year ending April, 1823, the cost of this department of the public service amounted to 227,145*l.*, and the seizures were valued at 67,000*l.* The Coast Blockade consisted of 1500 officers and seamen of the royal navy, who were employed on shore under the orders of the Admiralty; and the Coast Guard was under the authority of the Board of Customs. In 1832 upwards of 181,000*l.* had been expended in building cottages for the officers and men of the Coast Guard in Kent and Sussex. Lord Congleton estimated the total annual cost of protecting the revenue in 1831 at from 700,000*l.* to 800,000*l.* For several years frequent conflicts took place between the officers of the revenue and smugglers, the latter being generally aided by the country-people. In 1830 there were 116 persons under confinement in England, and 64 serving in the navy as a penalty for smuggling offences. The counties on the Scottish border were at one period rapidly becoming demoralized by smuggling, the duties on spirits being much higher in England than in Scotland. In two years 163 informations were laid in the counties of Northumberland and Cumberland for smuggling spirits. The duties being reduced more nearly to an equality, these evils ceased on the border; and the quantity of spirits charged with duty in Scotland rose from 2¼ million gallons in 1822, to nearly six million gallons in 1825. The reduction of the duties on silks, tea, and British spirits has done more to repress smuggling than all the efforts of the revenue officers aided by a large armed force. In 1841 the number of persons under confinement in England for offences against the Customs laws was 65, all for periods under six months, with two exceptions; and in Ireland there were none under confinement.

The direct cost incurred for the protection of the customs revenue was as follows in 1840:—Harbour vessels, 7250*l.*; Cruisers, 118,543*l.*; Preventive Water-Guard, 349,474*l.*; Land Guard, 19,662*l.*: total, 494,930*l.* The Board of Excise employs cruisers for the protection of the revenue collected under its authority, the cost of which amounted to 5458*l.* in 1840; and also a force in Ireland called the Revenue Police, whose maintenance in the above year cost 42,095*l.* The total charge for collecting and protecting the customs and excise revenues of the United Kingdom was 2,309,611*l.*; namely, 1,286,353*l.*, or 5*l.* 8*s.* 8¾*d.* per cent., for the customs; and 1,023,258*l.*, or 6*l.* 10*s.* 11½*d.* per cent., for the excise. In 1835 the number of persons employed in the department of the customs was 11,600; and in the excise 6072. The present Acts relating to smuggling are 3 and 4 Wm. IV., c. 53, and 4 and 5 Wm. IV., c. 13.

SMUT. [UREDO.]

SMYRNA, one of the most antient Greek cities in Asia Minor. There was an Old Smyrna (ἡ παλαιὰ Σμύρνα) and New Smyrna. The old town lay on the north-east side of the Hermæan Gulf, which is sometimes called the Gulf of Smyrna. According to some traditions it was originally an Æolian colony, and was afterwards taken possession of by some Ionian exiles of Colophon. (Herod., i. 16, 149.) Another account describes it as an Ionian colony of Ephesus, where a part of the old town is said to have borne the name of Smyrna from an Amazon of the same name. Afterwards however the Ephesian colonists are said to have been expelled by the Æolians, and to have fled to Colophon, whence a short time after they returned, and recovered their original home. (Strab., xiv., p. 633, &c.) This latter account is not only in itself the more probable, but also contains the elements out of which the other may have arisen. (See Thirlwall's *Hist of Greece*, ii., p. 93, in a note added to Schmitz's German transl.) After Melite, one of the Ionian towns, had been destroyed by the common consent of the others, Smyrna was admitted into the confederacy. This antient town of Smyrna was by some supposed to have been the birth-place of Homer; and in its vicinity, on the banks of the little river Meles, there was a grotto in which Homer was said to have composed his poems. The Smyrnæans were proud of this tradition, and endeavoured to propagate it. The Lydian king Sadyattes took and destroyed Smyrna, and distributed the inhabitants among a number of villages in the neighbourhood. (Strab., xiv., p. 646; Herod., i. 16.) In this state they remained, according to Strabo, for 400 years, after which the town was rebuilt with great splendour by Antigonus and Lysimachus, or, according to Pausanias (vii. 5, § 1), and Pliny (v. 31), by Alexander the Great. This new town however was 20 stadia distant from the site of Old Smyrna, and 320 stadia from Ephesus, and was situated on the north bank of the river Meles, covering the plain as far as the sea, and occupying also a part of a hill which Pliny calls Mastusia. It was adorned with several magnificent buildings, among which the Homereum was a square edifice surrounded by colonnades, and containing a temple and a statue of Homer. The streets were paved with stone, and built at right angles to one another; but as no sewers were constructed to carry off the water and filth, the streets were very dirty, especially in rainy weather. But notwithstanding this, the city was or soon became the finest and largest in Asia Minor. (Strab., xiv., p. 646; Marm. Oxon., n. 5.) When Asia Minor fell into the hands of the Romans, Smyrna became the seat of a conventus juridicus (Plin., v. 31), and flourished as a commercial town. It received various grants and privileges from the Romans as rewards for the part it took in the wars with Antiochus and Mithridates, as may be seen from several passages in Livy and Polybius. Trebonius, one of Cæsar's murderers, was besieged in Smyrna by Dolabella, who took the city, and destroyed a great part of it. (Strabo; Cic., *Philip.*, xi. 2.) But as in that most beautiful country even the heaviest calamities are soon got over, so Smyrna soon recovered and flourished as before. In the reign of Tiberius it received the honourable distinction of being allowed to erect a temple to the emperor. (Tacit., *Annal.*, iv. 56.) Christianity was early established here, chiefly owing to the zeal of Polycarp, who is said to have been the first bishop of Smyrna, and to have suffered martyrdom there. (Iren., iii. 3, 4, p. 176.) The whole neighbourhood of Smyrna appears in early times, as at present, to have been subject to frequent earthquakes; but that which occurred A.D. 178 visited the city most severely, and changed it into a heap of ruins, but it was restored by the emperor Marcus Aurelius. [ARISTIDES; ÆTIUS.] Before the introduction of Christianity the Smyrnæans worshipped chiefly the heroine Smyrna, Nemesis, Homer, and the mother of the gods, whose temple stood near the sea-coast, and whose head was represented upon several of their coins, as in that which is given below. (Eckhel, *Doctr. Num.*, ii. 537, &c.)

During the Eastern empire Smyrna again experienced several severe vicissitudes. Towards the close of the eleventh century it fell into the hands of Tzachas, a Turkish pirate, and was nearly destroyed by a Greek fleet under John Ducas. It was restored by the emperor Comnenus, but soon after fell into the hands of the Genoese, who continued in possession of it until the year 1364. In 1402 it was taken by Tamerlane, and suffered very severely. The conqueror erected within its walls a tower constructed of stones and of the heads of his enemies. Soon after it came under the dominion of the Turks, under whom it has always been the most flourishing city of the Levant, notwithstanding it has frequently been visited by earthquakes, fires, and the plague.

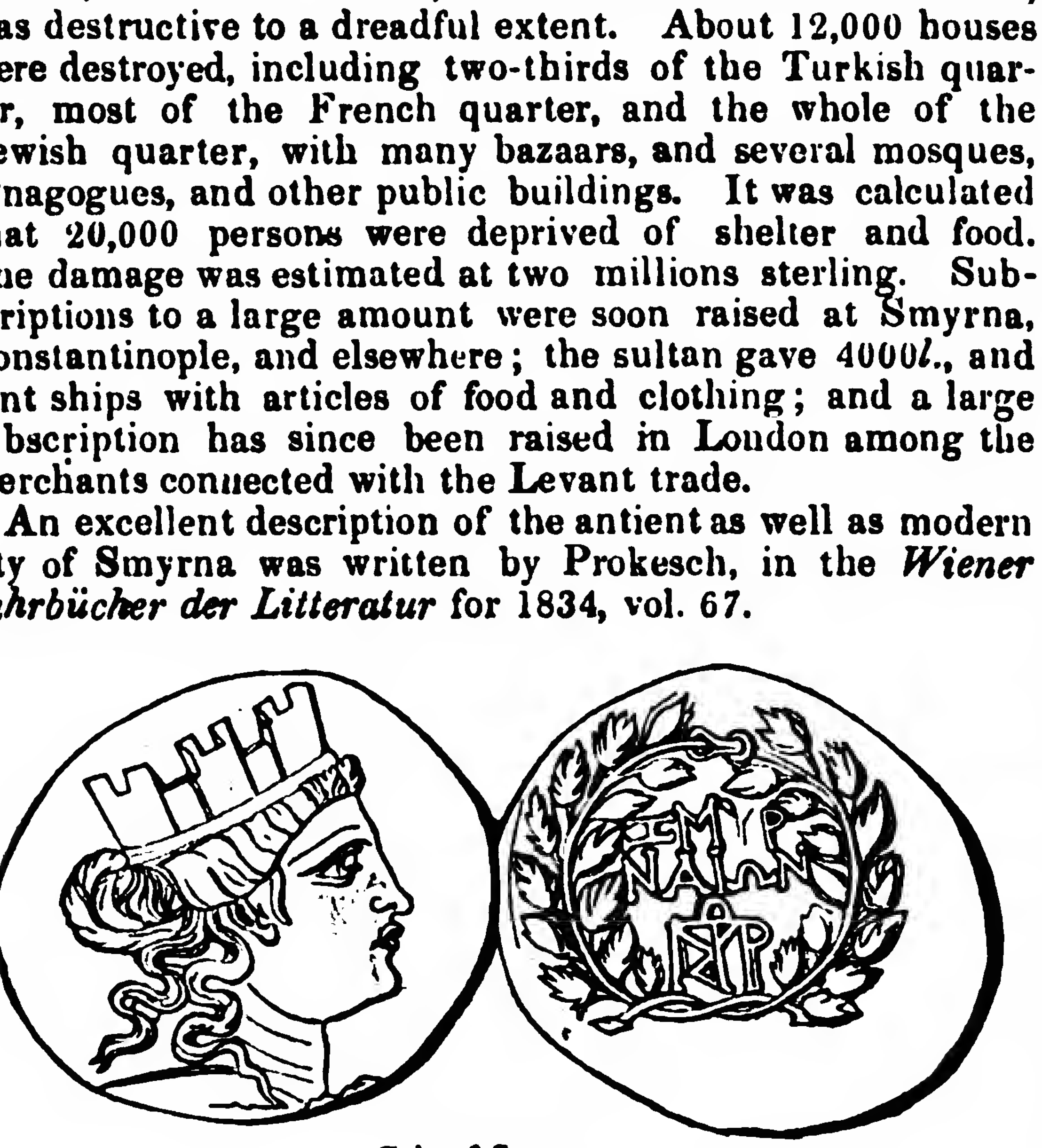
Smyrna, which the Turks call Izmir, is thus one of the very few antient cities which have survived to our times. At present it is the most important city of Asia Minor, and the centre of the Levant trade. Of her antient buildings however only very few traces remain. It rises in the form of an amphitheatre from the sea, and upon the hill there is an antient castle which forms the citadel; over one of the gates there is a head which either represents Apollo or an Amazon, and over another a Roman eagle.

The modern city of Smyrna is in 38° 25′ N. lat. and 27° 9′ E. long., about 210 miles south-south-west from Constantinople, direct distance. The situation is admirable, at the bottom of a capacious bay, with excellent anchorage, and so deep that large ships come close to the wharfs. The bay extends into the city, and its margin is lined with quays, on which there are handsome stone houses, so that the city, with its domes and minarets, has a fine appearance on approaching it from the bay; but a great part of the interior, and especially that part which is built on the side of the hill, consists of low wooden houses, and the streets are ill-paved, narrow, crooked, and dirty. The inhabitants are probably about 130,000, of whom about 70,000 are Turks, 30,000 Greeks, 12,000 Jews (the descendants of Jews who were expelled from Spain and Portugal), 7000 Armenians, and the remainder natives of various parts of the world, especially English, French, Dutch, and Italians, who reside there for purposes of commerce, and occupy, for the most part, the best quarter of the city near the bay. The port is frequented by ships from all nations, freighted with valuable cargoes both outward and inward. The greatest part of the trading transactions are managed by brokers, who are mostly Jews, the principals meeting afterwards to confirm the bargains. The chief imports are, coffee from America, England, France, &c.; sugar, chiefly from England and America; indigo, chiefly from England; tin, exclusively from England; iron, from England, Russia, Sweden, &c.; lead, from England and Germany; cotton-twist, from England; manufactured cotton-goods, from England, America, &c.; rum and brandy, spices, cochineal, and a variety of other articles. The principal exports are, silk, chiefly to England; opium, to England, America, and Holland; drugs and gums, mostly to England; galls, to England, Germany, and France; cotton-wool, valonia, and fruit; figs are brought to market early in September, and are only to be had at Smyrna, but raisins, which are ready early in October, are shipped also in large quantities from other neighbouring ports. Besides these exports there are various kinds of skins, goats' wool, olive oil, wax, and a variety of other articles. This large commerce has obviously arisen, not only from the advantageous situation of the port, but from the judicious and liberal policy of the Turkish government, which has imposed hardly any restrictive enactments, with few duties, and those extremely low.

Many of the European states have their consuls at Smyrna, such as England, Sweden, Prussia, France, Venice, &c. The city and its territory are governed by a pasha, and the revenues are raised by a muzelim.

About midnight, on the 28th of July, 1841, a fire broke out at Smyrna, which, from the crowded state of the wooden houses, the want of water, and the violence of the wind, was destructive to a dreadful extent. About 12,000 houses were destroyed, including two-thirds of the Turkish quarter, most of the French quarter, and the whole of the Jewish quarter, with many bazaars, and several mosques, synagogues, and other public buildings. It was calculated that 20,000 persons were deprived of shelter and food. The damage was estimated at two millions sterling. Subscriptions to a large amount were soon raised at Smyrna, Constantinople, and elsewhere; the sultan gave 4000*l*., and sent ships with articles of food and clothing; and a large subscription has since been raised in London among the merchants connected with the Levant trade.

An excellent description of the antient as well as modern city of Smyrna was written by Prokesch, in the *Wiener Jahrbücher der Litteratur* for 1834, vol. 67.



Coin of Smyrna.

British Museum. Actual size.

The female figure on the one side of this coin is the great mother of the gods; on the other side, within a crown of oak-leaves, we read ΣΜΥΡΝΑΙΩΝ; and underneath a monogram, the meaning of which is not clear. Eckhel is inclined to take it for ΠΡΥΤ., that is, Πρυτάνεις.

**SMY'RNIUM** (*σμύρνιον*), a genus of plants belonging to the natural order Umbelliferæ. It is known by its obsolete calyx; lanceolate or elliptical, entire, acuminate petals, inflexed at the point; didymous fruit, contracted at the side. The half-fruits are almost globose and reniform, with three fine prominent ridges on the back, and two on the side, but almost obliterated; the channels with many vittæ; the seed is involute; the species are upright smooth biennials with fleshy roots, various leaves, terminal umbels, and variable involucres. The flowers are yellow or yellowish-green, and are frequently polygamous.

*S. Olusatrum* (Common Alexanders) has a taper stem; the leaves of the stem are ternate, with ovate serrated segments, and very short involucels. It is a native of the middle and south of Europe in humid places. It is found in Great Britain, and is observed most frequently near the coast, although not confined to such a locality. This plant was formerly much eaten in Europe both as a salad and potherb, on which account, and the black colour of its stalks and leaves, it derives its specific name *Olusatrum*, from *olus* and *ater*. Ray says that this is the *Herba Alexandrina* of Italy and Germany, whence our name Alexanders. It is supposed to have been originally brought from Alexandria. It flowers in May, and the whole plant dries up by the middle of July, but remains laden with large black seeds.

*S. perfoliatum* (Perfoliate Alexanders) has the stem angularly winged above, with ovato-cordate toothed leaves, which embrace the stem. This plant was obtained in Greece by Dr. Sibthorp, and is also an inhabitant of Spain, Italy, and Dalmatia. It is the *Smyrnium Dioscoridis* of Sprengel; and Sir J. E. Smith was of opinion that this species is the true *σμύρνα* of Dioscorides, with whose description it remarkably agrees. (*Flora Græca*, p. 289.)

**SNAILS**, the English name for the SLUGS and shell snails. [HELICIDÆ.] N.B. The secretion of the so-called *saccus calcareus* of the snail and other molluscous animals has been found to contain uric acid. Consult the paper by Jacobson and De Blainville, *Sur l'Existence des Reins dans les Mollusques*, in the *Journal de Physique*, tom. xci., p. 318.

**SNAITH.** [YORKSHIRE.]

**SNAKE**, a term commonly applied to any serpent, but more particularly used to designate the common snake, *Natrix torquata*. [NATRIX.]

**SNAKEROOT.** [POLYGALA SENEGA.]

**SNAKEWOODS.** [STRYCHNOS.]

**SNELL, WILLEBRORD**, a Dutch mathematician and philosopher, was born in 1591, at Leyden, in the university of which city his father, Rudolph Snell, the author of several scientific works, was professor of mathematics. He at first applied himself to the study of the law, but he very soon abandoned that pursuit, and devoted himself to the mathematics. In these he early made great progress, and at seventeen years of age he published an essay, in which it was attempted to restore the lost treatise of Apollonius, 'De Sectione determinata.' The work is said to have possessed considerable merit, and to have procured for the author a reputation among the scientific men of that time, but it has lost its importance since the publication of the more complete restoration by Dr. Simson. [SIMSON, ROBERT.]

In order to acquire information relative to scientific subjects beyond that which his own country afforded, Snell travelled to Germany, where he obtained an introduction to Kepler. From the conversation of this mathematician, during the three years of his absence from home, he obtained a great accession to his knowledge of the sciences; he appears also to have acquired the esteem and friendship of the celebrated German, and he regularly corresponded with him during the rest of his life. On his return to Leyden, his father having resigned his post in the university, the young mathematician was immediately appointed to succeed him. From this time he applied himself to the fulfilment of the duties of his professorship, to the performance of philosophical experiments, and to the composition of the works which have procured for him a high reputation among the learned men on the Continent.

His first publication was an explanation of the monetary system of the antients, which appeared at Antwerp in 1613, in octavo, under the title, 'De Re Nummariâ Liber Singularis.' His second and most important published work was entitled 'Eratosthenes Batavus de Terræ Ambitûs verâ Quantitate à W. Snellio suscitatus' (Leyden, 1617): it contains a description of the method of determining the magnitude of the earth by trigonometrical operations, combined with the observed latitudes of the stations; and Snell has the honour of being the first who put in practice a method which has since been almost always adopted by those who have undertaken that great geodetical problem. He measured a base line on the ground, and observed with circular instruments the angles between the stations: he then by computation found the length of the terrestrial arc between Alkmaar and Bergen-op-Zoom, from which arc, with the difference between the observed latitudes of those places, he deduced the length of a meridional arc of one degree. The method possesses great advantages over the older process of actually measuring the whole length of the meridional arc with rods, or, as Fernel, in the beginning of the sixteenth century, is said to have ascertained it, by the number of revolutions made by a carriage-wheel. The imperfection of the instruments employed was the cause that some inaccuracies occurred in the performance of the operations; these were however discovered by Snell; and it is said that he intended to have given the necessary corrections in a second edition of his book, but he did not live to complete them.

He published, in 1619, a work, in quarto, entitled 'Descriptio Cometæ qui ann. 1618 primum effulsit;' and two years afterwards his 'Cyclometricus, seu de Circuli Dimensione,' in which is given an approximation to the value of the circumference of a circle by a method more short than that of Van Keulen. His next work (1624), called 'Tiphys Batavus,' constitutes a treatise on navigation; and in 1627, that is, after his death, Hortensius of Delft published his 'Doctrinæ Triangulorum Canonicæ Libri Quatuor,' which contains the theorems of plane and spherical trigonometry, together with rules for the calculation of sines, tangents, and secants.

According to both Vossius and Huygens, Snell was the first who made the discovery that if a ray of light be incident on a refracting surface, and be produced within the medium, the parts of the refracted ray and of the produced incident ray intercepted between the point where the refraction takes place and any line passing through them perpendicularly to the refracting surface, have to each other a constant ratio. This discovery, which is said to have been made in 1621, is no other than the now well-known law between the sines of the angles of incidence and refraction, which Descartes published in his 'Dioptrics,' in 1637, as the result of his own researches. The experiments by which Snell discovered the law were never published; but Huygens states that he had seen the manuscript containing an account of them; and Vossius relates that the heirs of Professor Hortensius communicated the contents of the manuscript to Descartes. It is therefore very probable that Descartes obtained the idea from the works of Snell, to whom Montucla, Bossut, and most of the English philosophers agree in attributing the honour of this important discovery.

After having suffered during several years from bad health, Snell died, October 31, 1626, when thirty-five years of age; his wife survived him only eleven days, and both of them were buried in the same grave.

SNEYDERS, or SNYDERS, FRANCIS, a painter, born at Antwerp in 1579, was a pupil of Henry van Balen, and for a time followed the style of his preceptor, confining himself to the representation of fruit, flowers, and other objects of still-life. He soon attempted the more difficult task of painting animals, in which, for freedom, truth, and energy, he became conspicuous, and for these qualities remains to this day, if not without a rival, at least inferior to no other artist. D'Argenville says that Sneyders went to Italy for professional improvement, and that at Rome he became an ardent admirer of the style of Benedetto Castiglione, from whose pictures he studied a considerable time. This statement is followed by M. Périès in the 'Biographie Universelle,' though the same work gives the date of Castiglione's birth as 1616. Mr. Bryan properly observes that the assertion of M. D'Argenville is not reconcileable with chronology, for the Flemish painter was thirty-seven years older than the Genoese; but how far he is justified in thence inferring that Sneyders did not leave the Netherlands is not so clear. During part of his career he lived at Brussels, having been invited there by the Archduke Albert, governor of the Low Countries, for whom he painted some of his finest works, particularly a stag-hunt, which was sent by the archduke to Philip III. of Spain, who was so charmed with the present, that he gave the artist commissions for several large pictures of huntings and other similar compositions, and which, down to a recent date, were in the old palace of Buen Retiro. Rubens although himself eminent as an animal painter, held the abilities of Sneyders in such admiration that he frequently entrusted that portion of his pictures, as well as the fruit and other similar accessories, to the masterly pencil of his brother-artist, and it would be difficult to point out any two masters who have worked in conjunction whose performances are in more perfect harmony than those of these eminent men. Jordaens too availed himself of the talents of Sneyders in a similar manner, and in a variety of instances both Rubens and Jordaens conjointly executed the human figures in compositions of Sneyders, and there are known to be several pictures in existence the joint production of these three great but friendly rivals. The works of Sneyders are in many of the best collections in England. One in the possession of the Marquis of Westminster, in Grosvenor House, London, representing a Bear Hunt, consists of a group of two bears and eleven dogs. This picture is stated, in Mr. Young's Catalogue of that collection, to have been painted for a noble family in Venice, and to have been sent to England about seventy years ago and purchased by the late Lord Grosvenor. M. Périès enumerates nine pictures by this master as being in 1825 in the museum of the Louvre, one of which contains the two lions afterwards introduced by Rubens into his picture of the Marriage of Henry IV. Although the works of Sneyders consist principally of boar and bear hunts, and other compositions of animals, views of interiors and subjects of still-life are by no means uncommon, though it is but reasonable to suppose that the chief number of these were executed soon after he had left the studio of Van Balen. Those however in which the human figures are painted by Rubens or Jordaens are of course of a later date. There is an admirable portrait of Sneyders by Vandyke, which was in the Orleans collection, and is engraved in the well-known series of heads after pictures by that master. There are, according to Mr. Bryan, a set of sixteen etchings of various animals by Sneyders, executed in a spirited and masterly manner. That there are a few etchings by him we know, but that they consist of so great a number as sixteen is very doubtful, for Bartsch in his catalogue does not mention even one as belonging to the extensive collection at Vienna, nor is there one by his hand among the prints formerly belonging to Mr. Sheepshanks, and now deposited in the British Museum, a collection confessedly rich in works, both with the graver and the point, by masters in the Flemish and Dutch schools. Although there are very few etchings by this eminent painter, there are many after his works. He died at Antwerp, in the year 1657.

(*Biographie Universelle;* Bryan's and Pilkington's *Dictionaries.*)

SNIPE, the English name for those grallatorial birds which belong to the second section of the SCOLOPACIDÆ [vol. xxi., p. 85], and form the genus *Gallinago*, Steph.

The Snipes most familiar to the English sportsman and ornithologist are the Common Snipe, the Jack Snipe, and the Solitary Snipe: Sabine's Snipe (*Scolopax Sabini*) is of very rare occurrence, and indeed the Solitary Snipe is far from common.

We proceed to illustrate this section by descriptions and figures of the Common Snipe and the Solitary or Great Snipe.

And first of the Common Snipe, *Scolopax Gallinago*, Linn., *Gallinago scolopacinus*, Bonap.

*Description.*—Normal number of tail-feathers fourteen, varying to sixteen (Brehm's Snipe), and twelve (Delamotte's Snipe). Upper parts variegated very nearly as in the Solitary Snipe; neck and breast striped longitudinally; sides striped transversely with white and blackish; middle of the belly and abdomen spotless, pure white; base of the bill ash-colour, the rest brown; feet pale-greenish; length about ten inches and a half, of which the bill measures about two inches and three-quarters.

The colours of the plumage, after the spring moult, are brighter and more brilliant with bronze reflections than after the autumnal moult: in winter the hue becomes more ashy.

*Varieties.*—Pure white; reddish-white; the feathers sprinkled or blotched with white, or some part of the plumage white.

This is the *Beccacino* and *Pizzarda* of the Italians; *Bécassine* or *Bécasseau* and *Chèvre volant* of the French; *Heer Schnepfe* and *Himels Ziege* of the Dutch; *Watersnep* of the Netherlanders; *Myr Snippe* of the Icelanders; *Horsgjok* of the Swedes; *Hossegioeg* of the Danes; and *Ysnittan y Fyniar* of the antient British.*

*Geographical Distribution.*—Mr. Gould (*Birds of Europe*) states, that, although the contrary has been long stated by naturalists, he conceives that the natural range of the Common Snipe is comparatively limited, and that the Snipes from India, Africa, and North America, which have been regarded as identical with our bird, will be found, on examination, to be specifically distinct; in the character of their plumage, he observes, they are indeed somewhat similar, but they nearly all present a different form in the feathers of the tail, and also a difference of number. The Prince of Musignano had, in his *Specchio Comparativo*, marked the North American bird with a ?, as identical with that found near Rome; and in his *Birds of Europe and North America*, the same identity is recorded, and the ? is withdrawn. Temminck says that an individual received by him from North America differs solely from those killed in Europe in the colours of the plumage, which are some shades brighter. He also states that the common snipe occurs 'jusqu'au Japon,' where, he remarks, the species is exactly the same, and has always fourteen feathers in the tail. Mr. Strickland notes it as abundant in Smyrna. It is said to be found in Lower Egypt.

The following localities have been given as the range of the common snipe in Europe and Asia:—Russia and Siberia, from Scona to Lapland, Norway, Sweden, Denmark, Faroe Islands, Iceland and Greenland, Germany, Holland, British Islands, France, Spain, Provence, Switzerland, Italy, Hungary, and Illyria.

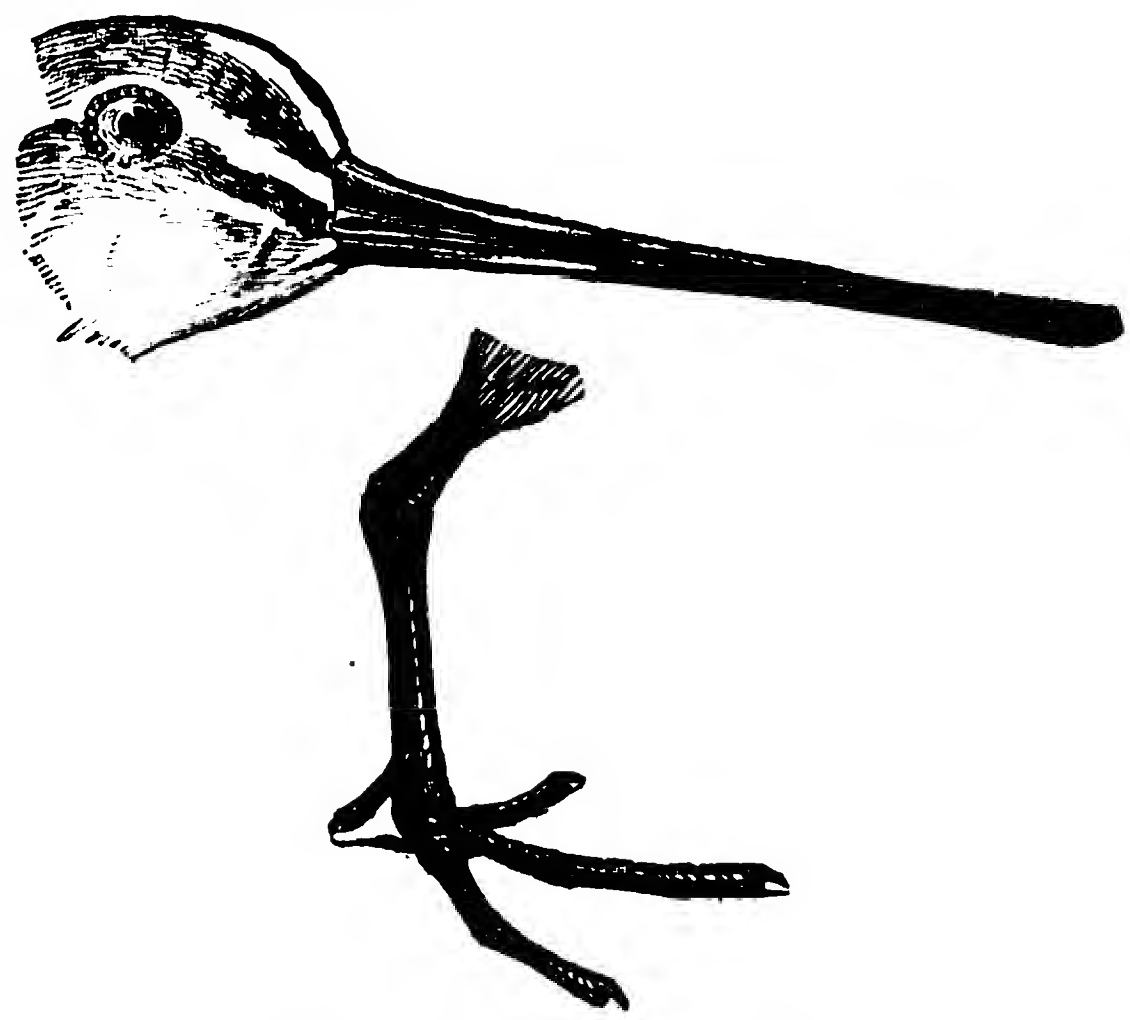
*Food, Habits, Nest, &c.*—Marshes, moist meadows, and, in frosty weather, the edges of rushy rills, are the haunts of the snipe. In such situations they have been seen pushing their bills, by means of repeated thrusts, quite up to the base in the mud, drawing them back with great quickness, and shifting their ground every now and then. Their food consists of such worms, insects, and small mollusks as haunt such miry places, and they have been shot in the act of feeding on leeches.

The bill of a fresh snipe presents above, at the end, and for some way up, a dimpled appearance, somewhat resembling the depressions on a woman's thimble: these little cells, which are continued into the bones of the upper mandible, are supplied by portions from two branches of the fifth pair of nerves. Thus this sensitive probe enables the bird to ascertain the presence of its prey, and to capture it securely, though hidden from its sight. The nest, which is rude and inartificial, being a mere depression in the ground under or upon a tuft of grass or rushes, scantily lined with dry grass or herbage, has been found among long grass by the side of small lochs, amid the long heather on the sides of hills, and in fens among rushes. The eggs, generally four in number, are pale-yellowish or greenish-white, with rather elongated spots of two or three shades of brown on the big end. They are large, being about one inch six lines in length, and one inch one line in breadth. Sir Humphry Davy, who came upon the nests of ten or twelve couple, in the heather surrounding a small lake in the island of Hoy in the Orkneys, where he was grouse-shooting in August, 1817, found usually two young ones in a nest, though he had seen three. He describes the parent birds as being exceedingly attached to their young, and says that if any one approach their nest, they make a loud and drumming noise above the head of the intruder, as if to divert his attention. In the British Islands they have been known to breed also in Dorsetshire, in the New Forest, in Cambridgeshire, in Norfolk, in Scotland, in Wales (on a marshy hill in the neighbourhood of Coytrahên, near Bridgend in Glamorganshire), and in Ireland. Mr. Selby observes, that, in addition to our native snipes, great flights come annually from Norway and other northern parts of Europe; and that in Northumberland they arrive in the greatest numbers in the beginning of November. He remarks what most snipe-shooters have noticed, that they seldom remain long in one situation, but move from place to place; so that the sportsman who has enjoyed excellent snipe-shooting one day, may find the same spots entirely deserted on the following. 'Towards the end of March or beginning of April,' says Mr. Selby in continuation, 'snipes, having perfected their summer or nuptial plumage, select appropriate places for nidification, and the male bird commences his calls of invitation for a mate. These are always uttered upon the wing, and consist of a piping or clicking note, often repeated, and accompanied at intervals by a humming or bleating noise, not unlike that of a goat,' whence probably its French names of *Chèvre volant* and *Chèvrette volante*, 'apparently produced by the action of the wings, as the bird, whenever this sound is emitted, is observed to descend with great velocity, and with a trembling motion of the pinions. At this season it soars to an immense height, remaining long upon the wing; and its notes may frequently be heard when the bird itself is far beyond the reach of sight. These flights are performed at intervals during the day, but more commonly towards the evening, and are continued during the whole time that the female is engaged in incubation.'

*Utility to Man.*—Few birds are better than a *fresh* snipe. The old quatrain says—

> 'Le becasseau est de fort bon manger,
> Duquel la chair resueille l'appetit.
> Il est oyseau passager et petit:
> Et par son goust fait des vins bien juger.'

'Snypes' were among the birds admitted to the earl of Northumberland's table (*Houshold*, 1512), and were then charged at 3*d*. a dozen.



Head and Foot of the Common Snipe.

The *Solitary, Double*, or *Great Snipe*, *Scolopax major* (*Gallinago major*, Bonap.), is a much larger bird.

*Description.*—Tail composed of sixteen feathers; midrib of the first quill whitish. The black of the top of the head divided by a band of yellowish white; eyebrows of that colour; upper parts variegated with black and bright rusty, the last-named colour disposed longitudinally; lower parts whitish rusty; belly and sides striped with black bands; bill inclining to reddish, brown at the point; feet greenish ash. (Temm.)

Mr. Yarrell gives a much more elaborate description, and as it is very correct, and the bird is not common, we here lay it before our readers:—

'The beak dark-brown at the end, pale yellow-brown at the base; irides dark-brown; from the base of the beak to the eye, a dark-brown streak; over that, over the eye and the ear-coverts, a streak of pale-brown; forehead and top of the head rich dark-brown, divided along the middle line from before backwards by a pale-brown stripe; neck all round pale-brown, the centre of each feather darker brown; interscapulars, scapulars, and back, rich brownish-black, with central lines and broad margins of rich buff or fawn colour; lesser wing-coverts nearly black, the upper series tipped with pale-brown, the lower series tipped with white; great coverts black, tipped with white; primary quill-feathers dull greyish-black, with white shafts; secondaries dull black, tipped with white; tertials black, barred and streaked with pale brown; rump very dark-brown, edged with pale brown; upper tail-coverts pale yellow-brown, varied with dark-brown; tail-feathers sixteen, the four on each outside nearly all white, the others rich brownish-black over

* *Giach* is the antient British name for the Jack Snipe.

three-fourths of their length from the base, then a patch of chestnut, bounded by a circle of black, and tipped with white; chin pale yellow-brown; breast and sides of the body with half-circular bands of brownish-black on pale-brown; belly and vent pale brownish-white; legs and toes greenish-brown; the claws black. The legs and toes are subject to some variation in colour. I have seen them in fresh-killed birds of a livid-green, and even of a light-drab colour. The whole length about twelve inches. From the carpal joint to the end of the first quill-feather, which is the longest in the wing, five inches and a half. The weight from seven to nine ounces, depending on age and sex. The females larger than the males. The males are lighter in colour above and below the dark stripe behind the base of the beak, like the woodcock; and the breast is less covered with the dark half-circular markings: the white spots at the ends of the wing-coverts are rather larger, and more conspicuous from their purer white colour. Young birds in their first autumn have short beaks, and fewer, if any, white outside tail-feathers; these are probably obtained at their first moult, as this species is sometimes described as being without any white outer tail-feathers, and at others with as many as five on each outside.'

This is the *Grande* or *Double Bécassine* of the French; *Beccacino maggiore*, *Pizzardone*, and *Croccolone* of the Italians; *Mittelschnepfe* and *Doppelschnepfe* of the Germans; *Poelsnep* of the Netherlanders; *Great Snipe*, *Double Snipe*, and *Solitary Snipe* of the modern British; and *Ysnid* of the antient British.

*Geographical Distribution.*—Head-quarters, the north of Europe. Norway, where specimens transmitted to the Zoological Society of London were shot by Sir Humphry Davy, Sweden, Germany, Holland, France, Italy, Switzerland, the borders of Asia, Trebizond, the neighbourhood of the Caucasus.

In the British Islands the bird has been killed in Lancashire (the specimen from which Pennant first described it, and which was preserved in the Leverian Museum), and has been noticed as not uncommon in Norfolk. Mr. Yarrell says, 'Their course, both in the spring and autumn (at which period they have been generally shot in this country), is considered by Mr. Selby to be generally to the east of the longitude of the British Islands; and I may mention, in corroboration of this view, that I am not aware of more than one record of the occurrence of this species in Ireland, and in England they are most frequent in the eastern counties.' From the Welsh name above noticed, it is plain that the bird has been not unfrequently observed in the principality, though published instances of its occurrence in that locality do not appear to be known. Whilst we write (late in September, 1841) a friend has sent us a fine specimen, killed on the marshy hill near Coytrahên, above alluded to. It was flushed from a dry hedge-row (the boundary to a wet field), into which it had been marked by the keeper, and was shot by our friend's companion. The bird uttered no cry in rising, and its flight was very heavy, more like that of a woodcock than a snipe. Several common snipes were found in the field, one not more than fifty yards from the place where the solitary snipe was put up. The keeper stated that the latter kept in a perfectly dry part of the hill, not near any other birds; and it was considered probable that it had been there all the summer, as it was in good condition, and no foreigners of the common kind had yet arrived in the low grounds, where they are very numerous late in the year. But it should be remembered that the bird was killed at a period when it most commonly occurs as a visiter to this country.

*Food, Habits, Nidification, &c.*—Sir Humphry Davy, who notices the fact of this snipe's breeding in the great royal decoy or marsh-preserve near Hanover, says that they require solitude and perfect quiet, and that, their food being peculiar, they require a great extent of marshy meadow. They feed on the larvæ of *Tipulæ* (commonly called Father Long-legs), or congenerous flies; and their stomach, the same author tells us, is the thinnest among the *Scolopax* tribe. Mr. Lloyd always found this bird singly, or at most in pairs, near Gothenburg, where they were by no means plentiful, and he states that they are so fat in the autumn, as apparently to be hardly able to fly; indeed, he remarks that, if flushed, they usually proceed but a short distance before they settle again. Their flight, he adds, is heavy and steady, and they present the easiest mark possible. The same sporting traveller quotes Mr. Greiff ('Förste Hof-Jagmästare'), who remarks that this species is a bird of passage, and amongst those which arrive the latest; and that at the end of July, when the meadows are mowed, shooting them commences and continues till towards the end of September. The pointer is the dog selected to accompany the sportsman, and Mr. Greiff speaks of the sport with rapture. 'The birds,' he says, 'are easy to shoot, and in some places fifty or sixty, aye, considerably more, may be killed in a day, particularly in autumn, when they are so fat that they almost burst their skins. They are most delicious eating.' Mr. Greiff adds, that he was already an old sportsman of thirty years' standing before it came to his knowledge that these double snipes had their *lek* or playing-ground. [CAPERCAILIE, vol. vi., pp. 262, 263.] He heard their cry a whole spring in a marsh where he had a good *Orr-lek*,* but never observed them, and therefore believed that the sound came from some frogs or reptiles; but at last he discovered that the cry was uttered by double snipes which ran like rats among the hillocks. This cry, according to Mr. Greiff, commences with a sound resembling the smack of the tongue, and thereupon four or five louder smacks follow.

The rude nest of the double snipe, which is very like that of the common snipe, is generally placed on a hummock or tuft of grass, or a bunch of rushes on the borders of a swamp, often near willow bushes. Eggs three or four in number, yellowish olive-brown, with great spots of reddish-brown; length, one inch nine lines; breadth, one inch two lines.

They breed in considerable numbers in the mountainous parts of Norway and Sweden, as high as the range of birch-woods extend. In the Dofre Fi-ell at Jerkin and Fogstuen, they are numerous on the edges of the grassy swamps, avoiding the wet. They also frequently resort to the borders of the small rills used for irrigating the grass-lands. During the pairing season they fly to a vast height. They make a drumming noise as they descend, which is produced by a slight and peculiar vibration of the wings. (Yarrell, ex relatione Dann.) Mr. Gould observes that there are two other snipes which exceed this in size, found in the hilly districts of India, and a third from Mexico, whose size is superior to that of a woodcock. (*Birds of Europe.*)

Solitary or Double Snipe.

SNORRI STURLUSON, also called *Sturleson* or *Sturlason*, and in Latin works *Snorro*, was the son of Sturla, and born in Iceland in the year 1178, on an estate belonging to his father, called Hoamms, whence the father is sometimes called Hoamms-Sturla. When Snorri had scarcely attained his fourth year, his father died, and he was thenceforth educated at Odi, in the house of Ion, the most learned man of the age. His education was conducted with great care, and his talents soon gave him distinction as a philosopher, a mathematician, a lawyer, a linguist, antiquary, and architect. At the same time he acquired great reputation for the enchanting manner in which he told the stories of former times, an art which is still highly valued in Iceland. Although his father had been the chieftain of an Icelandic tribe, the son appears to have been poor, until he improved his circumstances by a marriage with a wealthy lady, whom some years afterwards however he deserted. He managed his newly-acquired property so

* *Orre* is the Swedish name for the BLACK COCK.

well, that he became no less distinguished for his wealth than for his talents and learning. He was several times invested with the office of Logsögumadr, that is, interpreter of the law, the highest official dignity in Iceland, and gradually rose to the rank of Landur-madur and of Yarl, which was the highest title next to that of duke. During this period of his greatest prosperity he composed some of the most beautiful songs, tales (sagas) that exist in the literature of Iceland, and also wrote some historical works. He also spent considerable sums upon the building of splendid edifices, especially at Reykiahollt. His character as a man however was by no means in accordance with his great mental powers, for he was avaricious, quarrelsome, inconstant, and full of cunning, though wanting in active energy. A party was formed against him, which was headed by his own brother Sighwat and his nephew Sturla; and his sons-in-law, enraged at Snorri having abandoned his wife, joined his enemies. Snorri and his adherents were defeated and banished from the island (1234). They went over to Norway, where Snorri's patron, Duke Skuli, was preparing to revolt against King Hacon, and was supported by the poetical powers of Snorri. In the meanwhile however his enemies in Iceland were defeated, and Snorri, dreading the vengeance of King Hacon, returned to his native island. But the king declared him an outlaw, and Snorri was murdered on the 22nd of September, 1241, at Reykiahollt, by his own sons-in-law.

Snorri is one of the greatest, and at the same time the last of the northern Scalds. His most important work is the 'Heimskringla,' a beautiful collection of sagas, consisting partly of Scaldic songs by Snorri himself, and partly of the poems of earlier Scalds, who were contemporary with the events which they describe, and whose poems are interwoven in the Sagas of Snorri himself. This collection was first published by Peringskiold (Stockholm, 1697, fol.), with a Swedish and Danish translation; another edition, with a Danish and Latin translation, appeared at Copenhagen from 1777 till 1826. Vols. 1 and 2 were edited by Schöning; vol. 3 by Sc. Th. Thorlacius; vols. 4, 5, 6, with the separate title of 'Noregs Konunga Sögor,' by Birg. Thorlacius and E. Chr. Werlauf. The last Danish translation is that by Grundtvig, Copenhagen, 1818-1822, 3 vols. 4to. It has also been translated into German by Wachter, who has added a very valuable historical and critical introduction.

Among the other works ascribed to Snorri are, 1, 'The Gylfa-Ginning,' which forms the first part of the 'Snorra-Edda;' 2, 'The Scaldic Songs called Kanningar or Skallds-koparmal;' 3, 'Hattalykill,' or the Key of the Wise, consisting of two eulogies on Duke Skuli, and three others which are partly written in praise of King Hacon. All these poems form part of the 'Skallda,' which has been edited by Rask (Stockholm, 1818), under the title of 'Snorra-Edda ásamt Skáldu.' Besides several other poems upon contemporary heroes, Snorri also wrote a number of Fraedi-baekur, *i.e.* manuals of science, which have been very much used by his countrymen.

SNOW. It has been stated [RAIN, p. 269, col. 1] that rain, snow, and hail are formed by the precipitation of vapour when two volumes of air of different temperatures, and saturated with moisture, become mixed together; the nature of the precipitation depending on the temperature of the region of the atmosphere through which the aqueous particles descend towards the ground. Now when the particles are frozen in separate crystals of ice, and these afterwards unite together in such a manner as to reflect light to the eye in great abundance from all, thus producing a sensation of whiteness, the assemblages of crystals constitute snow.

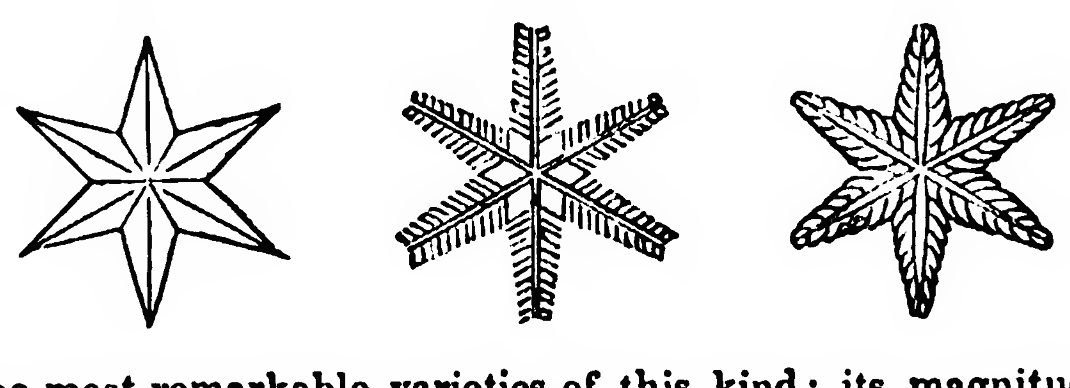
M. Monge observes (*Annales de Chimie*, vol. v., p. 1) that the crystallization of sal-ammoniac presents phenomena similar to those which are observed in the formation of snow. If a saturated solution of sal-ammoniac in a warm state be allowed to cool in a tranquil air, the surface of the liquid is that which first arrives at a state of supersaturation, and there the first crystals are formed; these sink immediately, and in descending they unite with similar crystals formed in the liquid itself, so that they arrive at the bottom of the vessel in white flakes. Thus also the elementary crystals, formed generally in the upper region of the atmosphere, gradually descend by their superior specific gravity, and by the laws of affinity cause the crystallization of the aqueous molecules which otherwise the air would have held in solution. These uniting, there would probably result, if the atmosphere were tranquil and the temperature very low, small flakes of some regular figure. From such as have been observed, it appears that these consist of brilliant spicular icicles, which diverge from a centre in six directions, and resemble stars having so many rays, upon each of which small crystals are sometimes formed; but if the atmosphere is agitated, the original flakes strike against each other, and uniting in groups, in consequence of small quantities of moisture adhering to them, they descend in irregular forms. In regions of the earth far to the north or south, the air, when allowed to enter through a small aperture into a heated apartment, has frequently caused the warm vapour to be converted into snow.

Snow has been observed to fall in a fine powder, not having any appearance of regular crystals; this is therefore supposed to have been formed near the surface of the earth, and is considered as being in an elementary state. (*Bibliothèque Universelle*, 1830.) The crystals are evidently those of ice combined together, and their primitive form is, from the experiments and observations of Sir David Brewster, considered as belonging to the pyramidal system; M. Haidinger infers this fact from the circumstance that tin-ore and rutile, which are of that class, produce crystallizations similar to the stellar figures of snow. The regularity of the formation of snow has been ascribed to electricity. Beccaria observed that his apparatus for ascertaining the electrical state of the atmosphere indicated the presence of the fluid in snow as well as in rain; and, according to the observations of Schübler, it is more commonly positive than negative. The lightness of the flakes, by which they float about in the air when agitated, is the result of their surface being great when compared with their volume. The specific gravity of snow is very variable; and according to Musschenbroek, that of some, of the stelliform kind, was only $\frac{1}{24}$ of the specific gravity of water; but M. Quetelet has since found that the greatest density is nearly $\frac{1}{2\cdot8}$ of that of water, the temperature being 34·5° (Fahr.). He ascertained also that the density of fine snow having no determinate form was about $\frac{1}{4}$, the temperature being 32°, and that the least density varied from $\frac{1}{10}$ to $\frac{1}{12}$ of that of water, at which time the snow had the form of small stars, and the temperature varied from 29·7° to 18·5°.

The flakes of snow have even in temperate regions many varieties of form, and are often very elegant; but the polar regions of the earth are those in which nature has displayed her power in creating this species of beauty in the highest degree and to the greatest extent. In the *Phil. Trans.*, 1775, may be seen numerous delineations of the figures assumed by flakes of snow as they were observed by Dr. Nettis of Middelburg in 1740; but Mr. Scoresby, in his 'Account of the Arctic Regions,' has given still greater varieties; the latter gentleman, besides dividing them into classes, has also expressed their magnitudes, and the state of the barometer and thermometer when the snow fell.

Of these classes the first is called 'lamellar,' and is divided into many different species: one of the latter is a thin transparent hexagonal plate, or a hexagonal plate with white lines parallel to the sides of the polygon, and sometimes there is a starlike figure in the centre; the magnitudes vary, and the greatest is about $\frac{1}{10}$ inch diameter. Another species, and this is the most ordinary appearance of snow, is the stelliform; the figures 1, 2, and 3 represent

1 2 3



the most remarkable varieties of this kind; its magnitude varies, but the diameter of the greatest is about $\frac{1}{3}$ inch, and it occurs most abundantly when the temperature of the air is near the freezing-point of water. Sometimes the stars appear to have twelve points, but Mr. Scoresby thinks that these are formed merely of two stellar plates applied one on the other. The six following figures represent assemblages of hexagonal crystals; the diameters of the two first kinds are respectively $\frac{1}{10}$ and $\frac{1}{20}$ inch, and those of the rest are $\frac{1}{8}$ inch diameter; they are usually formed at temperatures between 32° and 20° (Fahr.).

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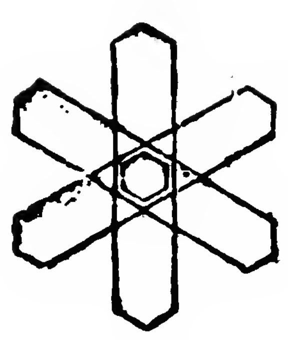

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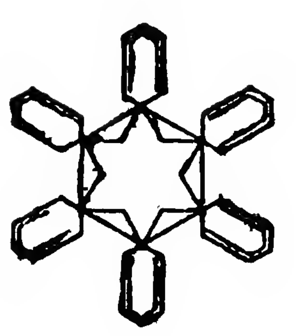

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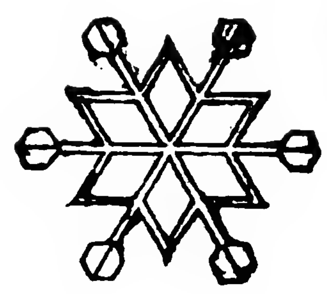

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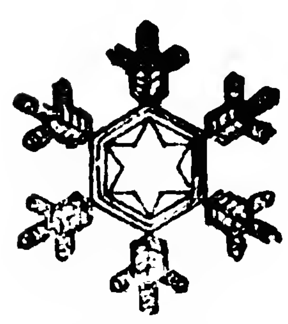

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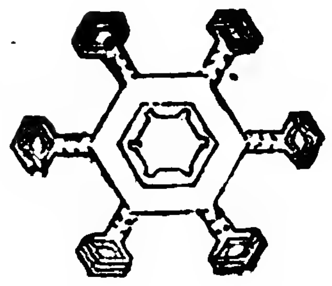

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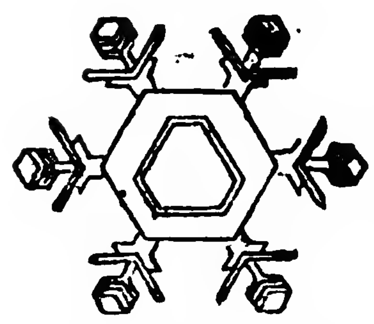


The second class is also lamellar, but it differs from the former in having a spherical nucleus, either transparent or white, about ¼ inch diameter; and sometimes spicular radii proceed from thence in different directions at angles of 60° with each other. The temperature at which this class is formed varies also from the freezing-point to 20° (Fahr.)

The third class consists of spiculæ, or six-sided prisms; of these, the finer sort, which are formed at the temperature of 28°, resemble white hairs very delicate and clear, and about ¼ inch long; the coarser kinds are formed in the lower region of the atmosphere, at about the freezing temperature.

The fourth class is of a pyramidal form and about $\frac{1}{30}$ inch high, but Mr. Scoresby could not determine whether the base was triangular or hexagonal. The fifth class consists of hexagonal crystals united together by a slender spicular crystal, so as to resemble two wheels with an axle. Both of these kinds are very rare. Mr. Scoresby saw the latter only twice and the former only once.

M. Huber Burnand, speaking of the character of the snow which fell at Yverdun in 1829 and 1830, states that it was crystallized in stellar plates with six rays, along each of which were disposed filaments arranged like feathers, and these again supported finer filaments similarly arranged; the plates, which were extremely thin, were perfectly plane and regular. (*Bibl. Univ.*, 1830.) It is also related in the same work, that in 1829 the frost at Yverdun assumed every day a different form, being sometimes disposed in parallel groups or fillets; sometimes it resembled leaves, and occasionally spines about an inch long, which were terminated by a flat rosette with six divisions.

Snow in the form of cylinders and spheres or spheroids has been occasionally observed in North America. The former were produced by the snow deposited in a second shower upon some which had previously fallen, and the surface of which had been covered by a thin coating of ice. A violent wind then caused the particles of snow to roll on the ice, and the masses thus produced assumed perfectly cylindrical forms of various sizes, the greatest being 2½ or 3 feet diameter; they were hollow at each end. The spherical balls were from 1 inch to 15 inches in diameter, and were also formed chiefly by rolling, though some were found in enclosures where they could not have rolled, and therefore they are supposed to have been formed in the atmosphere itself; they were very light, and were composed of crystals irregularly united. (Silliman's *Journal*, vols. ii. and vi.) Similar balls were observed in East Lothian, in 1830, by Mr. Sheriff; and this gentleman relates that they were composed only of snow, for one of them being cut through, was found to have no hard body for its nucleus. (*Edin. Phil. Journal*, ii. 58.)

That animalculæ exist in snow is evident from an observation stated in Silliman's *Journal* (vol. xviii.). We learn there that Dr. Mure having first examined some water in a glass by means of a microscope, and found it quite pure, put into the water a quantity of snow; he then found that, on solution, the water exhibited in full activity hundreds of animalcules, which, when viewed through the microscope, resembled very diminutive shrimps, and were quite unlike the eels discovered in acetous acid. It may be observed here, that snow-water, being drunk, is considered as unfavourable to the human constitution; the affections of the throat, to which the people in some parts of Switzerland are subject, are thought to be caused by its deleterious qualities.

The formation of hail is probably a result of the abstraction of caloric from the molecules of vapour in the atmosphere, by the agency of electricity or otherwise. Volta supposes that the hail, when once formed, may continue to acquire new accessions of frozen vapour, till the weight of the stones becomes sufficient to overcome the electrical attractions by which they are kept suspended; and thus the existence of very large hailstones may be accounted for. The violence with which they rush in a direction nearly parallel to the horizon when no wind is stirring, is ascribed by the same philosopher to a combination of the force of gravity with that which arises from the shock of two electrical clouds, by which the hail may be produced. The hypothesis of the formation of hail by the collision of electrical clouds has however been objected to by M. Arago; and the theory of Hutton respecting the formation of rain [Rain] is considered capable of accounting also for the phenomena both of snow and hail. The loss of heat in the descending molecules being greater when hailstones are formed than when the vapour is brought to the state of rain or snow. This hypothesis appears to be confirmed by the fact that the same cloud has produced both rain and hail.

Hailstorms often extend to great distances in one direction, while they are of very limited breadth. That which created so much destruction in France, in July, 1788, passed in two parallel lines over that country from south-west to north-east, one line being in length about 175, and the other about 200 leagues, while the mean breadth of each was only about 3 leagues; and in the interval between them, which was about 5 leagues, the country was deluged with heavy rains. The hailstorm which, in the month of May, in the present year (1841), visited this country, spent all its fury between Bagshot and Reading, within which tract immense damage was sustained.

Hoar-frost is only dew frozen immediately upon being formed. [Dew.]

SNOW, RED. The occasional occurrence of snow coloured red has for a long time created great interest, especially as the labours of the most eminent naturalists have not yet been able to determine precisely to what causes this singular phenomenon owes its origin. The chemist, the botanist, and the zoologist have in turn examined this extraordinary substance, and each has not failed to trace its source to objects belonging to his particular department of study.

It appears that this phenomenon did not escape the observant eye of Aristotle, and he mentions that living beings found in old snow had frequently a reddish colour, which he supposed they derived from the snow. (*Hist. Anim.*, v., cap. 19.) This observation of Aristotle's however does not appear to have excited any attention, and no other writer mentioned the occurrence of red snow till 1760, when Saussure discovered it on the Brevent and other mountains, but more especially on the Saint Bernard, where it existed in great abundance. He made some chemical analyses of this snow, and came to the conclusion that it was of vegetable origin, and probably consisted of grains of pollen mixed with the snow, such a cause having been known to discolour rain, producing what was called a *sulphur shower*. (De Sauss., *Voy.*, ii., p. 646.)

It was not however till the year 1819, when our countryman Captain Ross returned from his arctic expedition, that this substance was accurately examined with a view to the discovery of the origin of its peculiar colour. Whilst in Baffin's Bay, 75° 54′ N. lat. and 67° 15′ W. long., Captain Ross discovered a range of cliffs covered with snow of a crimson colour. The cliffs were about 600 feet high, and were coloured for the extent of eight miles. According to Captain Ross, the party he sent on shore 'found that the snow was penetrated even down to the rock, in many places to a depth of twelve feet, by the colouring matter, and that it had the appearance of having been a long time in that state.'

The colouring matter of the snow, in the first instance, excited the attention of chemists, and was first analyzed by Peschier, an Italian chemist, and subsequently by Wollaston and Thénard. They all obtained nearly the same results. The following is Peschier's analysis:—

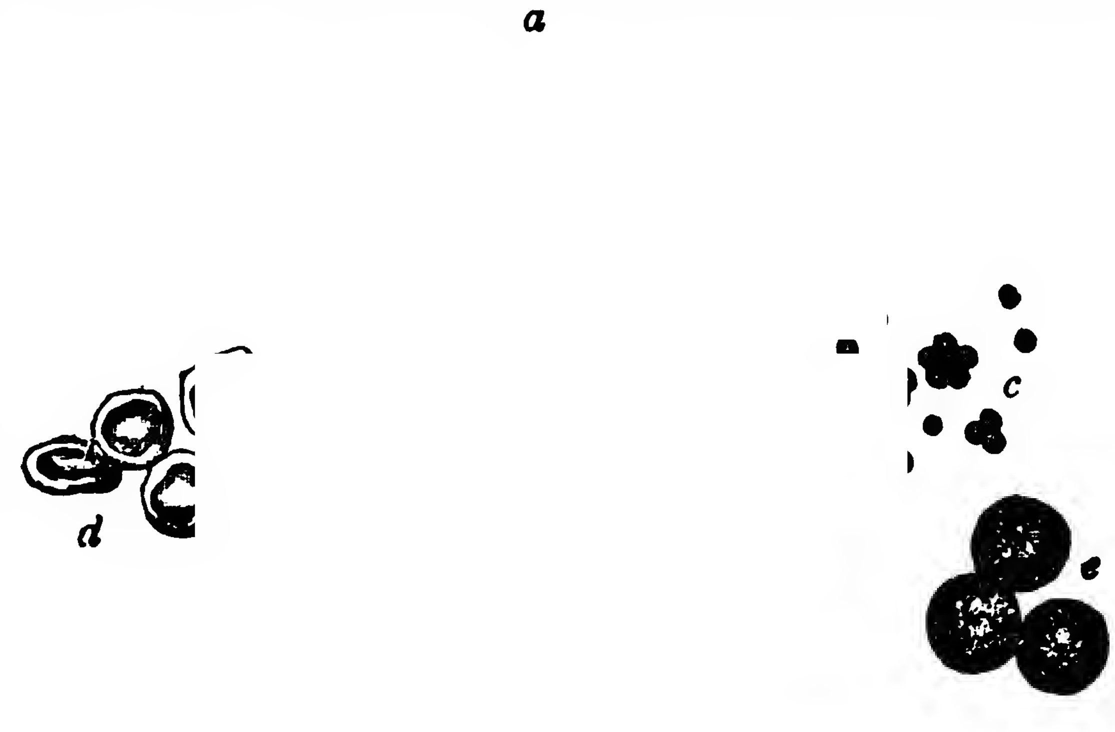
| | |
|---|---|
| Siliceous matter | 65·5 |
| Alumina | 6·35 |
| Peroxide of iron | 21·35 |
| Lime | 1·17 |
| Organic matter | 6·8 |
| | 100·0 |

But the labours of the chemist affording little that was satisfactory with regard to the nature of this substance, it was placed in the hands of the botanist, and in the Appendix to the account of Captain Ross's polar expedition, Mr. Robert Brown described the colouring-matter of the snow as a probable genus of the family of Algæ, and pointed out its resemblance to the *Fremella cruenta* of the English Botany. At the same time some of the red snow-water brought from Baffin's Bay was sent to Francis Bauer, who published the results of a very careful examination of it under the microscope, in the seventh volume of Brande's 'Journal of Science and Arts,' accompanied with several drawings. He found that the water contained a number of opaque or red spherical globules, which were heavier than the water, forming a sediment at the bottom of the bottle, and also of some transparent vesicular bodies which floated about in the fluid. On examining the red globules, he found them possessed of a pedicel resembling that of some species of *Uredo*, and regarded them as a species appertaining to this genus. He subsequently observed that many of the globules were attached to a gelatinous matrix presenting a cellular and articulated character. On exposing the water with the globules for some days to the air, he found that they lost their colour, and that on the sides of the vessel were developed new portions of the gelatinous matrix, which were covered with small globules, which he looked upon as young Uredos. He also found that on comparing the chemical analysis of the *Uredo fœtida* with that of the red snow, they in a great measure agreed, and hence he came to the conclusion that the colouring-matter of the red snow was a fungus belonging to the genus Uredo, and to which he gave the name *U. nivalis*.

But the question was not thus set at rest. In 1823 Baron Wrangel gave an account of a plant of a red colour, which he called *Lepraria Kermesina*, and supposed to be identical with the long-disputed *Byssus Iolithus* of Linnæus. This plant was obtained from the surface of white limestone rocks, forming over them a thin red crust, and was also found contained in the rain water remaining on the limestone. During the same year Professor Agardh of Lund, who had previously suggested the identity of this plant and that of red snow, received specimens of the Lepraria from Baron Wrangel, and also of the *Uredo nivalis* of Bauer from England, and he came to the conclusion, after a very minute examination, 'that the two plants were actually one and the same species.' 'We must conclude,' says Agardh (Greville's *Scottish Cryptog. Flora*, 'Protococcus,' p. 15), 'that the *Uredo nivalis* and the *Lepraria Kermesina* are alike called into existence by the gradual melting of the snow, and the intensity of light in their relative situations; and that they are neither washed down from the rocks, as some persons believe, nor are precipitated from the atmosphere, as might be inferred from the accounts transmitted by the Italians.'

The plants which Agardh had thus identified, he could not consider, with Bauer, a fungus, or, with Wrangel, a lichen, but, from its analogy to some of the Algæ, he placed it in his *Systema Algarum*, in that family under the name of *Protococcus nivalis*.

In 1825 the subject was taken up by Dr. Greville of Edinburgh. He had received specimens of the plant of red snow from the polar regions, and also from the island of Lismore in Scotland. From this latter situation it was sent to Dr. Greville by Captain Carmichael, who says:—'It occurs in abundance on the borders of the lakes of Lismore, spreading over the decayed reeds, leaves, &c. at the water's edge, but in greater perfection on the calcareous rocks within the reach of occasional inundation; and what is rather remarkable, it seems to thrive equally well whether immersed in water or exposed to the dry atmosphere. It is to be found more or less at all seasons of the year.' The specimens were immersed in water, and then examined by the microscope. In every instance Dr. Greville observed a gelatinous substratum varying in thickness, colourless, diffuse, without any border. Upon this gelatine rested a vast number of minute globules, the colour of fine garnets, exactly spherical, nearly opaque, yet very brilliant, and nearly equal in size. In the full-sized globules granules were detected in the interior, which gave to the surface a reticulated appearance. When mature, they burst, and the granules escaped, to the number of six, eight, or more, and the membrane only of the globule was left behind, buoyant and colourless. The globules or granules were never observed to move. Dr. Greville at first doubted the propriety of referring his plant to Agardh's genus Protococcus,




Protococcus nivalis, Grev.: Glœococcus nivalis, Shut.: *a*, mature globules mixed with younger ones (1) lying on a mass of gelatine. *b*, mature globules: some burst, with granules lying on the gelatine. *c*, granules. *d*, globules after discharging their granules. *e*, full-sized globules.

as in his definition Agardh had not mentioned any gelatinous substratum, which was so evident in his own specimens. He however determined on keeping up the genus with an amended character. Agardh's definition of Protococcus is merely, 'plants with aggregated, not mucous globules.' To this Greville added, 'globules containing granules seated on a transparent gelatinous mass.'

In the same year Sir William Hooker, in the 'Appendix to Parry's Second Voyage to the Arctic Regions,' described, under the name of *Palmella nivalis*, the plant of the red snow collected in that expedition. Sir William Hooker referred the plant to this genus, as it only differed in its globules being seated on a gelatinous mass, instead of being immersed in it.

From this time to 1838 a variety of memoirs and observations upon the red snow were published, chiefly on the Continent, by Kunze, Unger, Martius, and other observers, but no new matter of any importance was elicited.

We now come to another and very important point in the history of red snow. Hitherto all the examinations had been made on old specimens of the red snow, most of them removed at a great distance from the spots on which they were originally found. In August, 1839, Mr. Shuttleworth, an English gentleman resident in Switzerland, being at Grimsel, understood that there was red snow in the neighbourhood, and having a microscope with him, made observations on the recently procured snow. Having melted the snow and placed some of the red matter on the field of the microscope, he was surprised at finding, instead of the immoveable globules of an Alga, an immense number of exceedingly active animalculæ, not of one form only, but of various sizes and forms. The results of this examination he has given in an interesting paper accompanied with drawings, in the 'Bibliothèque Universelle de Génève' for February, 1840. The following are the forms of Infusoria, which he was enabled to detect:—1. An animalcule belonging to Ehrenberg's genus *Astasia*, which he called *A. nivalis* 2. An animalcule, red inside, with a transparent carapace, belonging to the genus *Gyges*, *G. sanguineus*, Sh. 3. One much smaller than the other two, moving, but resembling the globules of Protococcus. 4. One belonging to the genus Volvox. Several other uncoloured species were found, but they were considered accidental. In addition to the animalcules, Mr. Shuttleworth found bodies which he took to be true plants, and referred to the *Protococcus nivalis* of Agardh and the *P. nebulosus* of Kützing.

In 1840 Professor Agassiz of Neufchâtel made a visit to the glacier of Aar, where, having taken with him a microscope, he had several opportunities of examining the red snow, and communicated a paper on this subject to the meeting of the British Association at Glasgow in the same year. He confirmed the researches of Shuttleworth, having found all the animalcules mentioned by him, and added four others to the list. Three of these are comparatively unimportant, but to the fourth great interest attaches, as he supposes that the ova of this animal are the globules which have been taken for a plant, and called Protococcus, &c. This animalcule is the *Philodina roseola* of Ehrenberg. It was found abundantly in the lower glacier of the Aar. It has a much higher organization than the other animalcules, and contains in its inside a number of red globules, which may be distinctly seen through its transparent body. These globules are its ova, which, on being deposited, precisely resemble the globules of Protococcus as figured by Shuttleworth and others.

In the various papers referred to above, no mention is made of snow of any other colour than red. Martius however, a naturalist who accompanied the French expedition to Spitzbergen, mentions having found in one instance a field of green snow. It was accompanied however with the Protococcus, giving a red colour. From many observations Martius arrived at the conclusion that the red globules of the green snow are identical with those of the red snow, and that the green snow (*Protococcus viridis*) and the red (*P. nivalis*) are one and the same plant, only in different stages of development, but that it is difficult to state which is the original. The late Professor Meyen (Taylor's *Ann. Nat. Hist.*, August, 1841) remarks on this statement, that these Protococci are not plants, but animals, the *Euglena sanguinea* and *E. viridis* of Ehrenberg. The reason of their being so often taken for plants is, that they naturally pass a great portion of their existence in a passive state, only occasionally under favourable circumstances starting into activity. When they do this, their spherical form is changed, and they become the elongated beings described and figured by Ehrenberg.

From this sketch of our present knowledge on this subject, it will be found that a wide field still remains open for observation, which will have for its object not so much the determining the nature of the colouring-matter of the red snow, as the ascertaining the laws that regulate organic life in its simpliest forms.

SNOWDON. [CAERNARVONSHIRE.]

SNUFF. [TOBACCO.]

SNYDERS. [SNEYDERS.]

SOANE, SIR JOHN, was a remarkable instance of a career commenced in poverty and obscurity, and terminating in opulence and celebrity. Of his origin little is known, except that his father was a bricklayer or petty builder, and he himself born at Reading, September 10th, 1753. At an early age he was taken into the office of Dance, the architect (in whose family his sister was also a servant), first merely as errand-boy or attendant, but afterwards he was placed on the footing of a pupil. He subsequently entered that of Holland, another eminent architect, where he remained up to the time of his being sent to Italy for three years as travelling student of the Royal Academy, at the recommendation of Sir W. Chambers, in consequence of the talent displayed by him in a design for a triumphal bridge, which obtained the gold medal. It was perhaps a fortunate circumstance for him that an octavo volume of designs for temples, baths, &c., previously prepared by him, was not published till 1778, the year after he quitted England, since, so far from displaying any talent, it indicates the most wretched taste. No wonder, then, that at a later period the author should have bought up every copy he could meet with, more especially as his name is there printed *Soan*, which name itself, we have been assured upon excellent authority, was an improvement upon the original one of Swan. These designs exhibit the germs of many of his after peculiarities—of those whims and freaks, together with that littleness of manner, from which he could never totally divest himself even in his best works.

During his stay in Italy (1777-1780) he made good use of his time, studying antient buildings, particularly those arrangements of plan and picturesque combinations which occur in Roman Thermæ, or imperial baths. He also made original designs, among which were those for a British Senate House and Royal Palace. While in Italy he became acquainted with Mr. Thomas Pitt, afterwards Lord Camelford, to whose influence he is said to have been mainly indebted for his appointment as architect of the Bank of England, on the death of Sir Robert Taylor. Very soon after his return to England, he executed several private residences and country-seats in the counties of Norfolk, Suffolk, &c., the plans and elevations of which he published in a folio volume, 1788; but except that there are some good points in the former, and that they manifest great attention to convenience, they display very little invention or taste. On obtaining the lucrative appointment to the Bank, he married Miss Smith, the niece of Mr. George Wyatt, a wealthy builder in the city, whose death soon put him into possession of a very considerable fortune in right of his wife. Other advantageous appointments followed: that of clerk of the works to St. James's Palace, 1791; of architect to the Woods and Forests, 1795; and of surveyor to Chelsea Hospital, 1807; besides that of professor of architecture at the Royal Academy in 1806. Numerous commissions for both public and private buildings, in addition to his official engagements, kept him in constant occupation for many years; and some of them furnished him with more favourable opportunities than were afforded to almost any other architect of that day. Yet notwithstanding his undeniable attachment to his profession, and his industrious application to it, the majority of the buildings that he executed are little better than so many experimental attempts at originality, with considerable merits in parts, but more or less failures upon the whole. With all his apparent fertility of invention, they exhibit sameness of ideas, and those by no means of the happiest kind; while, with a good deal of study in some respects, they betray great neglect of it in others. Never was architect more unequal in his taste, not only at different times, but in the same building, for not a single building among all that he executed or designed is consistently finished up throughout. On the contrary, striking beauties and striking defects are so oddly mixed up in several of them, that it is hardly possible to say which predominate. Even in mere designs, where he was at liberty to exercise his fancy without restraint, there invariably occurs something most offensively mean or extravagantly uncouth and absurd. Proofs of this assertion are furnished by the folio of 'Public and Private Buildings,' published by him in 1828, and which was intended to be in some measure a record of his long professional career, although the plates are wretchedly executed; and nearly the same may be said of those in the 'Description' of his own house and museum, a quarto volume of some bulk, printed by him in 1832 for private distribution and presents. In both instances he was most niggardly towards himself, yet in the latter not altogether free at the same time from vanity. The same may be said with regard to his house itself, the exterior of which is by no means such a specimen of taste as an architect would be ambitious of bequeathing to posterity, though, taken altogether, the building and its contents form a monument sufficiently expressive of the character of the man—a strange jumble of insignificance and ostentation, of parsimony and extravagance, of ingenious contrivance in some parts, and of the most miserable conceits in others. Such as it is however, it was for years his favourite amusement, even from the time when he commenced it in 1812; and as he seems to have grudged no cost in making repeated alterations, it is singular, more especially considering the purpose to which he ultimately destined it, that he should not have rebuilt the front, and that of the house on each side of it (also his own property), so as to have produced a uniform façade of tolerably imposing aspect, even had he not added those houses to his own residence and museum.*

In 1833 he obtained an act of parliament vesting his museum, library, &c. in trustees, for the use of the public after his death. Availing himself of the power given by the act of parliament to make such regulations as he afterwards pleased, he thought proper to limit the time of the 'Soanean Museum' being opened to the public to two days in each week for three months in the year; when it can be visited only by tickets, and those are given in a very limited number for each day. On many occasions he indulged in ostentatious profusion, in donations to public bodies, &c., such as that of 1000*l.* to the fund for the Duke of York's monument, and similar sums to the British Institution, &c. Contrasted with his general economy—with the parsimony displayed in bringing out his own publications, it would indeed seem that such fits of expansive liberality were in some measure prompted by the desire of showing that it was not his love of money which prevented him from assisting his son, who had certainly some natural claims upon him. Whatever may have been the real cause, it is notorious that a most violent rupture had existed for years between Sir John and his only surviving son; nor could any reconciliation between them be effected—a circumstance which throws some light upon much that would otherwise be inexplicable in Sir John's character, including, among other points of it, his refusal of a baronetcy, and his determination to accept only simple knighthood (1831). His alienation from his son induced many to look

* An account of the building and its chief contents will be found in the 'Penny Magazine,' No. 363.

forward to considerable legacies from him; but if he ever encouraged any such expectations, he certainly did not realise them. Advanced as he was in years, he had not fallen into dotage: both his faculties and health remained unimpaired to the last, when, with scarcely a day's previous indisposition, he died at his house in Lincoln's Inn Fields, January 20, 1837.

Eminently successful as he was throughout life, Sir J. Soane was quite as much to be pitied as to be envied, and he is a striking lesson to the world that prosperity may be bitter to the man, and opportunity sometimes worse than useless to the artist. As an architect, he did not, with the exception of the Bank—and there only in bits—accomplish anything of sterling merit. He had great ingenuity and contrivance, and was often singularly happy in those picturesque and perspective effects which depend upon arrangement and plan, and on the mode of admitting light [SKY-LIGHT] in interiors, but he never fully wrought up his ideas, and often left them quite crude sketchings. His attempts at Gothic were almost beneath contempt. On the other hand, he is entitled to no small praise as being, if not the inventor of a new order, the first to apply and naturalise in this country the Tivoli Corinthian, employed by him at the Bank, the north-west corner of which structure so infinitely surpasses anything that he ever executed or designed, that his reputation would stand higher if that were all that he ever did.

SOAP. This term originally meant the compounds derived from the union between fatty bodies and the alkalis potash and soda; and although it is still usually thus limited in its meaning, it has nevertheless been extended to compounds of oleaginous bodies with some earthy and metallic bodies, having but few properties in common with soap properly so called.

It has been found by Chevreul that different varieties of fatty matter consist chiefly of two kinds: one hard, to which he gave the name of *stearin;* and the other soft, which he termed *olein.* He also discovered that stearin is composed of stearic acid and a peculiar principle which on account of its sweet taste he named *glycerin,* and it was further proved by his experiments that olein consists of oleic acid and glycerin; stearin is therefore a stearate of glycerin, and olein an oleate of the same substance.

When, in the manufacture of soap, an alkali (soda for example) is heated with tallow, the soda gradually dislodges the glycerin from combination with the stearic and oleic acids, and by combining with them forms soap, or in other words a compound of stearate and oleate of soda, and the glycerin remains in solution.

Glycerin was first noticed by Scheele, and is obtained in the greatest quantity and purity by saponifying olive-oil with oxide of lead mixed with a little water. This is the well-known process of preparing what is called diachylon or lead plaster, which is in fact a metallic soap, or a margarate and oleate of lead. The glycerin, which remains in combination with the water, is purified from oxide of lead by means of hydrosulphuric acid, and by cautious evaporation is obtained as a syrupy liquid of a decidedly sweet taste.

The principal kinds of soap manufactured in England are *white* or *curd soap,* made chiefly from tallow and soda, but for some particular purposes olive-oil and soda; *yellow soap,* composed of tallow, resin, and soda, to which some palm-oil is occasionally added; and *mottled soap,* made from tallow, kitchen stuff, and soda; the mottled appearance is given to this soap by dispersing the lees through it towards the end of the operation. There is also a *brown soap,* made from palm-oil and resin. This oil contains *palmitic acid.*

*Soft Soap* is generally prepared from fish-oil and potash, and it may be here remarked that while hard soaps are prepared with the alkali soda, the alkali potash always enters into the composition of soft soaps. Besides the fatty matters mentioned, linseed oil and cocoa-nut oil are occasionally used, and formerly *barilla,* an impure carbonate of soda prepared chiefly in Spain, was employed in England, while kelp (or incinerated sea-weed) was and still is to a certain extent used in Scotland. These changes have been effected by abolishing the duty on common salt, from which a very pure carbonate of soda is now made, and when treated with lime its carbonic acid is removed, and being thus rendered caustic, its solution is used in the manufacture; it is to this improvement in the nature of the alkali now used, and its freedom from sulphur, that the nuisance of soap-lees waggons passing through London is got rid of.

The harder or soda soaps are prepared by boiling the fatty matter with an aqueous solution of caustic soda, that is, of carbonate of soda deprived of its carbonic acid by means of lime; when combination has taken place, or in other words, when the soap is formed, a quantity of common salt is added, which, dissolving in the lees, increases their density, and the soap then floats on the surface of the liquid. The fire being then extinguished, the semifluid soap, after a proper interval, but while yet hot, is removed from the lees and put into frames of wood or iron, where it remains until it has become cold and hard, when it is cut into bars for sale. In making soft soap no lees are separated, the whole of the solution of potash, which is made strong on that account, being combined with the oily matter used.

In the opinion of Dr. Thomson, and according to his analysis, both white and yellow soda-soaps are subsalts consisting of one equivalent of fatty acids and two equivalents of soda, combined with variable quantities of water. The different analyses of soap which are on record can hardly be considered as satisfactory, for not only does the equivalent of the acid vary according to the fatty substance producing it, but the quantity of water is very variable. Thus a sample of yellow soap which had been left during nine days exposed to the air of a room with a stove, gave Dr. Thomson—

| | |
|---|---|
| Oily acids . . | 75·9 |
| Soda . . . | 10·6 |
| Water . . . | 13·5 |
| | 100· |

Another specimen of the same kind of soap, made by a different manufacturer, exposed 34 days to the air in a room with a stove, yielded the same chemist—

| | |
|---|---|
| Oily acids . . | 80·6 |
| Soda . . . | 13·7 |
| Water . . . | 5·7 |
| | 100· |

The excess of water in the former is evidently owing to its having been dried for a shorter time; but Dr. Thomson considers both these specimens as composed of one equivalent of acid and two equivalents of soda, and consequently the acids must be differently constituted, for their saturating powers are as 14 to 17 very nearly.

Braconnot, Thénard, and Pelletier, respectively, analysed Marseilles soap (1), marbled soap (2), and common French soap (3); the following are the results:—

| | (1) | (2) | (3) |
|---|---|---|---|
| Oily acids . | 68·40 | 64· | 60·94 |
| Soda . . | 10·24 | 6· | 8·56 |
| Water . . | 21·36 | 30· | 30·50 |
| | 100· | 100· | 100· |

In vegetable fat oils, olive-oil for example, the glycerin is combined with margaric and oleic acids, forming margarate and oleate of glycerin, and consequently soap made with this oil is a margarate and oleate of soda, instead of a stearate and oleate of this base.

The soaps which have the alkalis for their bases are soluble in water, though the solution is in general milky; they are also soluble in alcohol, and the solution is used frequently as a test of what is called the *hardness* of water; on the addition of the solution to a water containing earthy salts, as indeed spring and river water almost always do, a white curdy deposit is formed; this is an earthy soap, formed, in the case of sulphate of lime, by double decomposition, the sulphuric acid combining with the alkali and the fatty acids with the lime, thus forming an earthy soap, which, being insoluble in water, is precipitated. Bi-carbonate of lime produces a corresponding effect, and as the quantity of this in river water is generally much larger than that of sulphate of lime, the principal effect produced is owing to it.

Acids also decompose soaps, and though the effect is apparently similar, yet it is in reality different; thus when sulphuric acid is added to soap, a white precipitate is formed, but this is merely the fatty acid which the soap contained, and shows the change which the fat employed has undergone; it is either stearic, oleic, or margaric acid, &c., or a mixture of two or more of them; sulphate of soda remains in solution when a soda soap has been thus decomposed.

It is well known that there are certain preparations used in medicine under the name of emulsions and liniments, which are obtained by merely agitating either ammonia, potash, soda, or lime-water with oil: the first of these is an ammoniacal soap, the second and third are imperfect alkaline soaps, and the fourth is an earthy soap, and barytes and strontia-water form compounds analogous to it; these earthy soaps, as has been already remarked, are insoluble in water, or nearly so. Metallic soaps are formed by heating certain metallic oxides, as those of lead, mercury, and bismuth, with fatty matter; glycerin is separated, as has already been mentioned, and the metallic soaps formed are insoluble in water; the only soap of this kind extensively employed is that of oxide of lead, which is largely used under the name of diachylon, or lead plaster.

*Soap Trade.*—The Soap Manufacture is one of considerable importance, which contributes a million sterling to the revenue, and creates an annual demand for above 60,000 tons of tallow, 12,000 tons of palm oil, and 20,000 tons of rough turpentine as the raw material. From the Excise returns we ascertain that the total quantity of soap made in Great Britain in 1840 was 77,123 tons; that 4516 tons were exported to Ireland in the same year; 9379 tons to foreign parts; and 8072 tons were used in the various branches of our textile manufactures. The domestic consumption of the population of Great Britain was 58,593 tons. The principal seats of the soap manufacture in England are Liverpool and Runcorn, London, Brentford, Bristol, and Hull. In 1840 nearly three-fourths of the total quantities of soap were made at these places:—

| | Hard. | Soft. |
|---|---|---|
| Liverpool . | 46,103,782 lbs. | 5,643,542 lbs. |
| Runcorn . | 12,339,986 | |
| London . | 37,548,574 | 758,468 |
| Brentford . | 5,071,543 | |
| Bristol . | 7,813,721 | 287,097 |
| Hull . | 4,825,125 | 696,120 |

There are manufactories of considerable extent at Bromsgrove, Newcastle, Gateshead, Warrington, and Plymouth. In Scotland two-thirds of the total quantity of soap are made at Glasgow and Leith. In 1835 it was estimated that abou 1200 tons of soap were made at Belfast; 600 at Londonderry about 700 at Limerick and in the neighbourhood; and about 300 tons at Cork. The consumption of Ireland in 1835 was between 10,000 and 11,000 tons, one-half of which was imported from England, the remainder being of domestic manufacture.

In 1711 an Excise duty of 1*d.* per lb. was first imposed on all soap made in Great Britain, which was raised in 1713 to 1½*d.* per lb. In 1782 the duty was again increased, and a distinction was for the first time made between hard and soft soap, the duty on the former being 2½*d.*, and on the latter 1¾*d.* per lb. In 1816 another increase of duty took place, and hard soap was subjected to a duty of 3*d.* per lb. Since May 31, 1833, the duty has been 1½*d.* per lb. on hard soap, and 1*d.* per lb. on soft. The soap duty has not yet been extended to Ireland. In 1785, when the quantity of soap made in Great Britain was under 40,000,000 lbs., the number of manufacturers was above 900; but in 1815 the number had diminished to 447; in 1830 to 309; and in 1839 to 196, of whom 177 were in England, and 19 in Scotland. In 1832 one-twentieth part of the soap duty was paid by a single house. The number of manufacturers in Ireland has decreased from 214 in 1835, to 183 in 1839. Every manufacturer of soap, both in Great Britain and Ireland, is required to take out an annual licence, which costs 4*l.*

The interference of the Excise in the manufacture of soap was, until recently, exceedingly arbitrary and vexatious; but in the 'Seventeenth Report of the Commissioners of Excise Inquiry' (Soap), dated Dec., 1835, the discontinuance of the system of survey which then existed was recommended. The Act which at present regulates the manufacture is the 3 and 4 Vic., c. 49, passed in August, 1840. It repealed seventeen other Acts, so far as they concerned the making of soap. The article may now be made in any way or of any material which the manufacturer thinks most judicious, as the Excise does not interfere with the process of manufacture.

The quantity of soap made in Great Britain at the undermentioned periods was as follows:—

| Year. | Hard. | Soft. |
|---|---|---|
| 1791 | 43,123,578 lbs. | 3,842,136 lbs. |
| 1801 | 52,427,791 | 3,199,609 |
| 1811 | 70,596,590 | 5,509,677 |
| 1821 | 89,168,834 | 7,758,938 |
| 1831 | 109,080,944 | 9,641,007 |

The quantity made from 1832 to 1840 inclusive, has been as follows:—

| Year. | Hard. | Soft. | Duty. |
|---|---|---|---|
| 1831 | 109,080,944 lbs. | 9,641,907 lbs. | £1,433,817 |
| 1832 | 119,503,092 | 10,350,703 | 1,569,262 |
| 1833 | 138,170,787 | 11,731,156 | 1,174,421 |
| 1834 | 144,344,043 | 10,401,281 | 945,489 |
| 1835 | 148,806,207 | 12,103,109 | 980,468 |
| 1836 | 146,539,210 | 13,358,894 | 971,523 |
| 1837 | 140,822,611 | 11,794,834 | 929,286 |
| 1838 | 158,573,948 | 13,549,998 | 1,047,545 |
| 1839 | 155,585,756 | 14,874,963 | 1,034,390 |
| 1840 | 159,220,068 | 13,535,856 | 1,079,448 |

The quantity made in England and Scotland in 1840 separately, was,—

| | Hard. | Soft. |
|---|---|---|
| England . | 148,803,574 lbs. | 8,917,668 lbs. |
| Scotland . | 10,416,494 | 4,618,188 |

The quantity used by manufacturers, on which an allowance is made, has varied so little during the last few years, that it will be sufficient to give the quantities used in each class of manufactures for 1840:—

| Allowance to Manufacturers of | Hard. | Soft. | Allowance. |
|---|---|---|---|
| Woollens . | 6,021,114 lbs. | 6,611,178 lbs. | £42,519 |
| Linens . . | 6,798 | 1,325 | 47 |
| Silk . . | 1,578,483 | 1,286,531 | 14,574 |
| Flax or Cotton | 1,965,414 | 611,859 | 14,514 |
| Total . | 9,571,809 | 8,510,893 | £71,955 |

In consequence of the increase of duty in 1816, the price of soap advanced to 82*l.* per ton in the two following years; but in 1821-2-3, owing to the low price of the raw materials, the price fell to 68*l.*; and from this period it gradually declined to 52*l.* in 1830. In 1834, after the reduction of the duty in the previous year, the price was 47*l.*; and at present it is 50*l.* per ton. The old duty of 3*d.* per lb. discouraged cleanliness, and led to disease and its attendant evils. The reduction to 1½*d.* has not only been successful as a financial measure, but has conferred the greatest benefit on the poorer classes, who now consume a better and therefore more economical soap than before. In 1834 the consumption of Great Britain was estimated at 6½ lbs. per head, and though it has not yet reached 7 lbs., the proportion of soap of better qualities now consumed has increased. As the Excise allowance of one-tenth in favour of the manufacturer ceased in May, 1833, it is necessary to add one-ninth to the quantity charged previous to that year, in order to institute a comparison between the quantities made before and after the reduction of duty. The illicit manufacture of soap is still carried on, but not to its former extent. The time has probably arrived when the duty might be reduced to 1*d.* per lb. on hard soap, and ½*d.* per lb. on soft, and at the same time these duties might be charged on soap consumed in Ireland. At present a drawback is allowed on all soap exported to Ireland, and fraudulent practices take place in both kingdoms in consequence of this arrangement, and of the article not being subject to duty in Ireland. The quantity of soap exported to Ireland from Great Britain in each of the years under-mentioned was,—

| | Hard. | Soft. | Drawback. |
|---|---|---|---|
| 1834 | 11,258,526 lbs. | 33,604 lbs. | £76,595 |
| 1835 | 12,459,747 | 8,458 | 77,966 |
| 1836 | 11,086,072 | 86,326 | 69,647 |
| 1837 | 10,040,747 | 98,018 | 63,163 |
| 1838 | 10,240,399 | 195,328 | 64,816 |
| 1839 | 9,375,451 | 161,216 | 59,268 |
| 1840 | 9,930,108 | 187,244 | 64,457 |

In 1840 Ireland exported 708,126 lbs. of soap to England, on which duty was paid; but it is stated that a large quantity of Irish soap is annually smuggled into England.

A small quantity of foreign soap is imported: in 1840, the importation amounted to 729 cwts., of which 398 cwts. were re-exported.

The exportation of English soap to foreign parts has been increasing within the last few years. This may partly be attributed to the more liberal character of the present Excise regulations for the manufacture of soap, which do not render it necessary to conform to certain processes, but permit the manufacturer to make experiments and improvements, and thus enable him to unite cheapness and excellence. Formerly, though obtaining the raw material at a lower rate than the manufacturers of other countries, he was unable to compete with them in foreign markets. A few years ago an English manufacturer brought soap-makers to London from Marseille, where excellent soap is made; but it was found that these men could not pursue the processes to which they had been accustomed, in consequence of the Excise restrictions. The countries to which soap is exported are not distinguished in the public accounts separately from candles; but the gross quantities exported in each of the following years were as under:—

| | Hard. | Soft. | Drawback. |
|---|---|---|---|
| 1834 | 12,459,747 lbs. | 8,458 lbs. | £77,966 |
| 1835 | 12,987,365 | 8,954 | 81,209 |
| 1836 | 13,548,895 | 8,239 | 84,716 |
| 1837 | 11,119,515 | 13,274 | 69.552 |
| 1838 | 16,175,681 | 7,713 | 101,130 |
| 1839 | 21,148,724 | 9,231 | 132,218 |
| 1840 | 22,004,075 | 7,008 | 140,745 |

SOAP, *Medical Uses of.* In pharmacy and medicine the term soap is applied to combinations not only of oily and fatty matters with the alkalis soda or potash, but also with the volatile alkali (ammonia), lime (an alkaline earth), and metallic oxides, especially oxide of lead; likewise to solutions of resins in liquid potash, such as guaiacin [GUAIACUM], called therefore *Sapo guaiacinus.* The combinations of oils with ammonia or lime, being very thin, are generally termed *liniments;* the common one of hartshorn with oil is an example of the former, while oil and lime-water constitute the common application to burns termed Carron oil, from its frequent employment in the great iron-works at that place. The combination of oil with oxide of lead is generally termed a *plaster.* Some combinations of a volatile or fixed oil with an acid are sometimes called soaps, such as that of oil of turpentine with hydrochloric acid (artificial camphor), or of almond oil with sulphuric acid (*Sapo acidus*): but these are scarcely entitled to be so regarded. Among continental pharmaceutists, many cerates and mixtures of metallic salts with common soap are termed *soaps*, but they are more correctly called plasters.

Of soaps properly so called there are two kinds, the *soluble* and the *insoluble.* To the first belong the soaps of soda, potash, and ammonia; to the latter, the combinations with lime and lead; but even the soaps of soda and potash are only perfectly soluble in *soft* water, for *hard* waters, especially those abounding in salts of lime, decompose the original union and form an insoluble soap.

Soaps are further divided into *hard*, when soda is employed in their formation, and into *soft*, when potash is used: each of these presents some varieties according to the nature of the ingredients associated with them in the manufacture. A soap is sometimes prepared in which both alkalis are used, but it belongs to the class of soft soaps.

Of hard soaps, the fine kinds are made with soda and the purer vegetable oils, and the inferior kinds with animal oils or the coarser vegetable oils or resins. White soda soap is prepared with caustic soda and olive oil (in Spain), or with almond oil (in France). In its purest state it is called *medicinal* soap; in a less pure state, it is called Alicant, Venice, or Spanish soap. The Castile or marbled soap has this appearance communicated to it by sulphate of iron and red oxide of iron being added and stirred through it when the soap is nearly made. These are impurities which render it less fit for medical use in many cases than the white soap. When properly prepared, white soap should neither make an oily mark on paper nor have a burning alkaline taste. It should be perfectly soluble in pure water and in alcohol. Its alcoholic solution is the ordinary chemical test of the purity or softness of water. When an alcoholic solution is evaporated, the residuum constitutes *transparent* soap.

White soda soap is the only one which should be used internally. It is chiefly employed to form pills, which are gently aperient and antacid; their power in this latter respect is greatly increased by the addition of exsiccated carbonate of soda: this combination is of great utility in the treatment of gouty and calculous disorders, when an alkali is indicated. In other cases it is used to prevent the pills becoming hard and insoluble. White soap furnishes a ready antidote to the strong mineral acids, in cases of poisoning by any of these.

Soft soap is directed by the London Pharmacopœia to be made with potash and olive oil, but this order is seldom complied with. The soft soap above mentioned, in which both soda and potash are used, is made with olive and other oils and tallow. It is employed only to form the compound sulphur ointment. Common soft soap is made with train or cod-fish oil and tallow; from its ordinary appearance, it is sometimes called *black* soap. If a slight excess of alkali exist, its detergent powers are thereby heightened. Soft soap is of great service in many cutaneous diseases, several of which, when in a mild form, may be cured by it alone. It may be rendered still more useful by the addition of sulphur or sulphuret of potash (liver of sulphur). In the treatment of scabies, porrigo (ring-worm), and such diseases, this application is far superior to the ointments and other greasy compounds commonly employed, which increase the filth or uncleanness by which the disease is aggravated. It is also much cheaper.

SOAP-BERRY. [SAPINDUS.]

SOAPSTONE. [STEATITE.]

SOAR, River. [LEICESTERSHIRE.]

SOBIESKI, JOHN, son of James Sobieski, a Polish noble, castellan of Cracow, and a distinguished warrior, was born in 1629, in the district of Olesko, in the present Gallicia, or Austrian Poland, near the sources of the Bug and the Bog, on the feudal estate of his ancestors. He was carefully brought up under the superintendence of his father; he completed his education at Paris; served for some time in the mousquetaires, or body-guards, of Louis XIV.; and travelled with his brother Mark in France, Italy, and Turkey. The young Sobieskis were staying at Constantinople when the news of a fearful insurrection of the Cossacks, who were joined by a multitude of Polish serfs, made them hasten home. They overran Polish Russia, and destroyed many people, especially priests and Jews. Out of hatred of Catholic intolerance, they obliged all the monks and nuns whom they could seize to marry each other under pain of death: the khan of the Tartars had also espoused their cause. The king of Poland, John Casimir, a weak prince, harassed by the proud independence of the magnates, opposed but a feeble resistance to the devastating torrent. At last the insurgents met with a check under the walls of Zamosc, and a peace was made with the Cossacks, but it was soon broken; and the Poles suffered many reverses, in one of which Mark Sobieski was killed by the hands of the Tartars. His brother John concontinued to serve in the army with distinction against the Cossacks and Tartars, as well as against the Swedes and Russians; for at that time Poland was assailed on every side, and nearly ceased to exist as a nation. In 1660 John Sobieski gained a victory over the Muscovite general Sheremetoff; and for several years after he continued to fight with success against both Muscovites and Tartars, in consequence of which he was raised to the dignities of grand marshal and grand hetman of Poland.

In 1667 Poland was invaded by 100,000 Cossacks and Tartars. Sobieski marched to meet them at the head of only 20,000 men. At first he kept on the defensive, in order to weary out the assailants; but seizing a favourable moment, he sallied out of his entrenchments, routed the enemy, and compelled them to sue for peace. Poland was thus again saved from destruction. In 1671 he routed the Turks, who were led by Sultan Mahomet IV.; and some time after he took from them the fortress of Kotzim, till then considered impregnable. On the death of king Michael Wisniowietski, in 1674, the diet assembled to name a successor. Several candidates appeared: Charles of Lorraine was countenanced by Austria, and Philip of Neuburg by Louis XIV. Sobieski himself proposed the Prince of Condé; but the palatine Stanislaus Jablonowski having stated in an eloquent speech his objections to those candidates, concluded by saying, 'Let a Pole reign over Poland,' and he proposed the conqueror of Kotzim, John Sobieski. The effect was electrical; all the Polish and Lithuanian nobles shouted 'Long live John III.,' and John was proclaimed king. The country was in a state of exhaustion: the regular army consisted of only a few thousand men, the treasury was empty, and the crown jewels were pledged to the Jews. Sobieski redeemed the jewels, raised several regiments at his own expense, and then marched to oppose the Turks, who were advancing with a large force. He was obliged to shut himself up within Lemberg, which was speedily invested; but taking advantage of a heavy fall of snow which a high wind blew in the face of the Turks, he issued from the town with a small but devoted band, and the cry of 'Christ for ever,' and completely routed the besiegers. A fresh Turkish army came, at the head of which was the brave pasha of Damascus, who had acquired in war the surname of 'Shaïtan,' or 'the Devil,' accompanied by a formidable artillery. Sobieski entrenched himself, with about 10,000 men, between two villages on the banks of the Dniester, and there sustained for twenty days the attacks of the enemy and a continued cannonade. At last, on the 14th October, 1676, the Polish king issued out of his entrenchments with his few remaining followers, whom he drew up in order of battle. The Turks, who numbered between two and three hundred thousand, were astounded, and they began to cry out that it could not be a mere man who risked such odds, that Sobieski must be a wizard, and that it was useless to contend with the wizard king. The 'Shaïtan' pasha was superior to such superstition; but he knew that the 'pospolite,' or *levy en masse*, of the kingdom, was at hand; and he offered Sobieski an honourable peace, which was accepted.

A few years of peace followed, at least external peace, for Poland was seldom if ever at peace within herself. The king's authority was set at nought by the nobles, who would not listen to reform or redress of grievances, and by their veto dissolved every diet in which the attempt was made. In his own family, Sobieski was teazed and tormented by his wife, a French woman by birth, an ambitious domineering woman, whom he had not the heart to restrain. But a new storm was gathering to draw out Sobieski's energies. This time the attack of the Turks was directed against Austria. The Turks were countenanced by Louis XIV., the 'most Christian king' of France, who wished to humble the house of Austria to the dust. A most formidable army, commanded by the grand-vizier Kara Mustapha, after sweeping over Hungary, in the month of July, 1683, invested Vienna, from which the emperor Leopold and his family had fled. Germany, Italy, all Europe, were in consternation. All eyes were turned towards Sobieski. The Polish king had no reason to love Austria, but, as a Christian prince, he determined to defend the Eastern bulwark of Christian Europe against the dreaded Ottomans. Having assembled at Cracow an army of 16,000 men, he marched to the banks of the Danube, and was met on the way by the duke of Lorraine and other German princes with their contingents, and at length found himself at the head of 70,000 men. Having crossed the Danube, he ascended the ridge of the Kalemberg, which overlooks the Austrian capital. On the morning of the 11th of September, the allied army, reaching the summit of the ridge, saw before them the wide-spread tents of the Ottoman host in the plain below. On the following day Sobieski's army descended the mountain to attack the vizier, and, after a hard struggle, drove the Turks into their entrenchments, which were fortified with great care, and appeared even to Sobieski too strong to be forced. It was five in the afternoon, and he had given up all idea of attack for that day, when he spied the vizier sitting at the entrance of his splendid tent, tranquilly sipping coffee, with his two sons beside him. This composure provoked Sobieski, and he gave orders for an immediate attack. The Polish hussars cleared the ditch and rode into the camp, the infantry followed, and, after a rude shock, the Ottomans were driven in a confused mass towards the tent of the vizier. Kara Mustapha attempted to make a stand, but in vain: at last he fled with the rest; and Sobieski remained master of the whole camp, artillery, baggage, and all. On the news of the deliverance of Vienna, all Europe resounded with acclamations. Sobieski pursued the Turks into Hungary, and he experienced a defeat at Parany, where he was exposed to great personal danger; but he defeated them again at Strigonia, and at last cleared the whole country of them.

Returning to his own kingdom, he found himself again involved in domestic troubles. Every attempt that he had made for the regeneration of Poland was thwarted by some of the turbulent nobles by means of the veto which the constitution gave to each. Sobieski was even called a tyrant and traitor because he fretted at his own impotence to do good to his country. At the close of the stormy diet of 1688, he addressed the assembly in a sad and almost prophetic tone: 'What will be one day the surprise of posterity to see that after being elevated to such a height of glory, we have suffered our country to fall into the gulf of ruin; to fall, alas! for ever. For myself, I may from time to time have gained her battles; but I am powerless to save her. I can do no more than leave the future of my beloved land, not to destiny, for I am a Christian, but to God, the High and Mighty. You know that I am no believer in auguries; I do not seek after oracles; I place no reliance on dreams. It is not from auguries, but from faith, that I learn that the decrees of Providence cannot fail of accomplishment. The power and justice of Him by whom the universe is governed regulate the destiny of states. Wherever during the lifetime of the prince crime is attempted with impunity, where altar is raised against altar, and strange gods followed under the very eye of the true one, there the vengeance of the Most High has already begun his work.'

Sobieski was an accomplished scholar, and very fond of learning: he acquired the Spanish language at an advanced age, amidst the cares of his kingdom.

In 1696 Sobieski was suddenly taken ill, and died, on Corpus Christi day, and with him Polish greatness may be said to have expired. He was the last of its really patriot kings.

(*Lettres du Roi de Pologne Jean Sobieski*, publiées par De Salvandy, Paris, 1826; *Histoire de Pologne*, by the same author.)

SOCCAGE (more correctly *socage*) in its original signification, according to Bracton, Littleton, and others, is service rendered by a tenant to his lord by the soc (soke) or ploughshare. The term was afterwards extended to all services rendered which were of an ignoble or non-military character, and were fixed in their nature and quality. The certainty of the services to be rendered distinguished socage tenure from tenure in chivalry, or by knight's service, on the one hand, and from tenure in pure villenage by arbitrary services, on the other; and therefore Littleton says, 'A man may hold of his lord by fealty [Fealty] only; and such tenure is a tenure in socage; for every tenure which is not a tenure in chivalry is a tenure in socage.' By some modern writers 'socage' is derived from 'soke,' a term importing a district having a particular jurisdiction. But there is no ground for supposing either that all lands within a 'soke' were held by one species of tenure, or that socage tenure was limited to such districts.

Socage is said by old writers to be of three kinds: socage in frank tenure; socage in antient tenure; and socage in base tenure. (*Old Tenures*, 125, 126; *Old Natura Brevium*, title *Garde*.) The second and third kinds are now called respectively tenure in antient demesne and copyhold tenure. The first kind is called free and common socage, to distinguish it from the two others, though as the term socage has long ceased to be applied to the latter, socage and free and common socage now mean one and the same thing.

Land denominated in Domesday 'reveland' is supposed by Lord Coke to be land holden by socage tenure. It was probably so called as being land from which the Reeve (the collector of the king's or lord's dues within the district) received rent in money, or in produce, in commutation for agricultural services.

Every tenure which had the same incidents as socage, properly so called, as derived from service of the plough, appears to have fallen under the same denomination. We however find the word soke used at a very early period for rent; and it is possible that the term socage may be derived, not immediately from the ploughshare, but from this secondary or derivative sense of the term soke.

Besides fealty, which the tenant in socage, like every other tenant, is bound to do when required, the tenant in socage, or, as he was formerly called, the socager or sockman, is bound to give his attendance at his lord's court-baron, if the lord holds a court-baron either for a manor [Manor] or for a seigniory in gross. This tenure is also still subject to a payment amounting to one year's additional rent upon the death of the tenant; which payment is sometimes called relief [Relief], from one of a similar nature due to the lord upon the death of a tenant by knight's service on the reverter of land to the lord.

Both forfeiture and escheat are incident to tenure in socage, as they were also to tenure by knight's service. [Escheat.] In that species of socage tenure which is called gavelkind [Gavelkind], and which exists in some parts of Kent, there is no forfeiture.

Wardship is also incident to this tenure. But this incident is not, as formerly in knight's service, a benefit given to the lord, but a burthen imposed on the infant's next friend of full age, who must however be a person not capable of inheriting the estate upon his young kinsman's death. So anxious was the law to avoid entrusting the person and the property of the infant to the custody of a party who might benefit by his death, that we find that in the thirteenth century even illegitimate relations might not be guardians in socage. (Bracton, 88, 'Wardship.'

By the mutual consent of lord and tenant, socage tenure might have been converted into tenure by knight's service, or tenure by knight's service into tenure in socage. It sometimes happened that the tenant held by knight's service of a lord who held in socage; and, more frequently, that a tenant held in socage of a lord who held by knight's service.

In particular districts some of the incidents of tenure by knight's service were by custom annexed to the tenure in socage. Thus in the diocese of Winchester the lord claimed the wardship and marriage of his socagers.

Before the abolition of feudal burthens by the Commonwealth, confirmed upon the Restoration by 12 Car. II., c. 24, tenants in socage were bound to pay 20*s.* upon every 20*l.* of annual value, as an aid for making the lord's son a knight, and the same for marrying the lord's eldest daughter.

This tenure was also subject to the payment of fines upon alienations.

By the above statute, the provisions of which were extended to Ireland by the Irish Act of 14 and 15 Car. II., c. 19, tenure by knight's service was abolished, and all lands, with the exception of ecclesiastical lands held in free alms [FRANKALMOIGNE], were directed to be held in free and common socage, which, with the limited exception in favour of lands held in frankalmoigne, is now the universal tenure of real property throughout England and Ireland, and those colonies which have been settled by the English.

It is true that a large portion of the soil of all those countries is held by leaseholders, and in England also by copyholders; but the freehold of the land held by leaseholders and copyholders is in their lords or lessors, who hold that freehold by socage tenure.

SOCIAL WAR, also called the Marsian or Italian War (Bellum Sociale, Marsicum or Italicum), lasted from 91 till 89 B.C., and was the most formidable war ever carried on in Italy during the dominion of the Romans. The object of Rome was to maintain her supremacy over Italy, and that of her enemies was to annihilate Rome, and to establish an Italian republic on new principles of representation. It arose from the desire of the Italians to be placed on a footing of equality with the Romans as to the Roman franchise. The Italians contributed largely to the maintenance of the republic, and a great portion of the Roman armies always consisted of them. The natural result of this consciousness of their own importance was a wish to have a share in the administration of the state which they upheld, and for which they were constantly shedding their blood. The relation of the Italians to the ruling Romans at this time had great similarity to the position in which the plebeians had formerly been with respect to the patricians. Attempts to bestow the franchise upon the Italians had been made by C. Gracchus and M. Fulvius, but their hopes had been disappointed by the Roman aristocracy, who strenuously opposed all measures of that kind. During the period preceding the outbreak of the Social War, several distinguished Italians had taken up their abode at Rome, and had exercised the Roman franchise, and the Romans had connived, and tacitly recognised their citizenship. But just at the time when the Italians began loudly to demand the franchise, the consuls L. Licinius Crassus and Q. Mucius Scaevola the pontifex (95 B.C.) carried the Lex Licinia Mucia, which enacted that all those who had illegally exercised the Roman franchise should quit Rome, and return to their former homes. (Ascon. Ped. *in Cornel.*, p. 67, ed. Orelli; Cic., *Pro Sext.*, 13; *De Off.*, iii. 11.) This act at such a time naturally created great exasperation among the Italians, though they still hoped that their claims might be granted in a peaceful way. Four years passed without anything being done, until in 91 B.C. the tribune Livius Drusus, in his Lex de Civitate Sociis donanda, renewed the attempt of Gracchus and Fulvius; but he was assassinated before he had attained his object. (Appian, *Civil.*, i. 36; Liv., *Epit.*, lib. 71.) Immediately after this act of violence another law (Lex Varia) was carried by the tribune Q. Varius, which enacted that all those should be prosecuted who had either publicly or secretly supported the claims of the Italian allies (Appian, *Civil.*, i. 37; comp. Ascon. Ped. *ad Cornel.*, p. 73; Orelli, *Onomast. Tull.*, iii., p. 291), and in consequence of this law the principal friends of the Italians were compelled to go into exile. It was now evident that the Italians could never hope to obtain their end without resorting to force. There arose a general commotion among the several nations of Italy: the Picentians, Vestinians, Marsians, Pelignians Marrucinians, Samnites, and Lucanians entered into a sort of confederacy among themselves, secret embassies were sent from place to place, and at last a meeting of deputies was held at Asculum, in the country of the Picentians. The Latins, Etruscans, Umbrians, and Campanians did not join the insurgents. The Romans in the meanwhile also sent out their emissaries in various directions, with the intention of putting down the insurrection either by persuasion or by threats; but when the proconsul Servilius Caepio appeared at Asculum, and angrily exhorted the confederates to desist from their undertaking, he and his legate Fonteius were murdered by the enraged people in the theatre. All the Romans who were at the time at Asculum suffered the same fate, and their property was seized and destroyed. (Appian, *Civil.*, i. 38; Vell. Pat., ii. 15; Liv., *Epit.*, lib. 72.) After these occurrences an embassy was sent to Rome, to try whether the question might still be settled peaceably; and when this last attempt was fruitless, the Italians rose in arms. All their towns were protected by strong garrisons, independent of which their army, which was ready for fighting, amounted to nearly 100,000 men. The force which the Romans had to oppose to them was nearly equal, for they had drawn reinforcements from all quarters, and even enlisted their freedmen, which had never been done before. (Appian, *Civil.*, i. 49; Liv., *Epit.*, lib. 74.) The Italian allies were determined to raze Rome to the ground, and to form all Italy into one great confederate republic. Arrangements were made accordingly; Corfinium was made the capital of the new republic, and its name was changed into Italica. (Strabo, v. 4, p. 391, Tauchnitz; Vell. Pat., ii. 16.) The administration was entrusted to a senate, consisting of five hundred deputies, elected by the several towns of the confederacy, to two consuls, and twelve praetors. (Diodor., *Fragm.*, lib. 37, p. 245, ed. Tauchnitz.) The Marsians Silo Popaedius and C. Papius Mutilus were the first two consuls of the confederacy. Other distinguished generals among them were Herius Atinius, Insteius Cato, C. Pontidius, Marius Egnatius, Telisinus Pontius, and others. The war extended nearly over all Italy. The accounts which we have of it are so obscure, incoherent, and fragmentary, that it is impossible to trace all the operations in detail. The whole scene of the war may however be divided into three regions: the southern, comprehending the south of Italy as far as the river Liris; the middle, from the Liris to the frontiers of Picenum; and the northern, which was chiefly in Picenum. The Roman army in the south of Italy was under the command of L. Julius Cæsar and four legates; the forces of the confederates in this quarter were commanded by C. Papius Mutilus, who took many towns, and transferred the war into Campania, where the Samnites, commanded by Marius Egnatius, put L. Cæsar to flight, though some time afterwards he gained a victory near Acerrae. His colleague, the consul P. Rutilius Lupus, with five legates, commanded in central Italy, and was opposed to Silo Popaedius, a very distinguished general, whose uninterrupted success was only checked by the energy of the legates Marius and Sulla. Rutilius himself was slain in Apulia by Vittius Cato, and Q. Caepio, one of his legates, by Silo Popaedius. Marius was now entrusted with the command of the whole army of Rutilius. At the end of the first year the confederates had gained decided advantage over the Romans. The Etruscans and Umbrians also began to join the confederates, but they were soon reconciled to Rome. At this perilous juncture the Romans devised an admirable plan for strengthening themselves by the celebrated Lex Julia de Civitate, B.C. 90, which conferred the Roman franchise (Romana Civitas) upon all the Latins and Socii (Sociis et Latinis; Cic., *Pro Balb.*, 8), who had remained faithful to Rome. Upon these new citizens Rome could now place full dependence, and her armies were strengthened by them. Rome, with her central position, and surrounded by the faithful Latins, had thus great advantages over the Italians, who were obliged to leave strong garrisons in all their towns, and thus to split their forces into many fractions. The Latin colony Aesernia however was taken by the Samnites. The first signal victory which the Romans gained was in 89 B.C., under the consul Cn. Pompeius Strabo, who defeated 70,000 Italians at Asculum, which was destroyed. This victory was followed by several others, for L. Murena and Metellus Pius defeated the Marsians; Sulla, the Hirpinians and Samnites, who now transferred the seat of government from Corfinium to Aesernia, and henceforth, notwithstanding their defeat, became the soul of the war. Several of the confederates, disheartened by the success of the Roman arms, deserted the common cause, and concluded separate treaties with Rome, until at last the Samnites and Lucanians alone carried on the war. The undertakings of Mithridates in Asia, and the connections which the Italians began to form with him (Diodor., *Fragm.*, lib. 37, p. 247, Tauchnitz), as well as the hostility between Marius and Sulla, rendered the Roman senate now more than ever inclined to bring the destructive war to a close. In consequence of this the Roman franchise was promised to all who would lay down their arms. The offer was accepted by all, with the exception of the Samnites, who were resolved either to conquer or to perish, and who, in the civil war which soon ensued, joined the party of Marius. [SAMNITES, p. 380.]

Nearly all the nations of Italy now acquired, one after another, the franchise. Concerning the relation of these new citizens to the old ones, see ROME, p. 109. At the end of this war, then, Rome was, notwithstanding the reverses of the Italians, compelled to grant what at its commencement she had obstinately refused; but this refusal cost her and Italy the flower of their population, for nearly 300,000 lives were lost during these fatal two years (Vell. Pat., ii. 15), many towns were destroyed, and many districts laid waste, which were never restored to their former state of prosperity.

The history of the Social War is the subject of several separate works in modern times, among which there is one by Heyne, 'De Belli Romani Socialis Causis et Eventu, respectu ad Bellum cum Coloniis Americanis gestum habito,' in his 'Opuscula,' vol. iii., p. 144, &c.; C.G. Keferstein, 'De Bello Marsico,' Halae, 1812; C. A. F. Weiland, 'De Bello Marsico,' Berlin, 1834.

SOCIETIES, LITERARY AND SCIENTIFIC. A sketch of the origin and general history of associations for the cultivation of particular branches of science and literature will be found under the word ACADEMY, along with an enumeration of the most distinguished among such of these bodies or institutions as have adopted that name. As is there stated, what would be called academies on the Continent are more commonly called societies both in England and in the United States of America; and a few of them are also so designated in France and other Continental countries.

I. BRITISH SOCIETIES.

Of some of the principal of these, such as the Royal Societies of London and Edinburgh, detailed accounts are given under their names. Some of those established in provincial towns will also be found noticed in the articles on the towns. The following list however includes all the literary and scientific societies existing in the United Kingdom and its dependencies, that are of any eminence, whether elsewhere mentioned or not:—

Society for promoting the Discovery of the Interior parts of Africa, commonly called the African Association. [AFRICAN ASSOCIATION, vol. i., p. 188.]

Royal Agricultural Society of England; established 1838; incorporated 1840.

Agricultural Society of Ireland; established 1840.

Society of Improvers in the Knowledge of Agriculture in Scotland; (extinct) 'Select Transactions,' prepared for the press by Robert Maxwell, 8vo., Edinburgh, 1743.

Society of Antiquaries of London, commonly called the Antiquarian Society. [ANTIQUARIES, SOCIETY OF, vol. ii., p. 117.]

Society of Antiquaries of Scotland; established 1782, incorporated 1783; 'Transactions,' 4to., Edinburgh, 1792, &c.

Society of Antiquaries of Newcastle-upon-Tyne; 'Archaeologia Aeliana,' 4to., Newcastle, 1816, &c.

Society of Apothecaries of London. [APOTHECARIES, COMPANY OF, vol. ii., p. 175.]

Architectural Society of London; established 1806; 'Essays,' 8vo, London, 1808, &c.

London Society for the Encouragement of Arts, Manufactures, and Commerce; established 1753. 'Transactions,' vol. i., 8vo., London, 1783. [SOCIETY FOR THE ENCOURAGEMENT OF ARTS, &c.]

Bahama Agricultural Society; 'Communications,' 4to. Nassau, 1802, &c.

Bath Society for the Encouragement of Agriculture, Arts Manufactures, and Commerce; founded 1777; 'Letters and Papers,' 8vo., Bath, 1792, &c.

Society of Arts for Scotland.

Association for the Promotion of the Fine Arts in Scotland; established 1834.

Society of Artists of Great Britain; incorporated 1765; re-incorporated 1768, under the name of the Royal Academy of Arts. [ROYAL ACADEMY, vol. xx., p. 202.]

Asiatic Society of Bengal; founded at Calcutta, 1784 [ASIATIC SOCIETIES, vol. ii., p. 484.]

Royal Asiatic Society of Great Britain and Ireland founded at London, and incorporated, 1824. [ASIATIC SOCIETIES, vol. ii., pp. 484, 485.]

Bombay Asiatic Society, originally Literary Society of Bombay. [ASIATIC SOCIETIES, vol. ii., p. 485.]

Madras Royal Asiatic Society, originally Literary Society of Madras. [ASIATIC SOCIETIES, vol. ii., p. 485.]

Royal Astronomical Society of London; founded 1820; 'Memoirs,' 4to., London, 1822, &c.

Botanical Society of London.

British Association for the Promotion of Science; established 1831; 'Transactions' in 8vo. annually.

Cambridge Philosophical Society; established 1819; incorporated 1832; 'Transactions,' 4to., Cambridge, 1821, &c.

Camden Society for the Publication of Early Historical and Literary Remains; founded at London, 1838; first publication, 1839.

London Society for promoting Practical Design.

Society for the Diffusion of Useful Knowledge; established 1826; incorporated 1832; first publication, 1827.

Royal Dublin Society for Improving Husbandry and other Useful Arts; incorporated 1749 [DUBLIN, vol. ix., p. 172]; 'Weekly Observations,' 8vo., Dublin, 1739, &c.; 'Transactions,' 8vo., Dublin, 1799, &c.

Other Dublin Societies. [DUBLIN, vol. ix., p. 172.]

Central Society of Education; first publication, 12mo., London, 1837.

Smeatonian Society of Civil Engineers; incorporated 1818. [SMEATON, p. 145.]

Entomological Society of London; established 1806, 'Transactions,' 8vo., London, 1807, &c.

Royal Geographical Society of London; established 1831; 'Journal,' 8vo., Lon., 1832, &c.

Geological Society of London; established 1807; 'Transactions,' 4to., London, 1811, &c.; Second Series, 1824.

Royal Geological Society of Cornwall; established 1814; 'Transactions,' 8vo., London, 1818, &c.

Harveian Society of London.

Highland Society of London; founded 1778; incorporated 1816.

Highland and Agricultural Society of Scotland; founded 1784; 'Prize Essays and Transactions,' 8vo., Edinburgh, 1799, &c.; New Series, 8vo., Edinburgh, 1829, &c.

Horticultural Society of London; founded 1804; 'Transactions,' 4to., London, 1807, &c.; Second Series, 4to., 1835 &c.

Caledonian Horticultural Society; 'Memoirs,' 8vo., Edinburgh, 1814, &c.

Hunterian Society of London.

Royal Jennerian Society; founded 1803; 'Annual Reports,' 8vo., London, 1804, &c.

Linnean Society of London; founded 1788; incorporated 1802; 'Transactions,' 4to., London, 1791, &c.

Royal Society of Literature of the United Kingdom; incorporated 1823; 'Transactions,' 4to., London, 1827, &c.

Bath Royal Literary and Scientific Society.

Bristol Literary and Philosophical Society.

Hull Literary and Philosophical Society.

Leeds Literary and Philosophical Society.

Manchester Literary and Philosophical Society; founded 1781; 'Memoirs,' 8vo., 1789, &c.; Second Series, 8vo., 1805, &c. [See vol. xiv., p. 374.]

Edinburgh Society for Improving Medical Knowledge; founded 1731 (on the basis of the Edinburgh Philosophical Society, established in 1718); converted into Society for Improving Arts and Sciences, 1739 (now the Royal Society); 'Medical Essays and Observations,' 5 vols 8vo., Edinburgh, 1733-44.

Westminster Medical Society.

Medico-Botanical Society of London; 'Transactions,' 8vo., London, 1829, &c.

Royal Medical and Chirurgical Society of London; established 1805; 'Medico-Chirurgical Transactions,' 8vo., London, 1815, &c.

Medico-Chirurgical Society of Edinburgh; 'Transactions,' 8vo., Edinburgh, 1824, &c.

Mineralogical Society of London; established 1799 (incorporated with Geological Society in 1811).

Motett Society for revival of the Antient Choral Music of the Church; established 1841.

Royal Academy of Music.

Natural History Society of London.

Natural History Society of Manchester.

Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne; 'Transactions,' 4to., Newcastle, 1830, &c.

Natural History Society of Shropshire and North Wales.

Natural History Society of Warwickshire.

Literary and Philosophical Society of Newcastle-upon-Tyne; established 1793; 'Annual Reports,' 8vo., Newcastle, 1794, &c. [NEWCASTLE, vol. xvi., p. 187.]

Ornithological Society of London.

British Institution, established 1805, exhibits annually in Pall-Mall.

Society of British Artists, exhibiting in Suffolk Street, Pall-Mall East; first exhibition, 1824.

Society of Painters in Water Colours, exhibiting in Pall-Mall East.

New Society of Painters in Water Colours, founded in or about 1832; exhibits annually.

Percy Society, for publishing old ballad poetry, &c.; established 1840; first publication, 1840.

Phrenological Society of Edinburgh; 'Transactions,' 8vo., Edinburgh, 1824, &c.

London Phrenological Society.

Society of Physicians in London (extinct); 'Medical Observations and Enquiries,' 6 vols. 8vo., London, 1757-84.

Royal Physical Society of Edinburgh; established 1786.

Royal Polytechnic Society of Cornwall; established 1833; 'Annual Reports,' 8vo., Falmouth, 1833, &c. [FALMOUTH, vol. x., p. 192.]

Geological and Polytechnic Society of the West Riding of Yorkshire; established 1838.

Royal Society of London. [ROYAL SOCIETY, vol. xx., p. 206.]

Royal Society of Edinburgh. [ROYAL SOCIETY, vol. xx., p. 211.]

Shakespeare Society, for publishing works relating to Shakespeare and the drama; established 1840; first publication 1840.

Statistical Society of London; established 1834; 'Journal,' 8vo., London, 1838, &c.

Statistical Societies of Birmingham, Bristol, Glasgow and Clydesdale, Leeds, Liverpool, Manchester, and Ulster; all established since 1833; have almost all published Transactions or Reports.

Surtees' Society; first publication, 1835.

Wernerian Natural History Society; established 1808; 'Memoirs,' 8vo., Edinburgh, 1811, &c.

Yorkshire Philosophical Society

Zoological Society of London; incorporated 1825; 'Transactions,' 4to., London, 1835, &c.

Cambridge Antiquarian Society; established 1839. Some 'Transactions' published.

Royal Institute of British Architects; established 1835; incorporated 1837; London.

Oxford Architectural Society; established 1839.

Ashmolean Society, Oxford.

Royal Botanic Society; incorporated by charter 1839.

Cambridge Camden Society; established 1839.

Institution of Civil Engineers; established 1817; incorporated 1828. 'Transactions,' 1st vol., 4to, 1836.

Historical Society of Science; established 1840; first work published 1841.

Microscopical Society; established 1839.

Musical Antiquarian Society, for publishing scarce English Music; established 1840; first publication 1841.

Parker Society, for printing works of the early fathers of the Church; established 1841.

Spalding Club, Aberdeen; established 1840; for antiquarian objects.

Numismatic Society; established 1837.

Art Union of London; established 1836.

Art Union of Ireland.

Granger Society, for publishing portraits and memoirs of illustrious persons; established 1840; first publication 1841.

II. AMERICAN SOCIETIES.

American Philosophical Society, Philadelphia; founded 1769; 'Transactions,' 8vo., Philadelphia, 1804, &c.; New Series, 4to., Philadelphia, 1818, &c. [PHILADELPHIA, vol. xviii., p. 71.)

American Historical Society, Philadelphia. [PHILADELPHIA, vol. xviii., p. 71.]

Massachusetts Historical Society, Boston; founded 1791; 'Collections,' 8vo., 179 , &c.

Historical Society of New York; founded 1804; 'Collections,' 8vo., 18 , &c.

New York Literary and Philosophical Society; founded 1815; 'Transactions,' 4to., 1815, &c.

Medical Society of New York.

Historical Society of Concord, New Hampshire.

Essex Historical Society, at Salem, Massachusetts.

American Antiquarian Society; 'Transactions,' 8vo., Worcester, 1820, &c.

III. CONTINENTAL SOCIETIES.

Société Royale de Médecine; established 1776, afterwards incorporated with the Institut National [see vol. xii., p. 497]; re-established 1820; 'Mémoires,' 4to., Paris, 1779, &c.

Société des Pharmaciens de Paris; (?) 'Journal, ou Recueil d'Observations de Chimie et de Pharmacie,' 4to., 1797, &c.

Société Royale d'Agriculture de Paris; (?) 'Mémoires d'Agriculture, d'Economie Rurale et Domestique,' 8vo., 1785, &c.

Société de Botanistes; 'Journal de Botanique,' 8vo., Paris, 1808, &c.

Société Philomathique de Paris; 'Bulletin des Sciences,' 4to., Paris, 1797; 8vo., 1799; 'Nouveau Bulletin,' 4to, Paris, 1807, &c.

Société d'Histoire Naturelle de Paris; (?) 'Actes,' folio, Paris, 1792, &c.

Société Royale des Antiquaires de France, formerly Académie Celtique; (?) 'Mémoires et Dissertations sur les Antiquités Nationales et Etrangères,' 8vo., Paris, 1817, &c.

Société de Géographie de Paris; 'Recueil de Voyages et de Mémoires,' 4to., Paris, 1824, &c.

Société d'Arcueil; 'Mémoires de Physique et de Chimie,' 8vo.

Société d'Encouragement pour l'Industrie Nationale; Paris; 'Bulletins,' 4to., 1802, &c.

Société des Sciences, d'Agriculture, et des Arts du Département du Bas Rhin; 'Journal,' 8vo., Strasburg, 1824, &c.; 'Nouveaux Mémoires,' 8vo., Strasburg, 1832, &c.

Société de Physique et d'Histoire Naturelle de Génève; 'Mémoires,' 4to., Gén., 1821, &c.

Literary Society of Brussels.

Dutch Society of Sciences (Hollandsche Maatschappij der Weetenschappen), at Haarlem; (?) 'Transactions' (Verhandelingen), in Dutch, 8vo., Haarlem, 1754; in German, 8vo., Altenburg, 1758, &c.

Batavian Society (Bataafsch Genootschap der Proefenderfindelyke Wiisbegeerte); 'Transactions,' 4to., Rotterdam, 1774, &c.; new series, 4to., Amsterdam, 1800, &c.; 'Physical Transactions,' (Naturkundige Verhandelingen), 8vo., Amst. and Haar., 1799, &c.; 'Transactions,' (Wiisgeerige Verhandelingen), 8vo., Amst., 1811, &c.

Batavian Society of Language and Poetry (Bataafsche Maatschappij van Taal en Dichtkunde); 'Transactions' (Werken), 8vo., 1804, &c.

Societas Philologica Lipsiensis; 'Commentarii,' ed. curavit C. D. Beckius, 8vo., Lips., 1801, &c.; second series, 1811, &c.

Societas Artium et Doctrinarum Rheno-Trajectina; 'Nova Acta,' 8vo., Utrecht, 1821, &c.; and in Dutch, 'Nieuwe Verhandelingen,' 8vo., Utrecht, 1822, &c.

Literary Society of Flushing.

Hamburg Society (Hamburgische Gesellschaft); 'Transactions,' &c. ('Verhandlungen und Schriften, nebst der Geschichte'), 8vo., Hamb., 1792, &c.

Royal Botanical Society of Bavaria, at Ratisbon; 'Transactions' (Schriften), 8vo., Ratisbon, 1792, &c.; 'Memoirs' (Denkschriften), 4to., Ratis., 1815, &c.

Society of Natural History, and other Societies, at Berlin. [Vol. iv., p. 298.]

Societas Latina Jenensis; (?) 'Acta,' edita ab J. E. Walchio, 8vo., Jen., 1752, &c.

Mineralogical Society of Jena.

Natural History Society (Naturforschende Gesellschaft) of Danzig; 'New Memoirs,' 4to., Danzig and Halle, 1820, &c.

Bohemian Society of Mathematics and National and Natural History (Privat-Gesellschaft in Böhmen zur Aufnahme der Mathematik, der Vaterländischen Geschichte, und der Natur-Geschichte); 'Transactions,' 8vo., Prague, 1775, &c.; New Series ('Neuere Abhandlungen der K. Böhmischen Gesellschaft der Wissenschaften'), 4to., Vienna and Prague, 1791, &c.

Royal Society of Sciences of Göttingen; founded in 1751; publishes the 'Göttingische Gelehrte Anzeigen,' which first appeared in 1739, before the foundation of the Royal Society, and under the title of 'Göttingische Zeitungen.'

Suabian National Society of Physical Philosophy and Natural History (Vaterländische Gesellschaft der Physiker und Naturforscher Swabens); 'Memoirs,' 8vo., Tübingen, 1805, &c.

Copenhagen Society of Literature and Science, Domestic and Foreign (Kiöbenhavnske Selskab af Laerdoms og Videnskabers, &c.); 'Memoirs,' 4to., Copen., 1747, &c.

Royal Danish Scientific Society; 'Memoirs,' 4to., 1781, &c.; New Series, 4to., 1801, &c.

Icelandic Royal Society of Copenhagen; and other Icelandic Societies. [See vol. xii., p. 126.]

Upsal Royal Society of Sciences; founded in 1720; 'Transactions,' 4to., 17.., &c.

Gothenburg Royal Society of Sciences and Belles Lettres.

Société des Naturalistes de l'Université Imperiale de Moscow; 'Mémoires,' 4to., Moscow, 1806, &c.

The few American societies must be considered as set down according to a loose notion of their respective eminence or importance; and the Continental societies are grouped as French, Belgic, Dutch, Hamburg, German, Danish, Icelandic, Swedish, Russian following what seemed the most natural connection of the several countries.

SOCIETY FOR THE DIFFUSION OF USEFUL KNOWLEDGE. In the month of November, 1826, Mr. Brougham convened a meeting of gentlemen, who formed themselves into a committee for promoting the composition, publication, and distribution of elementary works upon all branches of useful knowledge. The two main objects in view were to give the people books which might convey knowledge to uneducated persons, or persons imperfectly educated, and to reduce the price of scientific and other useful works to the community generally. The committee then founded a society, under the name of The Society for the Diffusion of Useful Knowledge, composed of donors of 10*l.* and annual subscribers of 1*l.* The average income arising from annual and life subscription in each of the first five years was 300*l.*, from which one-half is to be deducted for works given to subscribers. From that time the subscriptions gradually diminished; indeed the pecuniary support of the Society was after the first year derived almost entirely from the sale of its works.

In the year 1832 the Society was incorporated by a charter, which vested in the London committee the whole of its property, and gave them the control over its proceedings. The London committee consists of a chairman, of a vice-chairman and a treasurer elected annually, and sixty members, who hold their seats until forfeited by neglect of the duties prescribed by the by-laws of the Society.

From its outset the Society excluded from its works all subjects that involved differences of religious opinion, partly because the different religious bodies had occupied that field far more efficiently than the Society could hope to do; partly because the Society was supported by men of various religious opinions, and intended to address itself to the whole people without distinction of sect. Excepting in so far as the history of the Church may trench upon matters that belong to controversial theology, this rule of the Society has been strictly observed. Upon two occasions the rule excluding theological matter has caused works which had been intended to be undertaken by the Society to be prepared and published by individuals connected with it in their separate and private capacity, namely, the 'Illustrated Edition of Paley,' by Lord Brougham and Sir C. Bell, and Mr. Charles Knight's 'Pictorial Bible.'

The usual method adopted by the Society for the preparation of its works has been to engage the assistance of authors; these in the first instance submit a plan for the approval of the committee, by whom the manuscript and proofs of the works are usually revised. The committee has also in several instances engaged the service of an editor, who conducts the works entrusted to him, under the superintendence and control of the committee. The proofs are often likewise referred by the committee for revision to gentlemen not members of their own body; and these referees are sometimes, according to circumstances, remunerated for their assistance. By means of the local committees, a list of which is printed periodically on the wrapper of the Society's publications, and with the assistance of friends to the diffusion of useful knowledge in many parts of Great Britain and Ireland, various works that have been published by the Society, and particularly articles in their periodical publications, have had the advantage of the revision of persons who, from possessing local knowledge, or from other circumstances, have been enabled to make valuable corrections and additions. The copyright of the works published under the Society's superintendence is usually assigned to the Society, unless when the work has been projected by one of its publishers, and produced and conducted with his capital. Such has been the case with many of those published by Mr. Charles Knight.

The revenue which the Society derives from its works is usually a rent paid by the publisher for the use of the copyright, proportionate to the cost and price of the work, and the number of the edition.

The Society has published or superintended the publication of the following works:—1, 'The Library of Useful Knowledge,' consisting of a series of treatises on various branches of knowledge, as pure mathematics, physics, history, biography, and geography. These treatises comprehend nearly the whole of the sciences taught, reaching to their most abstruse parts; but treatises on each branch of physics have been also published, adapted to the conveyance of instruction in the most elementary and popular form. There are for example treatises teaching as much of natural philosophy as can be conveyed without a knowledge of mathematical science. Three hundred and sixty numbers of this series have been published. 2, 'The Farmer's Series,' consisting of works on the horse, on various kinds of cattle, on planting, on farms, on farm implements, and other agricultural subjects. 3, 'The Library of Entertaining Knowledge,' which consists of volumes, largely illustrated, relating to history and biography, arts and antiquities, descriptive geography, and natural history, treated in a popular manner. 4, 'The Journal of Education,' 10 vols. 5, 'The Penny Magazine,' 9 vols. 6, 'The Penny Cyclopædia,' 21 vols. (not yet finished). 7, A series of Maps, almost complete, and consisting of nearly 200 maps and plans of great cities: these maps are founded on the best and most recent authorities, and are prepared under the superintendence of the Society. 8, Maps of the Heavens. 9, 'The Gallery of Portraits,' containing engraved likenesses of eminent men, from original portraits or other good authority, with memoirs, in 7 vols. 10, Almanacs and Companions to them, from 1828 to 1842, both inclusive. 11, 'The Working Man's Companion.' 12, 'The Library for the Young.' 13, 'The Statistics of Great Britain.' 14, 'A Treatise on Friendly Societies;' 'A Treatise on Annuities;' 'A Manual for Mechanics' Institutions, and a Report of the Condition and Prospects of these Institutions 15, A Series of Treatises on Governments. 16, 'Tables of Logarithms,' and Barlow's 'Tables of Squares, Cubes, &c.' The total number of volumes of various sizes hitherto (Nov., 1841) issued by the Society is 168.

From the profit of some of these works the Society has derived a considerable income, which it has devoted to the preparation of others, tending either to the advancement of science or to the moral or physical improvement of the people Thus the work on the Statistics of the British Empire, and afterwards a set of large astronomical maps, were prepared with the Society's funds without hope of profit. Again, in the year 1829 the Society collected from all the Friendly Societies in England returns of the amount of sickness and mortality experienced by them during the preceding five years; and from these returns and other data a work was written by Mr. Ansell. More recently it has made similar inquiries concerning the state of Mechanics' Institutions, and has published the result of the inquiries, with suggestions for the improvement of those useful bodies, which it has united into associations in various parts of the kingdom, for mutual advice and assistance. The Society is prohibited by its charter from dividing any profit among its members, or in any way deriving gain from its publications: all that it does and can do is to make the profit on one work pay for the loss on another.

An impartial estimate of the direct and indirect effects of the Society's labours can scarcely be expected in this place, nor shall we attempt more than the statement of a few facts. Until the publication of 'The Library of Useful Knowledge,' persons of small means were unable to procure any scientific works, except at a high price and in a cumbrous form; nor were there any separate elementary treatises of particular branches of science that could be had for a few pence. Thus in all the memoirs of men who have raised themselves by their own exertions from humble circumstances to literary or scientific fame, we find that the greatest difficulty which they have had to encounter has been the obtaining of books. Of many of the scientific treatises in 'The Library of Useful Knowledge,' more than 25,000 copies have been sold, and the demand for them continues. Of 'The Penny Magazine,' the sale at one time reached nearly 200,000 copies; and if the sale has diminished, it is because other publications of the same kind afford to purchasers an opportunity of selection. The extent of the sale may be conceived when it is stated that for one woodcut as much as fifty guineas have been paid, to replace which (independently of the authorship and the cost of paper and printing, and other illustrations of that number) nearly 20,000 copies must have been sold. Until the publication of the Society's series, maps were luxuries confined to the rich; now nearly 25,000 copies of many of its maps have been sold; and other maps of the same form, and nearly as cheap as the Society's, have been published with success. But besides the direct benefit conferred on the public by placing in their hands works carefully prepared, vast advantage has been derived from the example of the Society's success. No sooner had 'The Penny Magazine' become successful, than the Christian Knowledge Society devoted a part of its large funds to the publication of 'The Saturday Magazine,' a meritorious work, similar in design to 'The Penny Magazine;' and soon afterwards the same body superintended the preparation of a series of popular works on subjects of general literature and science. The publication of the Society's 'British Almanac' was followed by an immediate improvement in those issued by the Stationers' Company, the suppression of two of the most absurd, and the publication of an excellent almanac by that corporation. 'The Library of Useful Knowledge' was followed (almost immediately) by Lardner's 'Cabinet Cyclopædia,' a work different in its form, but identical in its plan; and 'The Family Library,' published by Mr. Murray, was issued very soon after the first parts of 'The Library of Entertaining Knowledge' had appeared.

The sale of many of the Society's works has demonstrated that it is in most instances more profitable to count on a large number of purchasers for a good work, and accordingly to fix a low price, than to publish books in a costly form for the few.

Translations of many of the Society's works, especially of 'The Library of Useful Knowledge,' have been made into French, Spanish, and German. 'The Preliminary Discourse' has been also translated into Dutch, Swedish, and Portuguese. Societies after the model of that which we are describing, and with much the same name, have been founded at Paris, Madrid, Lisbon, Stockholm, Bombay, and at Canton, most of these being in correspondence with the London Society.

The effect of the Society's labours is demonstrated by the extensive adoption of the general principles on which they started, which is now apparent in the proceedings of the publishers generally. In one particular indeed it would be ruinous for the latter to imitate the former, namely, in expending their profits upon useful but unsaleable works; though it must be acknowledged that publishers frequently do, from want of foresight, that which the Society does from principle. In either case the benefit to the public is the same: works which produce useful effects by means of the few who require them, are attainable through the miscalculation of the publisher, as well as through the intentional expenditure of the Society. With regard to the latter however, it must be stated that their name, and the mode of their publication, has frequently extended the circulation of their works beyond that which the same species of books could have been expected to have had proving that many have been induced, by the efforts of the Society, to attempt the acquisition of information which they would otherwise never have hoped for. A mathematical work, of the sort which usually circulates its hundreds, has been increased to thousands by the Society. In fact, without claiming any peculiar merit for the material of the Society's publications, the following may be insisted on without any degree of partiality, and the work in which these observations appear may be cited as an instance: namely, that its efforts have had a remarkable success in bringing before a large number an amount of accurate knowledge which was formerly the property of a few only. The industrious student, if he required books of a high character of instruction, was obliged to content himself with those of a past age, which had gradually descended within his means as to price. If he can now commence his labours with the advantage of more modern assistance, he has to thank in a great measure those who discovered for him that books of the more learned character might be successfully published on the principles of cheapness which had been so often applied to other branches of trade. The number of editions of the best writers on all subjects which have appeared at almost artisans' prices within the last six years, and the amount of books now attainable by persons with very small means, may without arrogance be attributed to the example of the Society.

SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE. The object of this Society, as expressed in their address or advertisement to the public, is 'to promote the arts, manufactures, and commerce of this kingdom, by giving honorary or pecuniary rewards, as may be best adapted to the case, for the communication to the Society, and through the Society to the public, of all such useful inventions, discoveries, and improvements as tend to that purpose.' It was projected in the year 1753; but the first public meeting took place in March, 1754. The plan, which has been styled by Anderson (*Hist. of Commerce*, vol. iii., p. 298), 'one of the noblest designs for the improvement of the general commerce of Great Britain which could possibly have been devised,' was formed by Mr. William Shipley, a drawing-master, whose public spirit appears to have been very superior to his station in life, and who acted for some time as secretary to the Society; and it was carried into effect by a few noblemen and gentlemen, among whom appear the names of Lord Folkstone, Lord Romney, and Dr. Stephen Hales. The services of Mr. Shipley were acknowledged by the Society voting to him, in 1758, a gold medal, 'for his public spirit, which gave rise to the Society;' and subsequently by the publication of his portrait as a frontispiece to the fourth volume of their 'Transactions.' The Society began, immediately after its formation, to advertise premiums for the encouragement of young persons of both sexes in the various departments of the fine arts; for improvements in agriculture and manufactures; for mechanical inventions; and for promoting the cultivation of valuable plants in British colonies. The utility of the scheme soon attracted a large body of supporters; and for many years the Society received constant additions to its members, and continued to dispense its rewards with increasing zeal and success. It has latterly fallen off in prosperity; a circumstance which may be partially accounted for in various ways, and is probably in great part attributable to the fact that its proceedings have not been made public so fully as the altered state of society has rendered desirable. While numberless other societies, different indeed in their aim, yet all having for their object the cultivation and diffusion of useful knowledge, have been brought into active operation, and while a new and popular scientific literature has been extensively introduced, the operations of the Society of Arts in collecting and diffusing information have remained almost stationary; and the result has been that the Society and its proceedings have fallen into a state of comparative obscurity, which is neither in character with its various and important objects, nor justified by the manner in which those objects have been pursued. Measures have been recently taken, and are now in agitation, for so far modifying the constitution of the Society and extending its operations, as to place it once more in the prominent station which it deserves to occupy; but of the proposed changes it would be premature to attempt to give any details.

For several years after the formation of the Society of

Arts, there was no authorized or official publication of the papers communicated to its various committees, or for making known the results of its labours. The publication of such information in an annual volume of 'Transactions' was contemplated soon after the commencement of the Society's operations; but the first volume did not appear until the year 1783. Many of the papers however which would otherwise have appeared in such a work, were published, with the sanction of the Society, in Dossie's 'Memoirs of Agriculture and other Œconomical Arts,' of which the first volume appeared in 1768, and the third and last in 1782. Some further particulars respecting the early proceedings of the Society are supplied by a 'Register of the Premiums and Bounties* given by the Society instituted in London for the Encouragement of Arts, Manufactures, and Commerce, from the original institution in the year 1754, to the year 1776 inclusive.' This register, which was prepared by a committee of the Society, and is arranged in a tabular form, was printed in folio, in 1778. From it, and from a brief history of the transactions of the Society, published in the first volume of Dossie's 'Memoirs,' the following summary of their early proceedings is taken. It is much to be regretted that there are no published statements from which the account can be readily continued to the present time.

In the department of *Agriculture* the pecuniary rewards given from 1754 to 1776 amounted to 3201*l.* 19*s.*; while during the same time 56 gold and 26 silver medals were distributed. In this class of rewards several were given to encourage the planting, raising, and preserving of timber-trees; especially of oak for ship-building. Some were given for the cultivation of madder, the supply of which had been previously dependent upon Holland. In addition to the premiums bestowed, the Society aided this undertaking by procuring an act of parliament to substitute, for a term of years, a fixed payment of 5*s.* per acre, instead of the payment of tithe in kind, which would have impeded the cultivation of so valuable a crop in England. The cultivation of hemp, of foreign grasses, and of several kinds of roots for the food of cattle, was also encouraged by prizes. Another object attempted, but not so successfully, was the production of bees'-wax in England in sufficient quantity to render this country independent of others for the supply of so useful an article. Several important agricultural implements were also brought into use, and experiments on drill husbandry were promoted and brought into public notice.

In the class of *Chemistry* the Society expended, in the same time, the sum of 1315*l.* 5*s.* in pecuniary rewards, besides giving 2 gold medals and 1 of silver. One of the most important objects attained in this department was the manufacture of crucibles, similar to the Hessian, of melting-pots suitable for smelting tin-ores, and of earthern retorts. The production of such vessels was commenced at Chelsea under the auspices of the Society: the supply had been previously obtained from the Continent. The discovery of a mine of cobalt in England, and the home manufacture of zaffre and smalt, were also encouraged. The manufacture of verdigris was established in this country; and the industry of the nation was further promoted by the introduction or improvement of the processes of tinning copper and brass vessels; dyeing woollen cloth, linen, cotton, silk, and leather; making buff leather; tanning with oak sawdust; making transparent varnish, white enamel, sal ammoniac, &c.

Under the head *Colonies and Trade*, the register shows an expenditure of 2785*l.* 13*s.* 8*d.* in pecuniary rewards, in addition to which 12 gold medals had been presented. The chief object of this part of the Society's operations is the introduction into British colonies of plants or manufactures previously confined to foreign countries; and in the period embraced by the document referred to, this object had been attained as far as regarded the production of potash and pearlash in North America, while much had also been done towards the raising of silk, the cultivation of the vine, and the manufacture of wine, indigo, vegetable oils, &c. The American war of independence put an end to many promising experiments in this department.

In the promotion of home *Manufactures*, besides those already alluded to under the head of chemistry, much was done in the early part of the Society's career; the sum expended in pecuniary rewards in this department being 2026*l.* 1*s.*, together with 1 gold and 3 silver medals. The manufacture of Turkey carpets, tapestry weaving, weaving imitations of Marseilles and India quilting, various improvements in spinning, lace-making, &c., were among the objects promoted. The improvement of paper, the making of chip and straw hats, of artificial flowers, and of catgut strings for musical-instruments were also encouraged.

In the *Mechanical* department 6 gold and 10 silver medals were given, and 2284*l.* 14*s.* 6*d.* was distributed in pecuniary rewards. The introduction of saw-mills into this country was one of the most important objects effected by the Society, while they also encouraged the use of many new or improved machines. The gun-harpoon for the whale-fishery was rewarded by them.

In the *Polite Arts*, embracing sculpture, painting, drawing, mapping, engraving, &c., the expenditure in money amounted to 8325*l.* 5*s.*; and the honorary rewards bestowed were as follows;—10 gold medals, 6 silver medals, 17 gold pallets, 47 great silver pallets, and 37 small silver pallets. The rewards offered by the Society not only had a great effect in encouraging individuals, but also promoted the establishment of the Royal Academy. The first public exhibition of paintings in the metropolis, which soon gave rise to others, was held in the rooms of the Society of Arts, in 1767; the apartments being gratuitously opened for the purpose in that and the two following years.

In addition to the matters embraced in the above classes, 3613*l.* in money and 16 gold medals were devoted to miscellaneous objects embraced by the comprehensive plan of the Society. The principal part of this expenditure, the sum of 3500*l.*, was applied to the promotion of a plan for supplying the metropolis with fish by land-carriage: a scheme which was also assisted by parliament to the amount of 2000*l.*

The total amount of pecuniary rewards bestowed by the Society down to 1776 was, according to the 'Register' above referred to, 23,551*l.* 18*s.* 2*d.*; or, including the cost of medals and pallets, 24,616*l.* 4*s.* 8*d.* This register was continued by manuscript additions to the end of 1813; and from the unpublished part, with a sight of which the secretary has favoured the writer, it appears that the pecuniary rewards bestowed from 1777 to 1813 amounted to about 2757*l.* 10*s.*, and that the medals and pallets distributed were 188 in gold and 464 in silver. Later than this there does not appear to be any condensed statement of the operations of the Society; but it has been stated for some years past, in their advertisement to the public, that upwards of 100,000*l.*, derived from voluntary subscriptions and legacies, has been expended in pursuance of their plan. It is needless to recapitulate the more recent proceedings of the Society, which have been the same in character, although more limited in extent, than those above mentioned; but it may be briefly remarked, in the words of the secretary's address at the distribution of prizes in 1841, that 'at a time when it stood alone in offering encouragement to the fine arts, it effected much good in that department; and that it can now point with proud satisfaction to the names of Bacon, Nollekens, and Flaxman, Cosway and Lawrence, Sharp and Sherwin, Pingo, Marchant, and Wyon, with many other eminent artists, the early manifestations of whose genius were noticed by the Society in a manner which, there can be no doubt, assisted very materially in its development.' Still more important perhaps have been the effects of the Society's encouragement of poor operatives, in improving the processes with which they are practically acquainted. The history of those inventions connected with weaving, which have been the objects of their encouragement within the last forty years, was adverted to in the address just quoted, as an illustration of what the Society have effected; about twenty pecuniary rewards having been given, chiefly to Bethnal Green and Spitalfields weavers, for inventions of great utility.

As before stated, the first volume of the Society's 'Transactions' was published in 1783. For forty-seven years from that time a volume appeared annually; but since 1829 the volumes have been biennial. An index to the first twenty-five volumes was published in 1808, and two others, embracing respectively from the twenty-sixth to the fortieth, and from the forty-first to the fiftieth, have since appeared. In 1774 the Society removed from their original premises, opposite Beaufort-buildings, Strand, to their present house in the Adelphi, which was erected purposely for them; and in the years 1777-83 Barry decorated their great room with a series of pictures. [BARRY, vol. iii., p. 511.]

* *Premiums* are the rewards bestowed for matters respecting which the Society has made a specific offer and *Bounties*, those which are given without any previous offer.

The Society of Arts consists at present of about eight hundred persons, of whom many are life members. Members are admitted by ballot, and subscribe two guineas or upwards annually, or twenty guineas or upwards in a single sum. The business is conducted by several committees, one being appointed for each department of its operations: and general meetings are held four times in each session, on the first Wednesdays of December, February, April, and June. Besides these, ordinary meetings are held every Wednesday evening, to receive reports from the several committees, &c. The Society issue gratuitously, every second year, a pamphlet containing a list of the premiums offered in the various classes of agriculture, fine arts, chemistry and mineralogy, colonies and trade, manufactures, and mechanics; and in which the privileges of the members are stated at length. The paintings in the great room, and the museum, which contains models of the machines rewarded by the Society, with specimens of the manufactures they have encouraged, may be seen gratuitously between the hours of ten and two on any week day, except Wednesday. According to the rules, admission must be obtained by an order from a member; but any respectable person can obtain admission even without this form. It is to be hoped that the utility of the collection may be soon extended by the suspension, in some cases, of a rule of the Society, which stipulates that all machines or processes rewarded by them shall be freely given up to the public, and not protected by patent,—a rule which now excludes many useful inventions from the benefits offered by its rewards and the publicity of its museum.

SOCIETY ISLANDS, the name given by Captain Cook, in honour of the Royal Society of London, to a cluster of islands in the South Pacific Ocean. They lie about 70 miles to the westward of another cluster, of which Tahiti (Otaheite) is the chief, named the Georgian Islands, in honour of George III. Mariners usually called the latter the Windward and the former the Leeward Islands. Recent geographers have been disposed to comprehend both the clusters under the name of Society Islands. As however the two clusters are politically as well as geographically distinct, it will be sometimes expedient to preserve the distinctive designations in speaking of them; although we are to be understood as noticing both groups under the general head. The following are the names and positions of these islands. The names are given according to the orthography introduced by the first missionaries, and used by the press now established among the people:

| | S. lat. | W. long. |
|---|---|---|
| Meatia | 17° 53′ 0″ | 148° 9′ 45″ |
| Tahiti (Otaheite), north point | 17° 29′ 17″ | 149° 33′ 15″ |
| Eimeo | 17° 30′ 0″ | 150° 0′ 0″ |
| Maiaoiti, or Charles Sander's Island | 17° 28′ 0″ | 150° 40′ 0″ |
| Tetuaroa | | |
| Huahine | 16° 43′ 0″ | 151° 6′ 45″ |
| Raiatea | 16° 46′ 0″ | 151° 38′ 45″ |
| Tahaa, three miles north of Raiatea. | | |
| Borabora | 16° 27′ 0″ | 151° 52′ 45″ |
| Mauarua | 16° 10′ 0″ | 152° 30′ 0″ |
| Tuba | | |
| Lord Howe's Island | 16° 46′ 0″ | 154° 12′ 45″ |
| Scilly Island | 16° 28′ 0″ | 155° 24′ 45″ |

The five first are those called the Georgian Islands, and the rest the Society Islands, when the two groups are distinguished. The list is exclusive of several islets which surround or are interspersed among these.

Of all these islands, Tahiti is by much the largest and the most elevated. [OTAHEITE.] All the islands are mountainous in the interior, and have a border, from one to four miles wide, of rich level land, extending from the base of the high land to the sea; and although the outline of each has some peculiarity distinguishing it from the rest, in their general appearance they resemble each other. Tetuaroa, Tubai, Lord Howe's and the Scilly islands however form exceptions, as they are low coral islands, seldom rising many feet above the sea. Tahiti is 108 miles in circumference; Eimeo is supposed to be about 25 miles; Huahine probably more than 30; and Raiatea is somewhat larger. The others are of smaller extent A corresponding resemblance prevails in the geological structure of the principal clusters and surrounding islands; the component substances being the same in all, although each has some distinguishing peculiarity of its own. A full account of these geological characteristics, analogous and distinctive, may be found in Ellis's 'Polynesian Researches.' There seems no reason to suppose that any of these islands are of altogether volcanic origin, like the Sandwich Islands. The entire mass of the latter has evidently been in a state of fusion, and offers no trace of any primitive or secondary rock. But in the Society Islands there are basalts, whinstone dykes, and homogeneous earthy-lava, retaining all the convolutions which cooling lava is known to assume; there are also kinds of hornstone, limestone, silex, breccia, and other substances, which under the action of fire do not appear to have altered their original form. Some are found in detached fragments, others in large masses. Although many unequal appearances of the action of fire occur in almost every island, yet Mr. Ellis states that he never met with any cavern, aperture, or other formation resembling a crater, nor had he ever heard of any, with the exeception of the large lake, called by the natives Vaihiria, situated among the mountains of Tahiti. 'The wild and broken manner however in which the rocks and mountains now appear, warrants the inference that since their formation, they have been thrown up by some volcanic explosion, the disruptions of an earthquake, or some other violent convulsion of the earth; and have from this circumstance assumed their bold, irregular, and romantic forms.' All the Society Islands, and many others in the Pacific, are surrounded by a belt of coral rock, from two or three to twenty yards in width, and situated at distances from a few yards to perhaps two miles from the shore. Against this barrier the long rolling waves of the wide Pacific are driven with terrific violence by the trade-winds, and, arrested by it, often rise ten, twelve, or fourteen feet above its surface. These reefs protect the low lands from the violence of the sea; for while, beyond them, the surface of the water is agitated by the slightest breeze, all within is smooth water. There is usually a break or opening in these marine barriers, which offers an easy passage for shipping. The soil is various. The sides of the mountains are frequently covered with a thin layer of light earth; but the summits of many of the inferior hills present a thick stratum of stiff red ochre or yellow marl. This is seldom found on the lofty mountains composed of basalt or cellular volcanic stone, but generally covers the lower hills that rise between the interior mountains and the shore. The natives use it as a pigment for staining or painting their doors, window-shutters, canoes, &c., and, when mixed with lime, the walls of their houses. The level tracts along the coast are the most valuable parts of the land. The soil of those tracts is a rich alluvial deposit, with a considerable mixture of vegetable mould, and is exceedingly prolific.

The climate, products, character, and condition of the inhabitants are the same as those of Tahiti, the principal island. [OTAHEITE.]

Rain is much more frequent in the Society than in the Sandwich Islands, during the whole year; but, except in the rainy season, it is seldom heavy or lasting. The rainy season, the only variation of the tropical year, occurs when the sun is vertical, and generally continues from December to March; during this time the climate is more insalubrious and the sickness of the inhabitants greater than at any other period. Thunder and lightning are frequent, especially in the rainy season.

Hogs and dogs, and sometimes rats, were the only animals whose flesh was formerly eaten by the natives. The missionaries have introduced all our domestic animals; and all have succeeded very well, except the sheep. Many of the natives now possess hundreds of cattle, which, with their other produce, they sell, with mutual advantage, to the ships which touch at the islands for refreshments. Rabbits could not be preserved; cats have become common in houses, and are great favourites. The birds of these and the neighbouring islands are not distinguished by brilliancy of plumage or melody of song. There are however several varieties, and some of them in immense numbers. The most numerous class are the aquatic fowl. The albatross (*diomeda exulans*), the tropic bird (*phaeton ætherius*), several kinds of petrel, with others, abound in all the islands, especially in Borabora and Mauarua. Among the lakes are several kinds of heron; and wild ducks resort to the lagoons and marshes. There are several kinds of birds of prey, and a number of the woodpecker tribe, with some small paroquets of rich and splendid plumage. The turtle-dove is found in the inland parts of some of the islands, and pigeons among the mountains. Among the few singing-birds the most conspicuous is that called by the natives *Omaomao*, which in appearance and note much resembles the thrush. Domestic fowl are abundant, and were found in the islands when originally discovered.

The Society Islanders are generally above the middle stature, but their limbs are much less muscular and firm than those of the Sandwich Islanders, whom in many respects they resemble; but they are more robust than the Marquesans, who are the most light and agile of the inhabitants of Eastern Polynesia. In size and physical power they are inferior to the New Zealanders, and more resemble the Friendly Islanders; but they as much lack the gravity of the latter as they do the vivacity of the Marquesans. The countenance of the Society Islanders is open and prepossessing, though the features are bold, and sometimes prominent. The facial angle is frequently as elevated as in the European, except where the frontal and the occipital bones have been pressed together in infancy. The prevailing complexion is an olive, a bronze, or a reddish-brown, equally removed from the jet-black of the African and Asiatic, the yellow of the Malay, and the red or copper colour of the aboriginal Americans: it is frequently a medium between the two latter colours. Considerable variety nevertheless prevails in the complexion of the population of the same island, and as great a diversity among the inhabitants of the different islands.

The mental capacity of the Society Islanders has hitherto been only partially developed. They are remarkably curious and inquisitive; and, compared with other Polynesian nations, may be said to possess considerable ingenuity, mechanical invention, and imitation. Totally unacquainted with the use of letters, their minds could not be improved by any regular continued culture; yet the distinguishing features of their civil polity—the imposing nature, numerous observances, and diversified ramifications of their superstition—the legends of their gods—the historical songs of their bards—the beautiful, figurative, and impassioned eloquence sometimes displayed in their national assemblies—and, above all, the copiousness, variety, precision, and purity of their language, with their extensive use of numbers, warrant the conclusion that they possess no mean mental capabilities.

By diseases, wars, infanticide, and the use of ardent spirits, the large population which these islands formerly contained was reduced to a mere remnant when the missionaries came among them, and was in rapid progress to extinction. The general adoption of Christianity put a stop to the evils in which this decline had originated; but for some years after, the number of deaths considerably exceeded the births. About the years 1819 and 1820, the births were nearly equal to the deaths, and since that period the population has been rapidly increasing. The latest information estimates the inhabitants of these islands at 18,000 or 20,000. Most of the natives can now read and write. Their moral conduct has become more regular, and their social condition much improved; they have acquired the knowledge of various useful arts, and profitable branches of commerce have been opened. Numerous vessels of from 30 to 80 tons burden are usefully employed in trade, and in maintaining an intercourse between the several islands. A press has for many years been actively engaged in supplying the natives with publications in their own language, suited to their wants and their condition.

(Ellis's *Polynesian Researches*; *Voyages* of Wallis, Cook, and Wilson; Tyerman and Bennet's *Voyage round the World*; Williams's *Missionary Enterprises*; the *Reports* and *Magazine* of the London Missionary Society, &c.)

SOCI'NUS FAUSTUS. The Socini were an antient family of Siena. Marianus Socinus, a lawyer, is highly extolled by Æneas Sylvius, Pope Pius II., with whom he was contemporary. This Marianus had a son Bartholomew, whom Politian calls the Papinian of his age; and also a son Alexander. Alexander had a son Marianus the younger, also a distinguished lawyer, who was the father of Alexander Socinus the younger and Laelius Socinus, by Camilla, who was related to the Salvetti of Florence. Alexander was a distinguished lawyer and a teacher of jurisprudence.

Laelius, the uncle of Faustus Socinus, was born at Siena in 1525. He was brought up to the law; but he turned his thoughts to the study of the Scripture, for which he was qualified by his knowledge of the Greek and Hebrew languages, and, it is said, the Arabic also. Having detected, as he supposed, various errors in the doctrines of the Roman church, he left Italy in 1547, either that he might ensure his safety, or have the advantage of prosecuting his theological studies more diligently. He was only about twenty-one years of age when he commenced his travels, which extended to England, France, Switzerland, Germany, and Poland. He first visited Poland about 1551, and a second time about 1556. He finally settled at Zürich, where he died in 1562, in the thirty-seventh year of his age. His nephew Faustus, who then happened to be at Lyon in France, succeeded in getting possession of his papers. Laelius was on intimate terms with all the great scholars of the time. By his prudent conduct he secured his personal safety amidst men who were the enemies of his opinions, which however he communicated freely to his friends, and principally to his countrymen who were in voluntary exile in Switzerland and Germany. He also corresponded with his family in Italy, and brought several of them over to his opinions. Laelius Socinus had put various questions to Calvin, among other great theologians. Calvin declined to answer his 'portentous questions,' and in a rough but well-meant letter, told him that 'if he did not timely correct this itch of inquiring, he would draw on himself great torments.' Calvin's letter was written in January, 1552; and in the month of October of the next year, Servetus was burnt at Geneva. This was a significant comment on the words of advice.

Faustus Socinus, the son of Alexander the younger, was born at Siena in December, 1539: his mother Agnes was the daughter of Burgesio Petrucci, a distinguished personage at Siena, and of Victoria Piccolomini, niece of Pope Pius the Second.

The parents of Faustus Socinus died young, and his education was somewhat neglected. He himself complains that he studied the liberal arts slightly, and without the direction of a teacher: he had learned nothing of philosophy or school divinity, and of logic he had only certain rudiments, and that very late. At the age of twenty he took refuge in France, on account of danger which threatened his family on a suspicion of heresy. On the death of his uncle Laelius he returned to Italy; and being taken into the service of the grand-duke of Tuscany, spent twelve years at the court of Florence. About the close of this period he began seriously to reflect on religious matters, and finally determined to abandon his country and his favourable prospects, that he might occupy himself about his own and other men's salvation. In the year 1574, at the age of thirty-five, he retired to Basle to study theology. About 1578 he was invited into Transylvania by George Blandrata, a person of great influence in that country, to oppose the opinions of Franciscus Davidis on the power of Christ and the honour due to him. The two theologians lodged together in the same house for four months, but Davidis could not be prevailed upon to change his opinions; and as he still continued to proclaim them publicly, he was put in prison by the prince of Transylvania, where he soon ended his life. Socinus was blamed in this matter, but without any reason; for whatever share any of those who followed his opinions had in the persecution of Davidis, there is no evidence that Socinus joined them.

In 1579 Socinus visited Poland, and wished to be received into the Unitarian churches of that country, which acknowledged none but the Father of the Lord Jesus Christ to be the most High God; but as he dissented from the Unitarian churches in some matters, his application was at first rejected.

Socinus however wrote in defence of the Polish Unitarian churches; and he also published his treatise, entitled 'Pro Racoviensibus Responsio,' in reply to the work of Jacobus Palæologus, which was entitled 'Defensio Veræ Sententiæ de Magistratu Politico.' Socinus maintains the doctrine of obedience to the sovereign power in its most unlimited extent, and he instances as an example of the mischievous teaching of those who inculcated the right of resistance to princes, the bloody wars of the Hollanders with Philip II. of Spain. It is singular that the Responsio was represented to Stephen Bathory, king of Poland, as a work against government, a charge which could not well be made against a treatise that was directed against all those who maintained the right of subjects to examine and pass judgment on the conduct of princes; however, Socinus thought it prudent to retire from Cracow, where he had lived four years, to the estate of a nobleman named Christopher Morsztyn, where he was safe. During this retreat he married Elizabeth, the daughter of his protector, by whom he had a child called Agnes, who afterwards married a Polish gentleman. By this marriage Socinus became connected with the principal families of Poland, a circumstance which greatly contributed to the influence which he subsequently obtained. His wife died in 1587, and his grief, which was excessive, was followed by a severe illness. He subsequently returned to Cracow, and in the year 1588 he assisted at the synod of Brest, which is a town on the borders of Lithuania, and disputed on the death and sacrifice of Christ, on justification, the corrupted nature of man, and with the followers of Davidis and Budny, on the invocation of Christ. Socinus was now beginning to gain over many persons of rank to his opinions, though some who were in authority, and most of the old ministers, still opposed him. It is said that Securinius was the first who maintained the doctrines of Socinus; but Petrus Stoinius, a young minister, became one of the most eloquent expounders of his tenets. It was during the second residence of Socinus at Cracow, and in 1598, after the publication of his book on the Saviour, 'De Jesu Christo Servatore,' that the rabble, being stirred up, as it is said, by the scholars, pulled him from his sick chamber, and dragged him half naked through the streets, and he was rescued with difficulty by one of the professors. His property was plundered, and his manuscripts were destroyed, one of which was against atheists. After this outrage he left Cracow for a neighbouring village, where he died in March, 1604.

Socinus was rather tall and slender: his forehead was lofty, and his eyes penetrating; he was a handsome man, and of dignified appearance. He was abstemious in all things; simple in his manners, though grave; and affable to all persons. He was naturally choleric, but he had so tamed his temper, that the mildness of his disposition seemed to be a natural gift. His services to the cause of the Unitarians in Poland, according to his Polish biographer, consisted in opening the genuine meaning of Scripture in innumerable places, and in confirming by solid arguments those opinions touching the person of God and Christ which he found in Poland. His biographer adds, 'As for the errors received from the reformed churches, which did, in a great number, as yet reign in that church, he did, with a marvellous felicity, root them out. Such were that of justification, that of appeasing the wrath of God, that of predestination, that of the servitude of the will, that of original sin, that of the Lord's Supper and baptism, together with other misconstrued doctrines.' With respect to Christ, Socinus declares, in opposition to the Theses of Davidis, 'that the man Jesus of Nazareth, who is called Christ, not only spoke by the spirit of prophecy, but more than prophecy, for he was the express image of God, in whom the whole fullness of the godhead dwelt corporeally, so that he never used a word in his teaching which ought not to be considered as uttered by the mouth of God himself;' and, further, for the reasons which Socinus alleges, 'Christ may now justly be called God, inasmuch as, by the appointment of God, he discharges the highest of all functions and is endued with divine power in heaven and earth;' and 'that we ought, in addition to keeping his commands, to obey and worship him as our Lord and God, appointed over us by the Supreme God, and now reigning over us with supreme power.' (Socini *Opera*, ii., pp. 801, 802.)

Antitrinitarian opinions had been promulgated in Poland in 1546, at the meetings of a secret society at Cracow. The works of Servetus were then read in Poland, and Laelius Socinus, in his visit to that country in 1551, is said to have propagated his doctrines. But it was Faustus Socinus who gave to the antitrinitarian opinions a definite form, and reduced them to a system. He did not form a catechism, though he designed one: but this was effected by Smalcius and Hieronymus Moskorzewski, who collected and digested the doctrines which were established or approved by Faustus Socinus. This catechism was published at Rakow in 1605, in the Polish language. It was translated into Latin in 1609, and an English translation appeared at Amsterdam in 1652. In 1819, the Rev. Thomas Rees published a new English translation, with an historical notice.

The works of Socinus are in Latin, and fill the first two folio volumes of the 'Bibliotheca Fratrum Polonorum quos Unitarios vocant, Irenepoli, 1656.' The first volume contains the exegetical and didactic works of Socinus, and the second his polemical writings. Socinus wrote in a pure perspicuous style, and the moderation with which he expresses himself contrasts favourably with the usual tone of polemical writings of that day.

('The Life of that incomparable Man, Faustus Socinus Senensis, described by a Polonian Knight,' *Harleian Miscellany*, vol. vi., p. 355 (this is a translation of the Life of Socinus, prefixed to his works, by Samuel Przypkowski); Bayle, *Socin (Fauste)*; Krasinski's *Historical Sketch of the Reformation in Poland*, London, 1840; Socini *Opera*.)

SOCORRO. [GRANADA. NEW.]

SO'COTRA, is an island in the Indian Ocean, situated about 200 miles from Cape Guardafui, the most eastern point of Africa. It lies between 12° 16′ and 12° 45′ N. lat., and between 53° 25′ and 57° 34′ E. long., and extends about 70 miles from west to east, with an average width of 15 miles. It contains 1100 square miles, being equal in extent to the county of Gloucester.

Socotra consists of an elevated table-land, which occupies about four-fifths of the surface, and two plains, which lie south and north of the table-land. The general elevation of the table-land is between 700 and 800 feet above the level of the sea. Its surface is in many parts level for a considerable extent; many hills are dispersed over it, but they rarely constitute ridges, except a granitic range of mountains, which stands on the northern edge of the table-land, about four miles from the northern shores of the island, and extends about eight miles, between 54° 2′ and 54° 10′ E. long. This mountain-mass may have a general elevation of about 3000 feet, but the most elevated portion consists of numerous peaks, some of which rise to 5000 feet. This range may be called the Haggier Mountains, from the most elevated of its peaks. From the western extremity of this range a ridge of limestone runs off in a south-west direction, but without forming peaks. Near the mountains its height may exceed 2000 feet above the sea, but it decreases as it proceeds southward, and at its termination, about seven miles from the southern shores, it is not more than 1200 feet high. The hills which are dispersed over the surface of the table-land attain an elevation varying between 1000 and 2000 feet. On the more level parts of the table-land there are many wide depressions, which generally extend south and north, and form long valleys. As the water collects in these depressions, it forms temporary watercourses, which give nourishment to numerous bushes, and to a fine turf, so that they constitute the best pasture-grounds of the island. But these watercourses disappear when the rains have failed for some time. There are fields of dukkum (*Sorgum saccharinum*) only in a few places. Plantations of date-trees skirt the banks of the watercourses to a great extent in the eastern districts, but are rarely met with in the western districts. In the former the fields on which dukkum and cotton are cultivated are much more numerous. The table-land descends to the plains generally with a steep declivity, but in a few places it comes close to the sea, as at Ras (Cape) Shuab, the western extremity of the island, and at Ras Kattany: near Ras Feling, on the southern coast, the cliffs skirt the shores for eight miles.

The plain, which skirts the southern base of the table-land, is from two to three miles wide, and nearly level, but it is as arid and barren as the worst part of Arabia. The sand on the sea-shore is very fine, and is put into motion by every strong wind. The force of the south-west monsoon, to which the coast is exposed, has carried it inland, where it forms a continuous range of sand-hills parallel to the beach, and hence it has spread over the plain, so that in many places great quantities of sand are disposed at the very base of the table-land. The shores run in a continuous line without being broken by any inlet. The few inhabitants of this plain live by fishing; but they have no boats, and take only those fishes which remain in the depressions of the beach after the retreat of the high tides. The northern plain varies in width between two and four miles. It is not so low as the southern, nor so level, the surface being intersected by flat valleys in many places, and in others some masses of hills rise from 300 to 600 feet. Sometimes these hills, or rather small table-lands, occupy several square miles. The western districts of this plain, though less sterile than the southern plain, are more adapted for pasture than for cultivation, but the eastern districts have a superior soil, which is a reddish-coloured earth, covered at certain seasons with abundant grass, and well adapted for the cultivation of grain, fruit, and vegetables. In the valleys through which the streams flow there are extensive groves of date-trees, and numerous enclosures of dukkum, and some plantations of indigo and cotton, which are all in a thriving state. The vigorous vegetation with which the lower declivities of the Haggier Mountains are clothed indicates a superior fertility in that district. In general the soil of this northern plain is stony, but it is generally covered with a dwarfish bush about six feet high.

With the exception of a few rivulets which originate in the Haggier Mountains, few if any of the streams contain water all the year round. Hence the inhabitants are obliged to collect rain-water in reservoirs, but in most parts of the northern plain water is found at a distance of from eight to ten feet below the surface.

As no European in modern times has spent a whole year in Socotra, we are very imperfectly acquainted with the climate. In the first three months of the year, the mean temperature is about 70½°, and in June and July about 88°. Though within the range of the monsoons, it is differently affected by them from the neighbouring countries. The north-east monsoon brings dry weather to Hindustan and the eastern coast of Africa, but in Socotra during that monsoon it rains almost daily. During the south-west monsoon, on the contrary, the sky is generally clear and cloudless, and the stars shine with uncommon brilliancy. But before the setting in of the breeze a dense white canopy of clouds extends over the sky; the air however is perfectly dry. The north-east monsoon blows with a steady breeze, but that from the south-west commences with a force almost like a hurricane.

The principal commercial products are derived from the wild plants, and are the aloe and dragon's-blood. The aloe plant (*Aloe spicata* or *Socotrina*) in the western districts covers the hills for many miles, at an elevation of from 500 to 2000 feet above the plains. The dragon's-blood tree grows in the same part of the island, at an elevation of from 800 to 2000 feet. These two plants are so abundant, that ten times the quantity which at present is exported could be collected in the island. There are several forest-trees, but none fit for timber. Yams grow wild in the Haggier Mountains, where also wild orange-trees are found, which probably have been introduced by the Portuguese. Dates are the only fruit-trees which are cultivated, and though numerous in the eastern districts, their produce is not equal to the consumption, and dates are imported from Muskat. Agriculture is limited to the cultivation of dukkum, a species of millet, beans and tobacco, with a little cotton and indigo.

There are no horses. Asses are only found in a wild state on the Haggier Mountains. They are probably the descendants of domestic animals. The camel is the only animal of burden, and is nearly as sure-footed as the mule; but there are only about 200 in the island. The cows are small, resembling in size the black Welsh cattle. They are only kept for their milk. Ghee forms one of the principal articles of export. Sheep and goats are numerous, especially in the western districts, where they constitute the principal wealth of the inhabitants. The sheep are small, but have a good wool, of which thick cloaks are made, which are well known in Arabia and Persia. There are several kinds of goats, and one of them is found in a wild state on the mountains: the flesh of this species is much prized by the natives. There are civet-cats all over the island, rats, mice, and chameleons. There are several kinds of vultures, and also the flamingo. Turtles are found on the southern coast. Fish abound in several parts of the coast, and some families live on the produce of their fishing.

The population is estimated by Wellsted at 4000 individuals, which, considering the large tracts consisting nearly of bare rocks, seems to be a very fair estimate. It consists of two different nations, of which one is foreign and the other apparently aboriginal. The former are called Socotran Arabs, and the latter Bedouins. The Arabs are a mongrel race, chiefly the descendants of Arabs who were left there by boats passing between Zanzebar and the Arabian coast, and have settled on the island. With these are intermixed the descendants of the Somaulies, or natives of the southern coast of the Gulf of Aden, of Portuguese, and of Arabian and African slaves. They generally understand the Arabian language, but usually speak that of the Bedouins. They are the only cultivators of the ground, but they also make ghee. They are zealous Mohammedans. The aborigines are called Bedouins in consequence of their pastoral habits and their wandering mode of life, though they differ widely from the Bedouins of Arabia in some points. Their language also appears to differ considerably from that of the Arabs. The mountaineers from the Arabian coast indeed are sometimes able to make themselves understood by the Bedouins of Socotra, but the Arabs from Muskat, or from any of the neighbouring towns, are quite unable to do so. They have no characteristics in common with the Arabs or Somaulies. They are tall, with strong, muscular, and remarkably well-formed limbs; a facial angle like that of Europeans, the nose slightly aquiline, the eyes lively and expressive, and the mouth well-formed. Their hair curls naturally, but does not approach to a woolly or crisp texture. Their general complexion is fair, but a few of them are as dark as the Hindus. The regularity of their features, the fairness of their complexion, and the symmetry of their bodies, render them a people distinct from any of the varieties seen on the shores of the continent on either side. They live on the produce of their sheep and goats, and collect aloes and dragon's-blood, which, together with ghee, they bring to the ports, where they exchange them for dates, dhurra, and clothes. As they frequently change their abodes, and live in a country not abounding in building materials, they inhabit the numerous caverns which are found in the limestone hills of their country. They are Mohammedans, but they do not show much zeal in the performance of their religious duties, nor are they tainted with the intolerance of the Arabs. They are divided into families or tribes, each occupying a determinate part of the island, and having a representative or head, who exercises what may be termed a patriarchal authority over them.

There is no place which can be called a town. The capital is Tamarida, which is built not far from the northern shores, and consists of about 150 straggling houses, of which however only one-third are inhabited. Wellsted thinks that the number of inhabitants cannot exceed 150.

Socotra was known to Ptolemy, who notices it under the name of Dioscoridis Insula, and Arrian says that the inhabitants were subject to the kings of the incense country. It was visited by the Portuguese Fernandez Perara in 1504, and taken possession of by Albuquerque in 1507. It is not known at what time the Portuguese evacuated the island, but probably before the sixteenth century elapsed. It then returned under the sway of the sultan of Kisseen on the southern coasts of Arabia, and its peace was not interrupted until 1801, when the Wahabees made a descent on the northern shores, and laid waste a part of it, together with the town of Tamarida. The sultan of Kisseen is still the sovereign of the country, but all the advantages he derives from this possession are a few hundred dollars, which are annually collected by a person whom he sends to the island. On the other hand he maintains no regular administration, and the people live without any laws or courts of justice. It is stated that crimes are of rare occurrence.

(Wellsted's *Memoir on the Island of Socotra*, in 'Lond. Geogr. Journal,' vol. v.)

**SO'CRATES**, considered by some the founder of Greek philosophy, was born at Athens on the 6th of Thargelion, Ol. 77. 4 (B.C. 468). His father, Sophroniscus, was a sculptor; his mother, Phaenarete, a midwife. He was originally destined for his father's profession, and we are told that he made no slight proficiency in his art; statues of the Graces, clothed in flowing drapery, were exhibited in the Acropolis as his work. He did not however devote himself to this profession; he carried it on so far as to earn a decent subsistence from it, but as he inherited some little property on his father's death, he was content to devote the greater part of his time and talents to the study of philosophy, for which he had a strong natural inclination. While still engaged in statuary, and much more so after he had given it up, he spent a great part of his time in reading all the accessible works of former and contemporary philosophers. Crito supplied him with money to pay the masters who taught various accomplishments at Athens, and he became an auditor of most of the great physical philosophers and sophists who visited Athens during his time, especially of Anaxagoras, who was expelled from the city when Socrates was thirty-seven years old, his successor Archelaus, and the luxurious and accomplished Prodicus, of whom Xenophon makes him speak in terms of the warmest affection (*Mem.*, ii., 1, sects. 21, 24). In a word, he may be considered as having received the very best education which an Athenian could command in those days. With regard to his public life, we know that he served his country faithfully as a soldier, according to the duty of all Athenian citizens. During the Peloponnesian war he made three several campaigns. In the first of these he took a part in the long blockade of Potidaea, and Alcibiades, in Plato's *Symposium* (p. 219, E, &c.) gives a full account, though perhaps rather a partial one, of his extraordinary hardihood and valour during this long service. He endured, with the greatest indifference, hunger and thirst, heat and cold; in one of the skirmishes which took place, Alcibiades fell wounded in the midst of the enemy; Socrates rescued him, and carried him off, together with his arms, for which exploit the generals awarded him the civic crown as the prize of valour (τὰ ἀρίστεια); this however he transferred to Alcibiades. The scene of his second campaign was Bœotia, where he fought for his country in the disastrous battle of Delium. Here he saved the life of another of his pupils, Xenophon, whom he carried from the field on his shoulder, fighting his way as he went. On his third campaign he served at Amphipolis. On the merit of his civil services it is more difficult to form a decided opinion. As a member of the deliberative senate (βουλή), he showed great firmness in voting against the iniquitous sentence by which the victors of Arginusae were condemned to death. But there is too much reason to believe that he really belonged to the party of Theramenes, who was the chief mover in that and other unhappy proceedings. At any rate he did not leave Athens even when the tyranny of the Thirty had reached its height; he was employed by them as an agent in one of the most detestable murders which they perpetrated—that of Leon, and though he did not actually assist in seizing the fugitive, his reluctance to do so arose probably from a goodness of heart quite consistent with a general adherence to the party which had selected him as their instrument. That Socrates favoured the aristocratic or oligarchical faction at Athens—that, at least, he was not well disposed to the democratic constitution of his country, is proved, to a certain extent, by the fact that the indictment on which he was condemned a d executed was brought forward by Anytus, one of the chief of those citizens who assisted Thrasybulus in restoring the old state of things. We are of opinion (and the subject is one on which many opinions have been entertained) that Socrates, though a thoroughly good and virtuous man, endued with great self-control, a strong sense of duty, wonderful amiability of disposition, and indeed with almost all those qualities which obtain for an individual the love and admiration of his fellows, was deficient in the higher kind of political virtue; that in fact he was not a good citizen, because, with every wish to obey the laws of the state, he could not refrain from broaching theories at variance with the first principles of a democratic constitution, because he could not prevail upon his intellectual convictions to bow before the supremacy of public opinion. That in the abstract he might have been in the right, while all Athens was in the wrong, is not the question. As laws, in a democratic state, are made by the majority, the voice of one man, or of a small class of men, though they may be all philosophers, will never justify the speakers in breaking through those rules, to which, as members of the body-politic, they are bound to submit. The Athenians were justified, by every principle of law which was acknowledged in those days, in the sentence which they passed upon Socrates, and it is only a matter of wonder that the votes of the judges were so nearly divided. An opinion generally unfavourable to him had for a long time been prevalent in Athens, and it is no slight evidence of this opinion being well-founded, that it was, in part at least, supported by Aristophanes, who introduced Socrates into his celebrated comedy, 'The Clouds,' as a mischievous speculator on matters of religion, and as a corruptor of the youth of Athens—as, in fact, one of the class of Sophists. Although there can be no doubt that the comedy just mentioned had no share in producing the condemnation of Socrates, it is at least remarkable that the two principal charges brought against him on his trial constitute the leading features in the satirical censure of Aristophanes. The accusers, Meletus, Anytus, and Lycon, state their charges as follows: 'Socrates is guilty of impiety in not acknowledging the gods acknowledged by the state, but on the contrary, introducing new deities; and he also does wrong in corrupting the youth.' It would be easy to confute the arguments by which Xenophon seeks to justify his master from these charges, and if we only put ourselves in the place of the Athenians, we cannot wonder that a small majority of judges were compelled by their duty to pronounce him guilty. It does not however follow that he would have been put to death in consequence of this conviction. But on being called up to receive his sentence, he treated the court with a contumelious disdain, which was not only at variance with Attic law, but also eminently calculated to provoke his judges, who were accustomed to the most humble and abject demeanour on the part of those who were brought before them, and who could ill brook the irony and ridicule of a condemned criminal. He was sentenced to death by a much larger number than those who had voted him guilty. The festival of the Theora gained him a reprieve of thirty days, during which his friend Crito provided for him the means of escaping from prison, but he would not avail himself of the opportunity. His sentence was carried into execution at the end of the month Thargelion, Ol. 95. 1 (B.C. 399). If we may believe the account given us by a friend and disciple of his, he met his fate with the most heroic calmness and resignation, discoursing with and consoling his weeping friends, even after he had drunk the cup of hemlock, and expressing with his last breath his debt of gratitude to Æsculapius for having at length supplied him with a cure for all earthly ills.

The philosophical merits of Socrates are less doubtful than his political character. The mere fact that he is made the chief interlocutor in those wonderful dialogues which contain the whole system of Plato, is sufficient to prove that he exerted no slight influence on that great philosopher, and though he never committed any of his own thoughts to writing, he has left indisputable traces of the important innovations in science, of which he must be considered as the real and first author. We have three authorities for the doctrines of Socrates: Xenophon's 'Memorabilia;' the 'Dialogues' of Plato; and the 'Strictures' of Aristotle. With regard to the first work, too much reliance has been placed upon it as a faithful delineation of the sayings of Socrates. It is too much of an apologetic nature to deserve the title of a just and accurate exposition of the doctrines which it defends; and even if Xenophon had wished to give a full account of the philosophy of Socrates, it is not possible, from all that we know of him, that he would have been able to do so. His talents, such as they were, were all of a practical nature; he does not seem to have had any toleration for philosophy; he clearly did not understand the definition of terms or ideas; and at any rate had not originality enough to enable him to appreciate such a thoroughly original character as Socrates.

As to Plato, there can be no doubt that he never meant to pass off as his own the doctrines and speculations which he puts into the mouth of Socrates; but we cannot help feeling that the Socrates, whom he represents with such dramatic truth, must have been a real person, and no creature of the imagination, and that Socrates must have been the philosophical as he is the formal basis of all that Plato has done for science. If then we seek to make up for the deficiencies of Plato and Xenophon, as exponents of the doctrines which their master actually promulgated, by turning to the criticisms of Aristotle, we shall find that Plato gives us a much truer conception of what he effected by his scientific labours, than we could have derived from Xenophon. Aristotle distinctly tells us that Socrates philosophised about virtue, and made some real discoveries with regard to the first principles of science. Now this is just the philosophical basis which we discern in the Socrates of Plato. We find him always endeavouring to reduce things to their first elements, stripping realities of their pompous garb of words, and striving to arrive at certainty as the standard of truth; and we also find that his philosophy is generally applied to ethics rather than to physics. He seems to have been convinced of the unity of virtue, and to have believed that it was teachable as a matter of science. In fact, with him the scientific and the moral run into one another, for knowledge is the final cause of the will, and good is the final cause of knowledge; hence he who knows what justice is, must needs be just, since no one wittingly departs from that which he knows to be good. Socrates considered it to be his particular vocation to arouse the idea of science in the minds of men. This is clear from the manner in which he is said to have insisted upon the consciousness of ignorance, and also from the use which he made of the Delphic response, γνῶθι σεαυτόν, 'Know thyself.' 'For,' says Schleiermacher (in his valuable paper on the 'Worth of Socrates as a Philosopher'), 'if he went about in the service of the god, to justify the celebrated oracle, it is impossible that the utmost point he reached could have been simply to know that he knew nothing; there was a step beyond this which he must have taken, that of knowing what knowledge is. For by what other means could he have been enabled to declare that which others believed themselves to know, to be no knowledge, than by a more correct conception of knowledge, and by a more correct method founded upon that conception? And everywhere, when he is explaining the nature of non-science (ἀνεπιστημοσύνη), one sees that he sets out from two tests: one, that science is the same in all true thoughts, and consequently must manifest its peculiar form in every such thought; the other, that all science forms one whole. For his proofs always hinge on this assumption—that it is impossible to start from one true thought and to be entangled in a contradiction with any other, and also that knowledge derived from any one point, and obtained by correct combination, cannot contradict that which has been deduced in like manner from any other point: and while he exposed such contradictions in the current conceptions of mankind, he strove to rouse those leading ideas in all who were capable of understanding or even of divining his meaning.' In all the isolated particulars which are recorded of Socrates, this one object is everywhere discernible. His antagonistic opposition to the Sophists is one very strong feature of this. They professed to know everything, without having the idea of science, or knowledge of what knowledge is, and as he had that idea without the mass of acquirements on which they prided themselves, he was naturally their opponent, and his strife with them is carried on entirely in this way, that he endeavours to nullify the effects of their acquired knowledge by shifting the ground from the objects to the idea of science, whereby he generally succeeds in proving their deficiency in the one thing needful to the philosopher. His irony, as it is called, is another remarkable proof of his devotion to his vocation as an awakener of the idea of science. The irony of Socrates has been well described as the co-existence of the idea of science in him, with the want of clear and complete views on any objects of science—in a word, as the knowledge of his ignorance. With this is intimately connected the indirect dialogical method which he invariably adopted, and which may be considered as his method of extracting scientific truth from the mass of semblances and contradictions by which it was surrounded. His *dæmonion*, or secret monitor, which was a great puzzle to his contemporaries, as it has been to many of the moderns, seems to have been little more than a name which he gave to those convictions on practical subjects which sprung up spontaneously in his mind, and for which he could not find any satisfactory means of accounting, though he felt himself constrained to follow in the course which they prescribed, as when he felt convinced of the issue of an undertaking, or was restrained by some secret misgiving from taking a certain route on his retreat from a disastrous battle.

Such are the leading outlines of the philosophy of Socrates, so far as they are capable of being established with any certainty. The importance of his doctrines is most clearly perceived when we consider them as they were developed and applied by the various schools which acknowledged him as their founder, and especially as they were carried out by Plato. [CYNICS; CYRENAICS; MEGARIANS; PLATO.] In all these schools, we find, along with the purely Socratic element, some foreign admixture which constitutes the diagnosis of the different systems, and it is not a matter of wonder that no school of Socratic philosophy merely adopted the principles and method of its great founder. A thoroughly original man like Socrates would naturally gather around him all the original and thinking men who fell in his way, and his business was best done by making them all think for themselves and work by themselves on the idea of science which he had awakened in their minds. The Socratic impulse being once communicated, it would take a different direction according to the character and natural bias of the subject on which it operated, and though Socrates may be considered as the basis of the whole superstructure, he can have no more claim to the whole merit of the Platonic philosophy than he is entitled to be blamed for the reckless inconsistencies of Alcibiades or the selfish policy of Xenophon.

In person, Socrates was no less singular than he was in manners and dress He had large projecting eyes, a sunken nose turned up at the end, with wide dilated nostrils, and a great unwieldy belly; so that his appearance was not unlike that of the Silens and Satyrs, whom he also seemed to resemble in the severe mockery of his ironical language. His dress was coarse and inelegant, and he seldom wore shoes. If we add to this, that as he walked along the streets he strutted about in a most haughty supercilious manner, staring to the right and left at every one he met, sometimes stopping suddenly in an absent fit and remaining for a considerable time fixed to the spot, we shall not wonder at the selection which Aristophanes made of him as a fit and proper subject for the caricature of comedy.

SODA. [SODIUM.]

SODA'DA has been named from *sodad*, the Arabic name of a shrub found in Egypt, as well as everywhere in the province of Yemen in Arabia. It was considered by Forskal, the discoverer, to be a distinct genus which belongs to the natural family of Capparideæ. It is now arranged only as a subgenus under Capparis [CAPPARIDACEÆ], distinguished by having concave leaflets of the calyx, stamens indefinitely numerous, berry ovate. It requires mention only as the unripe fruit is cooked and forms an article of diet among the Arabs. The same plant is known in Egypt by the name *Hombac:* it forms a shrub with thorny nearly leafless branches.

SODALITE occurs crystallized and massive. Primary form the cube, but usually met with in rhombic dodecahedrons, parallel to the planes of which it is cleavable. Fracture conchoidal, uneven, with a vitreous lustre. Hardness sufficient to scratch glass easily. Colour white, grey, greyish-green, and green. Streak white. Lustre vitreous. Transparent; translucent. Opaque. Specific gravity 2·295 to 2·37.

*Massive Varieties*, amorphous. Structure granular, compact.

When heated by the blowpipe, the edges are rounded with difficulty, and without any other alteration. With borax dissolves into a colourless transparent glass with great difficulty.

It is found in Greenland, in Mount Vesuvius, and in Siberia.

Analysis of the Vesuvian mineral by Arfwedson:—

| | |
|---|---|
| Silica | 35·99 |
| Soda | 26·55 |
| Alumina | 32·59 |
| Muriatic Acid | 5·30 |
| | 100.43 |

SODDOMA, IL. [RAZZI.]

SÖDERHAMN. [SWEDEN.]

SÖDERKÖPING. [SWEDEN.]

SÖDERMANLAND. [SWEDEN.]

SÖDERTILGE. [SWEDEN.]

SO'DIUM, a metal, the base of the alkalis soda, natron, and the fossil alkali, in which substances it is combined with oxygen, forming the protoxide of the metal.

Sodium was discovered by Sir H. Davy in 1807, and the method by which he obtained it is perfectly similar to that by which he procured potassium [POTASSIUM], which it strongly resembles in many properties. It will of course be understood that in the latter case the alkali soda in the state of hydrate was substituted for hydrate of potash. Gay-Lussac and Thénard soon afterwards procured it in greater quantity by decomposing soda by means of iron, as already pointed out. [POTASSIUM.] It is stated by Schœdler, that it may be economically procured by mixing one part of acetate of soda, which has been decomposed by ignition, with half its weight of coarsely-powdered charcoal, and one-fourth of finely-powdered charcoal, and then heating the mixture in an iron retort with the usual recipients for the product.

The properties of sodium are such as to prevent its occurrence in nature, except in combination. Immense quantities occur combined with chlorine, forming common salt; and considerable quantity is met with in the state of oxide, or soda, combined with carbonic acid: these are its principal sources.

Sodium has a colour and lustre resembling those of silver. It remains a soft solid at 32°, so that small portions may be welded together by pressure; it becomes much softer at 122°, fuses at about 190°, and by a white heat it is volati lised. Like potassium, it speedily tarnishes by exposure to the air, owing to its great affinity for oxygen, and this occurs more rapidly when the air is moist, and it requires for preservation the same precautions as have been mentioned with regard to potassium. It does not, like this metal, inflame when thrown upon water, but decomposes it with a hissing noise, the results being hydrogen and oxide of sodium, or soda, which, remaining in solution, exhibits the well-known alkaline character of that substance. When however it is placed on a moistened bad conductor of heat, as charcoal, it decomposes water with vivid combustion. Its specific gravity is 0·972, so that although it is considerably more dense than potassium, it is yet less so than water. It is a good conductor of electricity and heat; but if too strongly heated in the air, it burns with a yellow flame.

Sodium combines with all the elementary gaseous bodies, two of which, namely, those with oxygen and chlorine, are of great importance and utility.

*Oxygen and Sodium* form two compounds, protoxide and peroxide of sodium; the former of these has been long known, and extensively used in various arts and manufactures for many centuries. It was formerly called the *fossil alkali*, to distinguish it from potash, which, as being procured by the incineration of wood, was called the *vegetable alkali;* the peroxide has been discovered only since the metal was known.

Under the head of carbonate of soda we shall briefly mention the processes by which soda is procured for manufacturing purposes, stating merely at present that protoxide of sodium, or anhydrous soda, is prepared by heating the metal in sufficient dry oxygen gas, taking care that there is no excess, for if there be, then some peroxide will be formed; thus obtained, it is a grey solid, resembling potash in appearance, but it is less fusible and volatile. It is extremely acrid to the taste, and is very caustic. It has great affinity for water, dissolving readily in it, and in large quantity, and the solution has strongly marked alkaline properties.

Sodium differs remarkably from potassium in some respects: thus, while both become first alkaline oxides, and afterwards carbonates, by exposure to the air, the carbonate of soda remains dry, while that of potash becomes fluid, owing to the absortion of water.

Sodium, as has already been noticed, is oxidized by decomposing water, and the solution of soda obtained, when evaporated to dryness, leaves hydrate of soda. This is a solid white substance, greatly resembling soda in appearance and properties. It retains the water with so great affinity, that it cannot be expelled by heat.

Soda, or protoxide of sodium, is composed of—

| | |
|---|---|
| One equivalent of oxygen . . . | 8 |
| One equivalent of sodium . . . | 24 |
| Equivalent . . . | 32 |

The hydrate is composed of one equivalent soda and one equivalent of water (32 + 9).

Soda is met with in some mineral substances, but not so commonly as potash. It is found however in albite, or cleavlandite, a constituent of granite resembling felspar, except that it contains soda instead of potash.

*Peroxide of Sodium.*—This compound is formed by heating sodium in more oxygen gas than is required to convert it into a protoxide. It burns vividly, extricating much light and heat; the peroxide resulting is of a yellowish-green colour. When put into water, it is decomposed, oxygen gas being evolved, and soda, or protoxide of sodium, remaining in solution.

According to Davy it is a sesqui-oxide consisting of—

| | |
|---|---|
| One and a half equivalent of oxygen . | 12 |
| One equivalent of sodium . . . | 24 |
| Equivalent . . . | 36 |

The later experiments of Millon make it a compound of—

| | |
|---|---|
| Two equivalents of oxygen . . | 16 |
| One equivalent of sodium . . . | 24 |
| Equivalent . . . | 40 |

It is not applied to any use, and, being decomposed by water, it does not form salts with acids.

*Chlorine and Sodium* form only one compound, the important one, common salt, formerly called muriate of soda, and now chloride of sodium. Of all natural soluble salts this occurs in the greatest quantity. It is met with solid, constituting rock salt, in solution in salt springs and in the ocean, and in small quantity in almost all spring and river water. [SALT-TRADE.]

This salt may be obtained artificially, either by the direct action of chlorine gas on sodium, or by saturating hydrochloric acid with soda; by evaporating the solution, common salt is obtained, which, in whatever manner or from whatever source procured, has, when pure, the following properties:—it is colourless, inodorous, has a purely saline taste unmixed with bitterness; is transparent, brittle, and easily reduced to powder; its specific gravity is about 2·125; when exposed to moist air, it deliquesces; it crystallizes in cubes, which form under common circumstances is but little subject to modification. It is almost as soluble in cold water as in boiling. Water at 32° dissolves more than at 60°; the experiments of Gay-Lussac show that 100 parts of water at 58° dissolve 36 of salt, and in a boiling saturated solution, the temperature of which is 225°, 100 parts of water hold 40·38 of salt in solution. According to Berzelius, the quantities are very nearly 35·4 and 36·1. A saturated boiling solution does not deposit crystals on cooling, evaporation being necessary to produce this effect; in pure alcohol it is insoluble. At a red heat common salt fuses, and on cooling it becomes a transparent brittle mass; the crystals contain no water of crystallization, but decrepitate strongly when heated, owing to the expansion of mechanically interposed water. At a bright red heat it sublimes in the air, and tinges flame of a blue colour.

Chloride of sodium is composed of—

| | |
|---|---|
| One equivalent of chlorine . | 36 |
| One equivalent of sodium . | 24 |
| Equivalent . | 60 |

The uses of this salt have been known from the earliest ages. It is employed not only in seasoning food, but in preserving meat from putrefaction. It is used occasionally as a manure. In chemical manufactures it is employed for preparing hydrochloric acid, sulphate and carbonate of soda, and several other salts, as hydrochlorate of ammonia and the chlorides of mercury, and in the preparation of soap.

Sodium combines with fluorine, bromine, iodine, sulphur, phosphorus, &c.; but the compounds which they form are not very important, not being extensively applied to any purposes whatever. We shall therefore proceed to consider the properties of some of the more useful

### SALTS OF OXIDE OF SODIUM, or OXISALTS OF SODA.

It is perhaps scarcely requisite to state that these salts are never prepared by directly acting upon the metal sodium, although for purposes of curiosity they might all of them be so procured. The first which we shall notice is—

*Nitrate of Soda.*—This salt may be prepared either by adding the metal, or soda, its oxide, to nitric acid; as a natural product it has however of late years been largely imported from Peru, where it forms a stratum of some miles in extent. This salt has a cooling saline taste, is inodorous and colourless; in a moist atmosphere it deliquesces; it readily crystallizes, and the form of the crystal is an obtuse rhomboid; so obtuse indeed, and so near a cube, that the salt was originally called *cubic nitre*, to distinguish it from potash nitre, the crystals of which are prismatic. According to Gay-Lussac, 100 parts of water at 32° dissolve 73 parts of this salt; and at 212°, 173 parts. Berzelius says that water at 60° dissolves half its weight. It is sometimes found with crude nitrate of potash.

Like nitrate of potash, it deflagrates with charcoal; but owing to its property of attracting moisture, it cannot be used in the manufacture of gunpowder. It is however used largely in making nitric acid, sulphuric acid, and as a manure.

Nitrate of soda is anhydrous, and is composed of—

| | |
|---|---|
| One equivalent of nitric acid . | 54 |
| One equivalent of soda . . | 32 |
| Equivalent . | 86 |

There are three compounds of carbonic acid and soda, the carbonate, sesqui-carbonate, and bi-carbonate.

*Carbonate of Soda.*—This salt, formerly called *subcarbonate of soda*, was obtained from barilla [BARILLA] or kelp [KELP]: the former being the ashes of the *Salsola soda*, and prepared in Spain; the latter the ashes of burnt sea-weed, manufactured in Scotland. Since the duty has been taken off common salt, carbonate of soda is now prepared, for the numerous uses to which it is applied, by first converting common salt into sulphate of soda by means of sulphuric acid, and then treating the sulphate with small-coal and chalk in a reverberatory furnace: the result is a mixture of carbonate of soda and sulphuret or perhaps oxi sulphuret of calcium; and when this is treated with cold water, the sulphuret remains undissolved, while the carbonate of soda is taken up by the water, and by evaporation to dryness what is called *soda ash* is obtained; while by due evaporation crystallized carbonate of soda is formed.

This salt, when obtained by evaporation, is a colourless inodorous powder; it is devoid of smell, but has a disagreeable taste, though less so than carbonate of potash; it is readily soluble in water; does not deliquesce when exposed to the air. The primary form of this substance, when crystallized by moderate evaporation of the solution, is an oblique rhombic prism. The crystals are frequently very large. They contain about 62 per cent. of water, the greater part of which they lose by exposure to the air, and efflorescing, fall to powder. At high temperatures the salt becomes fluid and boils. Water at 60° dissolves half its weight of carbonate of soda, and boiling water considerably more. The solution possesses the alkaline property of turning vegetable yellows brown Like other carbonates, this salt is decomposed by the stronger acids, with effervescence of carbonic acid; and by lime, which separates its carbonic acid, it is rendered caustic.

Carbonate of soda is composed of—in the state of crystals—

| | |
|---|---|
| One equivalent of carbonic acid | 22 |
| One equivalent of soda | 32 |
| One equivalent | 54 |
| Ten equivalents of water | 90 |
| Equivalent of crystals | 144 |

The quantity of this salt prepared and used is enormous; it is required in making soap, and crown and plate glass, and for numerous other purposes.

*Sesqui-carbonate of Soda.*—This compound is found native in Hungary, and also near Fezzan in Africa. By the natives it is called *Trona*. It is found in hard striated crystalline masses, and it is not altered by exposure to the air, but is readily soluble in water.

This salt appears to be formed when a solution of the carbonate of soda is heated with carbonate of ammonia, and probably also when a solution of the bi-carbonate is heated. Its taste is less alkaline than that of the carbonate, into which it is converted, when strongly heated, by losing one-third of its carbonic acid.

It is compose of—

| | |
|---|---|
| One equivalent and a half of carbonic acid | 33 |
| One equivalent of soda | 32 |
| Two equivalents of water | 18 |
| Equivalent | 83 |

It is used in medicine, and it is stated that in Africa it has been used for building walls.

*Bi-carbonate of Soda.*—This salt is formed by passing carbonic acid gas into and through a solution of the carbonate of soda; a crystalline granular compound is formed, which consists of—

| | |
|---|---|
| Two equivalents of carbonic acid | 44 |
| One equivalent of soda | 32 |
| One equivalent of water | 9 |
| Equivalent | 85 |

This salt has a very slightly alkaline taste, and it acts very feebly on turmeric-paper. It requires about twelve times its weight of water for solution. When the solution is boiled, it loses one-fourth of its carbonic acid, and is converted into sesqui-carbonate; at a red heat it loses all its water and half its carbonic acid, and is then carbonate of soda. It resembles the sesqui-carbonate in giving no precipitate with the salts of magnesia till heated; and they both differ from the carbonate in this respect. It is used in medicine. This salt dissolved in water is called *soda-water*, when an additional quantity of carbonic acid has been forcibly combined with it.

*Sulphate of Soda*, formerly called Glauber's salt, may be formed by the direct combination of the acid and alkali; it is however generally prepared by decomposing common salt, in the preparation of hydrochloric acid, or for making carbonate of soda. It has also been met with in nature, but not largely.

This salt is readily soluble in water, and the solution by evaporation yields colourless transparent prismatic crystals, the primary form of which is an oblique rhombic prism. It has a very bitter taste; effloresces when exposed to the air, by losing water of crystallization. Boiling water dissolves its own weight of this salt, and water at 60° one-third of its weight. It is insoluble in alcohol. When exposed to heat it first undergoes watery fusion, by melting in its water of crystallization; when the water has been expelled, it becomes opaque white, and at a red heat it melts.

It is composed of—

| | |
|---|---|
| One equivalent of sulphuric acid | 40 |
| One equivalent of soda | 32 |
| Equivalent | 72 |
| Ten equivalents of water | 90 |
| Equivalent of the crystals | 162 |

It is employed in medicine, but much more largely in the preparation of carbonate of soda.

*Phosphoric Acid* combines with soda to form several compounds; for an account of which we refer to Brand's 'Manual of Chemistry.' No one of them is extensively employed.

*Borate of Soda* is a compound of boracic acid and soda. [BORAX.]

*Acetate of Soda* is a salt prepared by saturating the acid with the alkali or by double decomposition with acetate (pyrolignite) of lime and sulphate of soda. This salt has a saline but not a disagreeable flavour; it is colourless, inodorous, and crystallizes in oblique rhombic prisms; the crystals are soluble in three times their weight of cold water, and much more so in hot; when heated, it first melts in its water of crystallization, and at a red heat it is decomposed and converted into carbonate of soda. It is employed in the preparation of acetic acid and of sodium.

It consists of, in its crystallized state—

| | |
|---|---|
| One equivalent of acetic acid | 51 |
| One equivalent of soda | 32 |
| Six equivalents of water | 54 |
| Equivalent | 137 |

For an account of numerous other salts of soda we must refer to chemical authors; those whose properties we have detailed being merely the most useful.

*General Properties of the Salts of Sodium.*—Unlike the salts of potash, there is no acid nor any metallic oxide which forms an insoluble compound with the salts of soda, so that they cannot be precipitated in combination from solution. The best mode of distinguishing between these two alkalis is, to convert them into their respective sulphates or nitrates, and compare their distinctive characters.

SODIUM, *Medical Properties of the Preparations of*. This, when in the state of an oxide, is termed the mineral alkali, in contradistinction to potash, or the vegetable alkali; both however are found in plants, though the former exists in large quantity only in plants growing in the sea, on the sea-coast, or inland salt-marshes. In the form of the chloride of sodium, common or table salt, it is one of the most abundant principles in the mineral kingdom. It also exists in many fluids in the animal kingdom, such as the blood and urine, particularly in man.

It possesses the ordinary qualities of a fixed alkali, but notwithstanding the resemblance it has to potash, the preparations, even with the same acid, present some differences which may be here pointed out.

In the oxidized state, or soda (pure or caustic), it is not employed in medicine to counteract acidity; nor in surgery to form an ulcer or to open abscesses, though for this latter purpose it possesses some advantages over hydrate of potash, inasmuch as it is not liable to spread or run.

It is only when in combination with carbonic acid that it is used to correct acidity. It exists in three states, viz. carbonate, sesqui-carbonate, and bi-carbonate: the causticity of these is less in proportion to the increase of the acid. These preparations, administered in various ways, but chiefly in solution, are much used to counteract real or presumed acidity of the stomach. The abuse of the analogous preparations of potash has been already pointed out. [POTAS-

SIUM.] The same caution is necessary as to soda-water, when that really contains any carbonate or bi-carbonate of soda, as it not unfrequently consists only of carbonic acid compressed into the water. The saline draughts so commonly employed in the medical practice of this country are liable to the same objection, and in all cases of debility, especially in the phosphatic diathesis, do infinite harm. For an opposite reason, they are extremely serviceable in all inflammatory complaints: the period when they should be discontinued can only be determined by an intelligent medical attendant.

The preparations of soda possessed of purgative properties are—the sulphate, or Glauber's salts, the phosphate, and the triple salt, called sodæ-potassio-tartras, or Rochelle salts, of which potash is also a constituent. Of these it is only necessary to observe that of the sulphate a much larger dose is required than of the corresponding salt of potash; and that the phosphate, being nearly tasteless, and extremely mild in its action, is a very proper aperient for delicate persons. A nearly similar character belongs to the Rochelle salt, but as this is decomposed in the stomach, it is as hurtful as the common saline draughts in cases of debility, though very beneficial in inflammatory disorders, particularly in both acute and chronic duodenitis. The same remark is applicable to the so-called Seidlitz powders formed with Rochelle salt and bi-carbonate of soda, to which, when dissolved, a solution of tartaric acid is added, and the mixture drank in the state of effervescence. The most quickly acting aperient is a Seidlitz powder dissolved in warm water; this is most proper at the commencement of common colds, influenza, and inflammatory diseases, but it should not be repeated without medical sanction, especially in influenza, where extreme debility speedily ensues.

The preparations of soda possessed of diuretic properties are the bi-borate and the acetate. The former of these has been already treated of [BORAX], and the second is rarely used, though, from not deliquescing, it has the advantage over acetate of potash, that it can be administered in the form of powder.

Chloride of sodium possesses purgative and emetic properties, which render it useful as a domestic remedy. Its other uses have been already pointed out. [BATHING; ANTHELMINTICS; FOOD.]

Chloride or hypochlorite of soda is a powerful disinfecting agent. [ANTISEPTICS.]

SODOM, an antient city of Palestine, which, with Gomorrah, Admah, Zeboim, and Bela or Zoar, formed the five 'cities of the plain,' four of which were destroyed by fire from heaven for the wickedness and vices of their inhabitants, in the time of Abraham. (*Gen.*, xix.)

It has usually been assumed that the Dead Sea has existed only since the destruction of Sodom and the other cities; and of late years the favourite hypothesis has been, that before that time the Jordan had flowed through the whole length of the Wady-el-Arabah to the Gulf of Akaba, and that the present bed of the Dead Sea was a fertile plain. But from the recent discoveries of Dr. Robinson, we learn that this could not have been the case, at least not within any historical period. This traveller found that the Arabah, through which the Jordan was supposed to have once passed southward to the eastern arm of the Red Sea, actually sends its own waters northward into the basin of the Dead Sea; and that the waters of the high western desert, far to the south of the Arabah, all flow in the same direction. 'Every circumstance goes to show that a lake must have existed in this place, into which the Jordan poured its waters long before the catastrophe of Sodom. The great depression of the whole broad Jordan valley and of the northern part of the Arabah, the direction of its lateral valleys, as well as the slope of the high western desert towards the north, all go to show that the configuration of this region in its main features is coeval with the present condition of the surface of the earth in general, and not the effect of any local catastrophe at a subsequent period.'

But although it appears that the Dead Sea existed before the destruction of Sodom, it is also concluded that the lake then covered a considerably less extent of surface than at present; and that Sodom and the other cities stood in what is now the southern portion of the lake, which portion is even now sufficiently distinguished from the main body of that water. That Sodom was at the southern extremity of the lake is shown by the fact that it was near to Zoar (to which Lot fled, and which was spared), and the name of Zoar is now recognised at a spot almost at the southern extremity of the present lake. The fertile plain therefore in which Sodom is described as having been situated, and which 'was well watered, like the land of Egypt,' lay to the south of the lake 'as thou comest unto Zoar.' Even to the present day more living streams flow into the Ghor, at the south end of the lake, from the wadys of the eastern mountains, than are to be found so near together in all Palestine; and the tract, although now mostly desert, is still better watered through these streams, and by the many springs, than any other district throughout the whole country.

(Robinson's *Biblical Researches in Palestine*, ii. 601, et seq.)

SOFA'LA is a country on the east coast of Africa, extending from Cape Corrientes on the south (25° S. lat.) to the vicinity of the river Luabo, the most southern arm of the Zambesi (19° S. lat.). As the country, except in two or three places on the coast, where small Portuguese settlements are found, is occupied by small independent tribes, it is impossible to assign to it a western boundary. This country, together with the province of Senna [SENNA], was formerly known by the name of Monomotapa, and was noted for the quantity of gold which was supposed to exist there. It has sometimes been considered to be the Ophir of Solomon, whence his fleets returned laden with 'gold and precious stones.' [OPHIR.] At present the name of Monomotapa is antiquated, and the few gold-mines which exist are included in the province of Senna. [SENNA, vol. xxi., 239.]

The coast is low, and so beset with shoals and sandbanks, that it is very difficult of access for large vessels. Along the coast are several islands, as the Bazaruta Islands, and Chuluwan, which is sixteen miles in length, and is nearly divided into two parts by a salt creek, which opens into the small channel that separates it from the mainland.

The mouths of several rivers have been visited. The most northern is the river Boozy, commonly called Jarra, which falls into a large shallow bay called Massangzany. Then follows the river of Sofala, forming at its mouth a tolerable harbour, which however is very difficult of access on account of the bar. Farther south is the river Savey or Sabia, and then the Sawooro, which falls into the great bay of Maroonone. These two rivers are hardly navigable for boats at their entrance, but are stated to be large rivers in the interior. The most southern river is Inhamban, which is easy of access, and makes a superb harbour, but is scarcely navigable for ships beyond the town, eight miles from the entrance; and five miles farther up it is not navigable even for boats.

Ivory and bees'-wax constitute the principal if not the only articles of export: they go to Mozambique. When the inhabitants have had a war with their neighbours, a few slaves are brought to the settlements.

The native tribes are very warlike. They are not acquainted with fire-arms, and use only spears and shields made of hide. They are divided into numerous tribes, and their chiefs come annually to the Portuguese settlements, where they receive some trifling presents.

The most northern of the Portuguese settlements is Sofala, which consists only of a paltry fort and a few miserable mud huts. At the mouth of the river Sabia a serjeant and six men are stationed. The most important settlement is Inhamban, which is a small trading town with tolerably good buildings. The Portuguese population, exclusive of the military, is only twenty-five, but the coloured inhabitants are numerous.

Sofala was visited by Pedrão Cavalhão, a Portuguese, before the way to India by sea was known. He went there by the way of the Red Sea and Calicut, in 1480, a year before Bartolomeo Diaz succeeded in reaching the Cape of Good Hope. Albuquerque took possession of it, and in 1508 the fort of Sofala was built. The Portuguese have always remained in possession of the country; but in proportion as their power in the East Indies decreased, the importance of these settlements was lessened, and in consequence they have been neglected.

(Capt. Owen's *Narrative of Voyages to explore the Shores of Africa, Arabia, and Madagascar.*)

SOHAM. [CAMBRIDGESHIRE.]

SOHO. [BIRMINGHAM.]

SOIL. Wherever the surface of the earth is not covered with water, or is not naked rock, there is a layer of earth, more or less mixed with the remains of animal and vegetable substances, in a state of decomposition, which is commonly called the *soil*.

The nature and composition of the soil, and consequently its greater or less aptitude to the growth and maturity of vegetable productions, depend chiefly on the proportion and mechanical structure of the various substances of which it consists. When the soil is favourable to the chemical action by which the elements are combined to form vegetable substances, and admits that quantity of air and moisture without which this chemical action cannot take place in any given climate or temperature, vegetation goes on rapidly, and all the plants which are suited to the climate grow in the greatest perfection, and bear abundant fruits.

It is not however very frequently the case that a soil possesses all those qualities on which great fertility depends. So many circumstances must concur to make a soil highly fertile, that the great majority of soils can only be made to produce abundantly by being improved by art both in their texture and composition. Hence the practice and science of agriculture, which is founded on experience, but to which every progress in science also affords great assistance, by the additional light which every new discovery throws on the true theory of vegetation.

There are various modes of distinguishing soils, without entering into a minute analysis of their component parts. The simplest and most natural is to compare their texture, the size and form of the visible particles of which they are composed, and to trace the probable source of their original formation from the minerals which are found around or below them, or the rocks from which they may have been slowly separated by the action of the elements. The science of geology, which teaches the relative position and nature of the minerals of which the outer crust of the earth is formed, is consequently of the greatest utility in aiding us to compare different soils and ascertaining their composition.

The knowledge which geology imparts is however not sufficient for the minuter classification of soils; for it is found by experience that the soils which lie over or near the different strata, as they appear near the surface, vary greatly, although they retain some general character which distinguishes them from others. The streams which descend from the hills, and flow towards the valleys, and through them to the sea, carry to a great distance the minuter portions of the minerals which they flow over in their course, while the larger and heavier are deposited much sooner. Hence the heterogeneous mixture of various earths and stones, and their stratification in thin layers, as is often found when a soil is examined which has never been disturbed by cultivation. A sudden flood rising rapidly carries stones and fragments of rocks in its course, while a gentler stream deposits fine sand or clay over these, and forms every variety of sandy, gravelly, or clayey soil. If chalky hills are near, carbonate of lime abounds in almost every proportion, with its usual concomitant irregular flints. If the waters have accumulated in a basin, and formed a temporary lake, the soil will consist of all the finest portions of the minerals, which from their minute size have remained long suspended in the still waters, and slowly deposited in the form of mud. In proportion to the shallowness of the lake, vegetable matter will have been produced, and intimately mixed with the minerals; and where vegetation has gone on rapidly, peat and soft bogs are formed.

It is not sufficient to class soils according to the substance which predominates, as has been usually done, such as sandy, gravelly, chalky, or clay soils; for this gives very imperfect information respecting their nature or fertility; neither is it altogether sufficient to class them according to any particular geological formation. It is important to enter into a more minute examination of their component parts. But as the geological investigation of the different strata is a great help in the examination of soils, we will in the first place give a short description of those which have the most distinct characters, from their connection with different geological formations.

The soils which are immediately derived from those rocks in which no traces of organic remains are to be found, consist either of visible fragments of quartz and other hard minerals, which are not affected by exposure to air or water, and are only ground and comminuted by being rubbed against each other in floods and torrents, or of minuter particles of the same, of which the shape is not readily distinguished by the naked eye. When they are altogether composed of visible particles and stones, the water readily passes through them; and unless they are kept continually moist by a regular irrigation, without any stagnation of the water, they are absolutely incapable of sustaining vegetation, or of bringing fruits to maturity. It is seldom, however, that any gravel or sand does not contain some portion of earth or other matter, of which the particles become invisible when diffused through water, and to which, for the sake of perspicuity, and to prevent confusion, we will here give the general name of *impalpable substance*. A certain portion of this finer part of the soil, and its due admixture with the coarser, especially where there is some regular gradation in size, and no stones of too large dimensions to obstruct the instruments of tillage, may be considered as essential to fertility. The chemical composition of the impalpable substance no doubt greatly affects the degree of fertility; but the general texture must be considered as by far the most important circumstance. To improve this texture permanently is the great object of all the labours of the husbandman. For this purpose he carries various earths from one spot to another; clays one field, and limes or chalks another; brings peat upon sands and clays, and carries gravel and lime on his peat-bogs. Without an adequate knowledge of the composition and texture of a soil, it is impossible to make permanent improvements with any certainty, or without incurring the risk of failure or of useless outlay.

The soils which have been formed from the disintegration and decomposition of the primitive rocks, such as granite, basalt, schist, or limestone, and especially those which contain all these minerals minutely divided and intimately mixed, are always naturally fertile, and soon enriched by cultivation. The hard particles of quartz maintain a certain porosity in the soil, which allows air and moisture to circulate, while the alumina prevents its too rapid evaporation or filtration. The silicate of potash also seems highly favourable to the vegetation and growth of those plants which contain silica in their stems, such as the gramineæ, especially wheat, of all plants the most important to the husbandman in our northern climates. If organic matter be an essential ingredient in a fertile soil, it is soon produced by cultivation, or added by judicious manuring.

Where there is a deficiency of impalpable matter, and the fragments of the rocks of which the soil is composed are large, and lie loosely, it is in vain to expect vegetation, except along gently flowing streams, which supply the roots with moisture, and thus form a bed of vegetable matter; but in a climate suited to the vine, and in a good exposure, these loose soils often produce excellent wine, as may be seen along the steep banks of the Rhine and other rivers. The roots of the vine run deep into the fissures of the rocks below, and there find nourishment suited to their nature.

The primitive limestone, which is very hard, is yet gradually decomposed by the action of air and water, being, in a very small degree, soluble in the latter. The water which flows through these rocks is soon saturated; but when it springs out and comes to the light, the carbonate of lime is deposited by the evaporation of the water; and, if this meets with the clay which results from the decomposition of the slate, it forms a marl, which, naturally or artificially added to silicious sand, forms the basis of a very good soil, particularly well adapted to pasture.

The soils which have been evidently formed from the rocks which are supposed to be of secondary formation, are fertile according to the proportion of the earths of these rocks which they contain. It is of these chiefly that those loose sandy soils are formed of which the particles appear as distinct crystals, easily distinguishable with the aid of a lens, or even by the naked eye. Air and water have been the chief agents in the decomposition of those secondary rocks called *sandstones*, and agitation in water has washed from them the finer portions, which have remained suspended. The immense sandy plains which are either barren or have been fertilized with great trouble and expense, have probably once been the shores of the sea, from which the waves have washed all that portion which was impalpable and easily suspended in water, depositing this in the depths, which, by some convulsion of nature, may some time or other be raised above the level of the waters, and form hills or plains of clay, such as are often found in extensive basins of great depth.

Argillaceous earth exists in some proportion in almost every rock. Some of the hardest gems are chiefly composed of alumina. It has the property, when mixed with other substances, as silica or lime, of fusing into a stone of great hardness and insolubility. In this state its effect on the soil is not to be distinguished from that of silica; and by burning common clay, or clay mixed with carbonate of lime, a sandy substance is produced resembling burnt brick, which tends greatly to improve the texture of those clays which contain little or no sand in their composition. It must be remembered that the stiffest clays contain a large portion of silica in an impalpable state; but this, instead of correcting their impermeable and plastic nature, rather adds to it. It is only palpable sand which with clay forms what is commonly called loam, and which, when the sand is in due proportion with a mixture of organic matter, forms the richest and most easily cultivated soils. Some of the rocks of secondary formation contain a considerable portion of alumina and lime; and when these earths meet with crystallized sand, a compound, or rather a mixture is formed, which has all the requisite qualities, as to texture, to produce the most fertile loams. The only deficiency is that of organic matter; but this is so readily accumulated wherever vegetation is established, or can be so easily added artificially, that these loams may always be looked upon as the most favourable soils for the usual agricultural operations; and if a considerable depth of loam is found, which neither retains water too long nor allows it to percolate too rapidly, it may be looked upon as a soil eminently capable of the highest degree of cultivation, and on which no judicious outlay of labour will ever cause loss or disappointment to the farmer.

The greensand which lies under the chalk, and appears near the surface in several parts of Britain, consists of siliceous, argillaceous, and calcareous earth, intimately combined and in a high state of subdivision, and yet not forming a compact paste with water so as to dry in hard lumps, but having rather the loose appearance and granulation of fine sand, whence its name. On this soil are found the finest wheats; but such is the variety of its form as it approaches towards the chalk or crystallized sand, or the plastic clay, that the soils which it forms have every degree of texture, from loose sands to stiff marls, whose chief use is to mix with other soils and improve them. In general however it may be said that the soils of which the greensand forms a considerable part are productive and easily cultivated, and that they repay the labour and manure expended on them better than most others. A narrow strip of this sand crosses Bedfordshire, and in the neighbourhood of Sandy and Biggleswade are raised some of the finest culinary vegetables which come to the London market. This sand, though light in appearance, and very easily worked, contains much of the impalpable substance mentioned before; and this, with careful cultivation and manuring, makes it peculiarly suited for gardens as well as for corn-fields. In its natural state it is easily distinguished from other sands by certain dark particles in it, which give it the greenish hue from whence it has been called greensand, and also by its effervescence with strong vinegar or any other acid.

Chalk is perhaps the mineral most widely spread throughout Britain. The chalk formation of itself forms a very poor and barren soil. In the course of ages the surface of the chalk has been covered with a thin coating of soil, consisting of chalk and organic matter chiefly. On this soil the finest and most aromatic plants are found, but of minute dimensions, affording a sweet short pasture, much relished by sheep. The constant treading in of the dung of the sheep, and the stimulating effect of their urine, gradually increase the quantity of vegetable and animal matter; and thus the turf becomes close and rich: but if this thin coat be disturbed by the plough and mixed with the chalk below, it will, after one or two tolerable crops of corn, be reduced to its original sterility; and it requires ages to restore the fine pasture which once covered it. Such is the case with those hills which are called the South Down Hills, in Sussex and Wiltshire, on which are bred the excellent sheep which bear that name.

But the chalk has in many places been carried down by the rains and transported in a comminuted state to the sandy or clayey valleys around them, and by the mixture has greatly improved both, forming various loams and marls in themselves highly fertile, or very useful in increasing the fertility and texture of other soils. Chalk has the peculiar property of neutralising acids of every description, and of preventing their formation in the soil by the fermentation of vegetable substances; while it assists in that slow decomposition which causes the evolution of carbonic acid, and thereby assists and invigorates vegetation. The presence of carbonate of lime, if it does not exceed a third part, and if it is intimately blended with alumina and silica, is always a sign of fertility, especially when loose sand is mixed with it, so as to form one-half of the whole soil. This is called a light calcareous loam, and is usually found on the slopes or around the base of chalky hills.

The Weald clay consists of very minute particles of alumina and silica, forming a tough unctuous earth, fit for the growth of oaks, with very few stones or visible particles. This soil is found in Sussex and Kent chiefly. The plough cuts it into continuous slices, when it can be ploughed, which is only in a certain state of moisture; for when it is dry, the surface is as hard as a rock, while the subsoil is continually moist, the water being unable to pass through its pores. It has the most unpromising aspect, drying into hard lumps like brick, and apparently incapable of being brought to such a state of mellowness as to admit the seed or cause it to vegetate; yet this stubborn soil may be rendered fertile by tillage, draining, and exposure to frost in winter: and its tenacity may be corrected by the application of lime, ashes, and other substances, especially fresh stable-dung, which interpose and prevent the clods from re-uniting into one tough impervious mass. Lime and chalk do this most effectually; and when the weald clay has been brought to a looser texture, it produces beans, wheat, oats, and clover in great perfection.

The system of complete under-draining by parallel drains, at the distance of from 10 to 20 feet, which carries the moisture into the surrounding ditches, has in many instances so greatly improved the weald clays, that those who had formerly attempted to cultivate them can scarcely believe their eyes when they see the abundant crops produced. Subsoil ploughing has also done wonders after complete draining, in some cases rendering the soil so mellow and loose as to allow of the cultivation of turnips, especially the Swedish. As clay soils predominate in England, and their improvement has been almost despaired of, it is of great importance that it should be generally known that no soils repay the cost of improvement better than clays, provided the surface be such as to admit of perfect draining.

Another clay is called the Oxford clay. This is of a bluish colour, which alters on exposure to the air, probably from a change in the oxidation of the iron which it contains. This clay is favourable to the growth of grass, and some of the richest pastures in Wiltshire and Oxfordshire have it for a subsoil, over which the decomposition of the roots and leaves of the grasses has formed a layer of vegetable mould of the highest degree of fertility. In the fens of Lincolnshire the Oxford clay is covered by a coat of peat, formed by the decomposition of aquatic plants, which have accumulated wherever the water had no natural exit. When these fens were laid dry by an extensive system of draining, the peat was converted into a rich soil by the admixture of the clay which was found under it.

The *Oolite* formation contains much carbonate of lime cemented by an unctuous earth into a species of stone. The soil which lies over this stone, and which is of nearly the same nature, but broken and disunited, is various in its qualities. Sometimes it is of great fertility, and sometimes nearly barren, according as the impalpable matter in it abounds and contains a due proportion of the different earths, or it resembles a loose chalky sand, in which moisture is retained with difficulty. In the first case it produces every kind of grain in abundance with moderate cultivation. In the latter it requires a great outlay of manure which readily disappears, and it is justly called a poor hungry soil.

On the red-sandstone is found a soil which is usually of the finest quality. The fine loose soils of Devonshire and Somersetshire are of this description. It unites most of the requisites of a good soil in its texture, neither too close nor too loose, and in the impalpable matter in its composition. It is peculiarly adapted to the growth of potatoes and all roots which form the basis of a judicious cultivation. When it contains a proper portion of calcareous earth, it may be reckoned amongst the most fertile soils, and where this is deficient, the addition of lime or chalk is the best means of improving it. The calcareous earth seems greatly to add to the effect of the usual manures, so that a much smaller portion is required to produce good crops.

The neighbourhood of coal, however valuable it may be to the proprietor of the land in a mercantile point of view, is generally accompanied by a great degree of poverty in the soil wherever this mineral crops out to the light. Coal seems not only barren in itself, but almost incapable of being fertilised. The slate which usually accompanies it crumbles into a very poor earth, which lets the water through, and is composed of visible fragments of irregular shapes. The same may be said of the slate which rises into high hills in Devonshire and Cornwall. The strata here are generally very upright and narrow, and the water finding an easy exit downwards between them, leaves the surface too dry to favour vegetation, even if the soil which covers it were more fertile; but every portion of organic matter is carried off, and none can accumulate to form vegetable mould. The lands which are in cultivation in the valleys whither the waters have carried a mixture of earths, and where the subsoil is of slate, require much manure to produce even moderate crops.

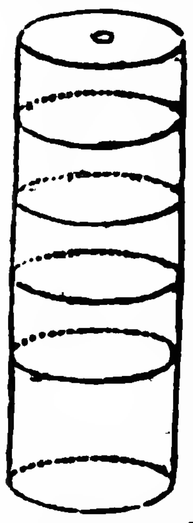
These are some of the principal natural soils found in Great Britain. It will be seen that each distinct formation gives rise to a great variety with respect to fertility, even where the basis remains the same: but it is of great importance to the farmer to ascertain the general nature of the rocks and strata on which his farm is incumbent, and no chemical analysis can determine the exact value of the land, unless the geological situation of it is distinctly known. But with this guide the analysis may distinguish the varieties, and point out the spots which can be cultivated at the least expense, or improved by the simplest means, while it may also show the deficiencies which render a soil on the most favourable formations difficult of cultivation or improvement, when these deficiencies are not easily remedied for want of those substances which are not found within reach of the farm. In all these soils no notice has been taken of organic matter, because this seems not in any great degree to be connected with their formation. The primary strata are distinguished by having no traces of organic remains in their composition. The secondary have not a sufficient proportion to call for an especial notice of it. It is in the tertiary strata, especially those which have been formed by the destruction of animal and vegetable substances, that organic matter becomes a peculiar object of attention, and from this reason alone the alluvial soils of later date are found highly fertile, whenever the circumstances which prevented their cultivation are removed; whether it be the waters which are to be shut out by dykes or carried off by draining, or a want of labourers which has left them to a state of nature, whenever the soil is turned up and the seed sown, the crops are always, for a greater or less period, certain and abundant.

The alluvial soils formed by the deposit of a variety of earths in a state of great division, and mixed with a considerable portion of organic matter, form by far the most productive lands. They will bear crop after crop with little or no addition of manure, and with a very slight cultivation. These soils are found along the course of rivers which traverse extensive plains, and which have such a current as to keep very fine earth suspended by a gentle but constant agitation, but not sufficiently rapid to carry along with it coarse gravel or sand. Wherever there is an obstruction to the current and an eddy is formed, there the soil is deposited in the form of mud, and gradually accumulating, forms those alluvial soils which are so remarkable for their fertility when carefully protected from the inroads of the waters. In these soils the impalpable matter greatly predominates; but the intimate mixture of the earths with organic matter, in that state in which it has been called *humus*, prevents their consolidating into a stiff clay; and the gasses which are continually evolved from the organic matter keep the pores open, and give scope to the growth as well as the nourishment of the roots. It is in the alluvial soils principally that an accurate analysis is useful; because the proportion of their constituent parts varies in innumerable degrees. It may be laid down as a general rule, that the most fertile of these soils are those in which the primitive earths are nearly in equal proportions, silica being the most abundant, with about 10 per cent. of organic matter: a greater proportion of this last would form too loose and spongy a soil to bear good crops of corn, especially of wheat. But 4 per cent. of humus, with a good mixture of earths, and some phosphate of lime from the decomposition of bones and marine shells, produces a very good wheat soil. The rich warp-lands along the Humber are artificial alluvial soils, and although they contain but a small proportion of humus, are highly fertile after their first deposition, but it is observed that they gradually become more tenacious and difficult of cultivation as this humus is carried off by the crops; and that it is soon necessary to add animal and vegetable manures to supply its deficiency.

Organic matter is no doubt essential to great fertility in a soil, but some soils require more of it than others. *Humus*, which is the form which organic matter naturally comes to by slow decomposition in the earth, gives out certain elements which the roots can take up in their nascent state, and from which they obtain the carbon which is so abundant in all vegetable productions. But organic matter in every stage of its spontaneous decomposition keeps the pores of the soil open, and admits, if it does not even attract, air and moisture to the fibres of the roots. In all rich soils which have been long cultivated, especially in gardens, there are particles of a dark colour and fibrous texture, which in the microscope appear like minute logs of charred wood. These keep the soil open, and supply carbonic acid, when the air reaches them, or they are slowly transformed into humus, which remains inert as long as it cannot imbibe oxygen and form carbonic acid by a species of slow combustion. Humus is no doubt one of the chief causes of fertility, but its presence does not appear to be so indispensable as has been imagined. A proper texture seems a much more indispensable condition. Humus can undoubtedly be formed from the elements of water and of the atmosphere. Whether it be directly or by the slow process of vegetation and subsequent decomposition, does not so readily appear, but it is certain that there are soils which are highly fertile in which scarcely a trace of humus can be discovered, and which, from their igneous formation, cannot well contain organic matter; such are the soils which are produced by the decomposition of the lava which has run in a liquid state from the craters of volcanoes. This is composed of different minerals, which have been fused by the action of heat, but in which the mixture of the earths and salts has not been in such proportions as to form a perfect glass. When exposed for a time to the influence of the atmosphere, the lava crumbles into an earth, which is neither so loose as silicious sand nor so plastic as clay, and which has such a porosity as suits the growth of the roots of vegetables. By the effect of a warm climate and frequent rains, vegetation goes on rapidly; and by cultivation humus is soon formed and accumulated, so that it is only in the more recently cultivated lavas that it can be said that vegetation goes on without any supply of organic matter; and the addition of humus greatly increases the fertility of these soils. It is much easier to supply the deficiency of humus, which at best forms but a very small portion of the soil, than of silica or alumina, which should enter into its composition in the proportion of one-half or a third of the whole. It is practicable to carry lime or chalk upon soils which do not contain calcareous matter; clay may also be carried upon loose sandy soils, where it can be found below the surface, or at a moderate distance; but if a soil is very deficient in silica, it requires so large a proportion of this earth to give porosity to stiff clay, that it very seldom can repay the trouble and expense. Hence the difficulty of bringing poor wet clay soils into a fertile state, except where an abundance of chalk and vegetable manures can be easily procured. In this case the perfect draining of the land, and exposure of the ploughed surface to the frosts of winter, with the addition of chalk and manure, produces such an alteration in the texture of the clay, that by continuing the improving process it is entirely changed into a mellow and fertile loam. The burning of a portion of the retentive subsoil into a brick-like earth gives it a porosity which renders it mechanically similar to silicious sand, and converting the iron which all these clays contain into a peroxide, the soil is thereby greatly improved in fertility; for it seems that iron, in a state of slight oxidation, or combined with any acid, is hurtful to vegetation, whereas the red peroxide is not only innocuous, but seems to have fertilising properties.

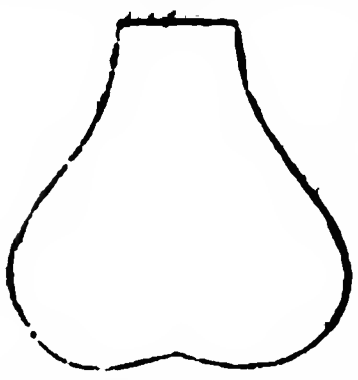
The comparison of the different fertile soils leads therefore to the conclusion that the texture or porosity arising from the admixture of particles of various dimensions is the most important object of examination; and subordinate to this is the chemical constitution of the earths and other substances of which it is composed. In the examination and analysis of soils for the purpose of ascertaining their power of production, we must therefore first examine them mechanically, and afterwards chemically, and on this principle has been proposed the mode of *analysing soils*, in a paper which obtained one of the first prizes given by the Royal English Agricultural Society, and published in the first number of its journal. We will here insert a short account of the process, with such alterations and additions as more extensive practice has suggested.

There are two easy methods of ascertaining the size of the particles of a soil. The first and simplest is by drying the portion under examination, gently triturating it with a wooden pestle in a mortar, so as not to produce a grinding of the more solid portions, and then separating the coarser from the finer parts by means of several metallic sieves of different fineness. A simple instrument is recommended for



this purpose, which is very portable, and consists of three or four sieves fitting into each other like the percolators in a coffee-biggin; the coarsest sieve being uppermost and covered with a lid; the finest fitting into a recipient, and the whole forming a cylinder three or four inches in diameter, and from six to eight in height. The coarsest sieve has threads at the distance of $\frac{1}{20}$ of an inch, the second has 80 in an inch, the third 120, and the fourth is the finest metallic tissue which can be made. What remains in the two first is easily examined by the eye, or with the help of a lens. The third and fourth require a microscope to see whether any crystallized particles remain in the impalpable dust which has gone through all the sieves. By carefully weighing these different earths their proportion is known, and by taking the specific gravity of each their nature can be guessed at with tolerable accuracy.

As this analysis is not intended for experienced chemists, the simplest methods are preferred to the more accurate. There is a mode of taking the specific gravities of substances, which are in the form of powder insoluble in water, so easy and so little liable to error, that any person, however unaccustomed to experiments, can soon become sufficiently expert to have full confidence in the result. It is as follows:



a small pear-shaped phial is blown of thin glass, and the neck cut and ground smooth. The size is such as to contain 300 grains of water, more or less; the exact quantity is not essential. It is now filled with pure water at 60° of Fahrenheit's scale, and accurately poised in a delicate balance: 100 grains weight are then placed in the same scale with this phial, and, by means of a very fine tube, water is gradually sucked out of the phial, till the equilibrium is restored; that is, exactly 100 grains of water have been taken out. A counterpoise is now made of lead or brass, when the 100 grains weight has been removed, and this serves for all future experiments. When the specific gravity of any substance is required, the phial, partly filled with water, is placed in one scale, and the counterpoise, made as above described, is placed in the other; water is added or taken from the phial till an equilibrium is obtained. The substance to be tried is slowly and carefully poured into the phial, until the water rises to the ground surface of the neck and stands quite level, which is easily seen by observing the reflexion of the light from the surface. It is then carefully replaced in the scale, and grain weights are added to the other scale to restore the equilibrium. The number of these grains at once indicates the specific gravity of the substance; for the space above the water was that of 100 grains of water, and this space is now filled up by the earth examined. Its weight therefore denotes its specific gravity compared to water as 100; and as a delicate balance readily turns with a decimal of a grain, the decimals give the specific gravity to the third figure. Thus if the grains are 256 and the decimals 4, the specific gravity is accurately 2564, water being 1000.

By taking the specific gravity of the pure earths, it is found that silica is the heaviest, next carbonate of lime, and the lightest is alumina, while organic matter is much lighter than any earth. Thus a tolerable guess can be made of the composition of that impalpable portion of the soil which generally contains all the salts and organic matter. To separate these chemically requires more experience and a more extensive apparatus; but the quantity of carbonate of lime in any soil which effervesces with acids, when its presence is thus ascertained, can be calculated by a simple process, almost as easily as the specific gravity: for this purpose it is necessary to have a balance with a somewhat larger scale, in which can be conveniently placed a small glass cup and a phial. The cup is placed in the scale, with 100 grains weight in it; and the phial, also containing 200 or 300 grains, more or less, of very dilute muriatic acid. The whole is accurately poised. Fine dry sand is the most convenient counterpoise, when the exact weight is not required. The 100 grains are now taken out, and replaced by the dried soil to be examined; when the equilibrium is restored, the diluted muriatic acid is poured carefully and gently on the earth in the cup, as long as it continues to effervesce. It is then left for awhile, and a little more of the acid added. If no bubbles appear, then all the carbonic acid has been expelled, and the opposite scale preponderates. The grains and decimals of grains required to restore the equilibrium give the weight of the carbonic acid expelled, which will sometimes be considerable. Since 100 grains of carbonate of lime contain 44 grains of carbonic acid, we have only to take the proportion as follows: let $a$ denote the grains of carbonic acid indicated in the experiment; then, $44 : 100 :: a : \frac{100a}{44}$ = the quantity of carbonate of lime in the soil. That is, multiply the grains added to the scale by 100, and divide by 44. This experiment repeated with a very accurate balance will surprise by its correctness; and no chemical analysis could give it with equal certainty, especially in the hands of an inexperienced person. When the weights are ascertained by substitution, the accuracy of the balance is of less consequence; all that is required is that it be sensitive, or turn readily by the addition of very minute weights. Thus, by two simple and easy experiments, some of the most important qualities of the impalpable portions of a soil may be accurately ascertained, viz. its specific gravity, and the quantity of carbonate of lime which it contains.*

It is more difficult to separate the fine silica from the alumina, and this is of less importance than might be supposed; for silica, when extremely divided, so as to remain long suspended in water, and mixed with alumina, becomes as impervious to water as alumina itself, and therefore its mechanical effect on the soil is the same. Phosphate of lime, where it is found, is no doubt of importance; but this requires a much greater knowledge of chemistry to separate it than is presumed in practical farmers, for whom this is chiefly written. Gypsum likewise has a considerable effect; but these substances are not generally diffused, and may always be suspected when the rocks and minerals in the neighbourhood indicate their presence; in which case it is prudent to submit the soil to a strict chemical analysis.

It is however very important to know how much organic matter exists in a soil, especially in alluvial soils. The specific gravity of the impalpable portions will often give some idea of this, when organic matter abounds, as in peaty soils. But the only sure test is its destruction by fire. This must be done very carefully. The soil must be dried and heated over a lamp to about 300° of Fahrenheit, stirring it often. This will expel the water, but not burn the organic matter or humus. It is then weighed in an open platinum capsule, and heated very gradually over the lamp, or in a clear fire, continually stirring it with a glass rod till it appears red; very minute portions of pure nitrate of ammonia may be added from time to time, taking care that there be no decrepitation, so as to throw any of the earth out of the capsule. After it is supposed that all the organic matter is destroyed, and expelled in the form of vapour or gas, the capsule is accurately weighed, and the loss indicates the quantity of organic matter in the soil. It will require some correction; for if alumina abounds, it will have retained some water, even after the first heating, which a red heat will have expelled. But this is not of very great importance in a mere comparison of different soils, for the same circumstances will be common to all.

The coarser portions of the soil, which have been separated in the sifting, are easily examined by the eye. If repeated washing carries off nothing from them, they may be considered as so many crystals, which have no other

* A very neat instrument has been invented by Dr. Ure to facilitate this operation. It consists of a bent tube with two bulbs, which communicate by a very small aperture, one bulb being a little above the level of the other. The whole can be suspended from the arm of a balance. The diluted muriatic acid is poured into the lower bulb, and the earth into the other. By inclining the instrument the acid is gradually made to pass into the bulb containing the earth. Thus the carbonic acid is expelled without danger of loss by ebullition, and the loss of weight is accurately ascertained.

effect in the soil than to keep it open. If some of these are of a calcareous nature, they will dissolve with effervescence in muriatic acid, and their proportion can be ascertained by the process above described; if not, they may be all considered as mere silicious sand or gravel.

A good soil is composed of one-third coarse sand, one-third very fine sand, and one-third impalpable matter, in which there is silica in the greatest quantity, alumina and lime in a smaller, and from four to ten per cent. of organic matter, without any appearance of tannin, which is readily discovered by pouring into the water which has filtered through it a weak solution of sulphate of iron; if a blackness appears, the gallic acid is present, and in proportion to its quantity the soil is less fertile. In this case quicklime is the best corrective.

In ascertaining the value of a soil for the purposes of agriculture, two circumstances should be carefully noticed. The first is the permeability of the soil to water; and the second is its power of absorbing moisture from the atmosphere. To ascertain the first, it is only required to place an equal weight of different soils in glass tubes of equal diameter, pressing them so that they shall occupy equal spaces, but not filling the tubes. Then pour an equal quantity of water over each soil, and place them upright with cups under them. Examine which has the surface first dry, and how much water runs through each in a given time. That which presents a dry surface, while it holds most water in its pores, is probably the best. To ascertain the comparative absorption of moisture, the soils are dried in pairs on a plate of metal heated by steam, or at a heat of 212°, to expel the water. They are then placed in equal quantities in similar flat cups or dishes, and placed in opposite scales of a balance, and poised. The apparatus is exposed to a moist atmosphere out of doors, or in a cellar, and occasionally examined. That which is heaviest is, in general, the most fertile, and contains most humus. If there are more than two soils, they are compared with each other, and with a third as a standard.

By these simple means any person, however ignorant of chemistry, or unaccustomed to make accurate experiments, may soon satisfy himself as to the comparative value of different soils which have never yet been cultivated; how they may be improved, and what crops are best suited to them;—things of the greatest importance to those who go to distant colonies in the hopes of obtaining good land at a moderate price, and cultivating it to advantage.

But we have intimated that there were other means of ascertaining the mechanical texture of soils than by sifting them. This is by washing with pure water. For this purpose nothing is required but a few flat plates and large cups. Some of the soil is formed into a very thin mud by stirring it in a cup nearly full of water. The finer particles are successively poured off from the sand or grit, which at last remains pure, so that the water added to it is no longer discoloured. This being dried and weighed, gives the coarse sand. The water and earth poured off are allowed to settle. A common soup-plate is found a very convenient vessel for this purpose. On the surface of the deposited earth will be found all the undecomposed vegetable matter, which with a little care is easily taken off, dried, and weighed. The finer portions of the earth can be poured off successively, by shaking the whole moderately, till nothing but very fine sand remains. The alumina and impalpable silica will remain long suspended in the water, and allow any sand yet remaining to be deposited. They may be rapidly separated from the water by filtration through stout blotting-paper; but it is preferable to pour them into a glass tube about one inch in internal diameter, with a cork fitted into the lower end. In this tube the earths slowly fall to the bottom, and any variety in the size of the particles causes a line more or less distinct, which can be observed through the glass; and thus a very good idea may be obtained of the porportion of the different earths, as far as regards the size of their particles. For their chemical differences, the preceding process must be adopted.

It is often useful to ascertain nearly the composition of a soil, without having time or opportunity to make accurate experiments. A graduated glass tube, which can be carried in the pocket, and a small phial with a ground stopper, containing diluted muriatic acid, and secured in a wooden case for fear of accident, is all the apparatus required. A little of the soil is taken and moistened with water; a few drops of the acid are poured on; and by the greater or less disengagement of bubbles the proportion of calcareous matter is guessed at, and its presence proved. The soil mixed with water is poured into the glass tube and well shaken. In a few minutes the coarse sand is deposited: shortly after the finer sand, and, lastly, the clay and impalpable matter, of which the lightest remains longest suspended. Distinct rings can be observed in the deposits, and the graduated tube shows their proportion. A person accustomed to this method will guess with great precision the general qualities of the soil; and when the geological structure of the neighbourhood and the nature of the subsoil are taken into consideration, the value of the land for pasture or cultivation is guessed with little danger of making very glaring mistakes. To surveyors and valuers this method is of very great help, when other means are not at hand.

In practice, soils are usually divided into light, mellow, and stiff; but this gives very little information, there being every imaginable variety in each of these. In the article ARABLE LAND, we have given a more particular classification from Thaer, but this is found chiefly applicable to alluvial soils. There are still minute circumstances which produce great fertility or the reverse, and which it is difficult to investigate. An accurate chemical analysis, joined to a careful mechanical examination, and very correct accounts of the average produce under different systems of cultivation, can alone give us a scale according to which the natural fertility of different soils can be classed; and this must be the work of time and industry joined to science and practical knowledge. We shall therefore conclude this article by recommending to every lover of agriculture to observe and note the peculiarities of the soils with which he is best acquainted; to analyze them frequently and under various circumstances, and thus endeavour to find to what peculiar substance or condition is to be ascribed a greater or less degree of fertility; so as to lead to the simplest and easiest mode of rendering indifferent soils fertile, and increasing the productive power even of the best.

SOILING is the name given in agriculture to the mode of feeding horses and cattle in the stable or yards with food brought to them as it is cut in the meadows or fields. The great advantage of soiling cattle is the increase of manure of the best quality, which is thereby produced; and this circumstance alone can counterbalance the great trouble and expense incurred in cutting and carrying all the green food from a distance to the farmyard.

The system of soiling is not very generally adopted in British husbandry, it being so much easier to allow the cattle to crop their food in the pastures; but in those countries where property in land is greatly subdivided, and where farms are small and good pastures scarce, as in Flanders, France, and Switzerland, especially where the vineyards render manure scarce and dear by taking a considerable portion of it and returning none, there the soiling of cattle is almost a matter of necessity. A cow or ox requires from two to three acres of pasture or meadow to feed it all the year round, allowing a portion for hay. But by raising clover, lucern, sainfoin, tares, and other green crops, three cows or more can be fed with the produce of one acre, especially if a portion is in turnips or other succulent roots. Thus the straw of the white crops is converted into excellent manure, and the land kept in a state of fertility.

In proportion as a farm is larger in extent, so the expense of soiling increases, both from the distance of the fields where the green crops grow, and from the same distance to which the dung is to be carted. There is a limit therefore to the soiling system, unless there be many yards or stables in different parts of a farm, so as to subdivide it, and make each yard the centre of a distinct system of soiling, with fields near at hand for the green crops. In almost every experiment on a large scale it has been found that soiling was only a certain mode of purchasing dung, and that it often was more expensive to procure it in this way than to send to a considerable distance to purchase it in towns. Where it cannot be purchased at all, there are no other means, in many situations, of producing a sufficient quantity; and the trouble and expense of soiling must be submitted to. In almost every case where sheep can be folded to feed off the crops, the soiling of cattle is a loss, because the sheep pay something for their food; the cattle in the stall seldom do.

But there are animals which must be fed for the work of the farm, such as horses or oxen; and these are much more profitably and economically fed by soiling than by any other means. A horse or ox, if he works eight or ten hours, has no time for rest if he has to crop his food from a short pasture, however sweet; whereas an abundant supply of clover, lucern, or tares enables him to take a hearty meal and lie down to rest. He wants no corn with this food, and does his work without losing flesh or activity.

There is nothing easier in a mild climate, and especially a moist one, like Britain or Ireland, than to have a succession of green food from the beginning of spring to the end of autumn. Rye and winter barley, sown early in autumn, will be ready to cut as soon as the mild weather of spring commences: some sown later with winter tares, and the young clover, which has not been cropped in autumn, will succeed. After this come artificial grasses, as Italian rye-grass and the grass of water-meadows mown early; although this last is not so hearty food for working cattle; but when joined to a mixture of oats and cut straw, their watery nature is corrected. Clover and spring tares (when these last are sown at proper intervals), lucern and sainfoin (if the soil is suited to them), will afford a constant and abundant supply to the scythe which cuts the daily allowance. It is prudent to provide against failure, and have more land in these crops than is absolutely necessary, because the surplus can always be made into hay or reserved to ripen its seed; and these green crops, valuable as they are, far from deteriorating the soil, clear it of weeds, and render it more fit to bear corn afterwards. In this case soiling is profitable and economical.

It is generally thought in those countries where the soiling system is most universally adopted, that it is best to allow the green food to remain twelve or twenty-four hours after it is cut, before it is given to cattle. This may be prudent with cows and oxen, who are apt to eat voraciously, and are subject to be hoven from the fermentations of the green food in the paunch or rumen: but for horses there is little danger; and if the food is not wet with dew or rain, the fresher it is eaten, the better it will nourish the animal, and the more he will relish it.

If any one is desirous of calculating the expense of soiling any number of beasts, he has only to reckon what time of men and horses it will take to cut the food and carry it to the cattle, from the average distance of the fields in which it can be raised in succession. Much of their time is lost in the morning and evening in going backwards and forwards from the field to the yard; for there can scarcely be an establishment so large as to keep them employed a whole day; and if there was, the fields must be so large and so distant, as to greatly increase the expense of carriage. Not to enter into minute calculations, it is fully proved, that, to a certain extent, soiling is profitable and economical, when it can be done before and after the usual hours of labour; but that when undertaken on a large scale in any one locality, it is usually attended with loss, the manure produced being purchased at too great a price.

If a labourer who has an allotment of half an acre of good light land would devote it entirely to raise food for a cow, his wife and children cutting the food and tending the cow in a small yard with a shed, or in an airy cow-stall, he would find that he had a much greater clear profit, than if he had sown his land every year with wheat, and had always a good crop, which last supposition is impossible. There would be no better stimulus to industry than to let a piece of land for this purpose to every man who could purchase a cow and feed it by soiling.

**SOISSONS**, a town in France, capital of an arrondissement in the department of Aisne, 62 miles north-east of Paris, on the road to Namur, Liege, and Aix-la-Chapelle. This town existed in the time of the Romans, by whom it was called Augusta, with the distinctive epithet 'Suessionum,' from its being the capital of the Suessiones (Σουεσσιῶνες, or Σουεσσιῶνες, Strabo), or, as Ptolemy writes the name, Οὐέσσονες. From this people, who were of the Belgic race, it afterwards took the name of Suessiones, or Suessonæ, from whence is derived the modern Soissons. D'Anville, Dulaure, and others are disposed to identify Augusta Suessionum with the Noviodunum of Cæsar (*De Bell. Gall.*, lib. ii., c. 12), but we think this position not consistent with Cæsar's narrative. In the 'Notitia Imperii,' it is recorded that there was at Augusta a government manufactory of shields, balistæ, and armour for the cavalry called Clibanarii, or Cataphracti (*fabrica scutaria, balistaria, et clibanaria*). The Roman roads popularly called *Les Chaussées de Brunhaut* are near this town, which in the later period of the Roman domination was one of the most important places in the north of Gaul; and one of the last which remained under the government of the emperors. It was the seat of government of Ægidius and his son Syagrius, and near it the latter was defeated by Clovis.

Under the early Frankish princes, Soissons continued to be of importance, and was the seat of a bishopric. Here Clovis espoused Clotilde; and upon the division of his dominions among his descendants, it gave name to one of the kingdoms formed out of them. Here, A.D. 752, Childéric III., the last Merovingian king was deposed, and Pepin le Bref, the first Carlovingian, proclaimed and consecrated. In A.D. 922 Charles le Simple was defeated at Soissons by the troops of Robert, his competitor, who fell in the battle. Under the kings of the third race (the Capetian) Soissons was the capital of a county, and received from Louis VI. (le Gros), with the consent of the count, a municipal charter; but the burgesses, weary of the contentions which they had with their counts and with the canons of the cathedral, surrendered their charter to the king Charles IV. (le Bel), A.D. 1325. Philippe VI. (de Valois) granted them some privileges, but would not re-establish the municipality. The county had in the meantime come by marriage to the Count of Hainault and Holland: it was subsequently divided, part soon falling to the crown, the other part, with the title, passing to a branch first of the house of Bourbon, and then of the house of Savoy; the last holder of this portion was the father of the well known Prince Eugene. [EUGENE FRANÇOIS DE SAVOIE.] In A.D. 1413 the town, then garrisoned by the Bourguignon party, was taken by the rival faction of the Armagnacs, who committed the most dreadful excesses. Having again fallen into the hands of the Bourguignons, it was a second time taken and pillaged by the Armagnacs. In A.D. 1544 the emperor Charles V. in his invasion of France was at Soissons. In the religious wars of the sixteenth century and in the troubles of the minority of Louis XIII. it suffered again. In the campaign of 1814 it was twice taken by the allies and retaken by the French; it was a third time besieged by the allies, bombarded, and much damaged.

The town stands on the south bank of the Aisne, over which river is a handsome stone bridge, uniting the town to the suburb of St. Vaast on the northern side. The town and the suburb of St. Vaast are fortified; the circuit of the walls includes many gardens and void spaces. The other suburbs are without the walls. The streets, though not wide, are for the most part well laid out and neatly kept; the houses, which are commonly of one story, are built of stone, and many of them covered with slate. The cathedral is a large and fine Gothic church, with a tower 160 feet high. Of the church of the ex-abbey of St. Jean des Vignes, the west front, with two noble towers, and spires remains, and is of rich Gothic architecture. The church of St. Pierre is of Lombard architecture; that of St. Leger belongs to the period of the revival of the arts. There are an antient castle and some remains of the antient abbey of St. Médard, in which Louis le Debonnaire was imprisoned by his rebellious children. The ex office of the intendant (*i.e.* the director of the finances and judicial administration) of the Generality or province of Soissons, is one of the finest buildings in the town. There are public walks, a theatre, and public baths.

The population of the commune of Soissons, in 1826, was 7483; in 1831, 8149 (7946 of them in the town); and in 1836, 8124. The townsmen have few manufactures; some fine carpets, woollens, hosiery, linen, twine, seed, oil, leather, and percussion caps for guns are however made. Considerable trade is carried on in corn, flour, and pulse (especially French beans), for the supply of Paris, and timber and firewood, which are sent down the Aisne to the capital. There are a considerable weekly market and fourteen yearly fairs. Soissons has a college, two seminaries for the priesthood, a society of sciences, arts and belles-lettres, a public library, a drawing-school, an hospital, a foundling-hospital, a tribunal of commerce, a subordinate court of justice, and two prisons. The revolutionists Collot d'Herbois and Ronsin were natives of Soissons.

The arrondissement of Soissons had, in 1831, a population of 68,036; it comprehended six cantons or districts, each under a justice of the peace, and 169 communes. The diocese comprehends the department; the bishop is a suffragan of the archbishop of Reims.

**SOJA HI'SPIDA** (Mœnch), Soja Japonica (Savi), the Dolichos Soja (Linn.), a leguminous plant, native of Japan and the Moluccas, and abundant in the peninsula of India, though probably introduced there. The seeds resemble those of the haricot, French or kidney bean, and are used by the Chinese to form a favourite dish, called *ten-hu*, or *tau-hu*, which looks like curd, and which, though insipid in itself, yet with proper seasoning is agreeable and wholesome.' (Don's *Dictionary*.) The Japanese call the seeds *Miso*, and put them into soup, of which they sometimes partake three times a day. They likewise prepare with them the sauce termed *Sooja*, which has been corrupted into *Soy*. 'The beans are boiled until all the water is nearly evaporated, and they begin to burn, when they are taken from the fire, and placed in large wide-mouthed jars, exposed to the sun and air; water and a certain proportion of molasses or very brown sugar are added. These jars are stirred well every day, until the liquor and beans are completely mixed and fermented; the material is then strained, salted, and boiled, and skimmed until clarified, and will after this process become of a very deep brown colour, and keep any length of time. It has been stated that the gravy or juice of meat was used in preparing this condiment, but it appears to be entirely made from vegetable materials. There are two or three qualities of soy. To make the best requires much care and attention. Japanese soy is much esteemed in China on account of the superior manner in which it is made. Shopkeepers at Canton who sell soy have large platforms on the roofs of their houses, where the jars for preparing soy are arranged and exposed to the sun; for the consumption of soy is enormous. Neither rich nor poor can breakfast, dine, or sup without it; it is the sauce for all kinds of food; gives a zest to every dish, and may be said to be indispensable at a Chinese repast.' (Dobell's *Kamschatka*.) Soy is only sparingly used as a sauce in this country. It has the character of being a useful stomachic, but not more so than any of the other condiments when used with moderation.

SOKENS. [ESSEX.]

SOL, in music, the name given, in sol-fa-ing, by the English, Italians, and French to the fifth of the scale; and by the two last also to the sound called G by the Germans and English. [SOLMISATION.]

SOLA, frequently *Shola*, is the name of a plant common in moist places, and in the rainy season in many parts of the plains of India. It belongs to the genus Æschynomene, and has been called *Æ. aspera* by Linnæus, from the lower part of the stem being rough and scabrous, as well as the legumes. It has been called *Æ. lagenaria*, both by Loureiro and Roxburgh. The plants are remarkable for their light and spongy texture, and seem indeed to be composed almost entirely of pith. On this account the thicker stemmed plants are collected in the dry months and the light substance applied to a variety of uses, as for making some kinds of toys, and the floats of fishermen's nets; cut into thin slices and pasted together, they are much employed for making hats, which, being light and having broad brims, are well suited for protecting the head from the influence of the powerful Indian sun, especially if a handkerchief be put loosely into the crown of the hat. This substance has also been employed for lining drawers of natural history, and in its texture very much resembles the substance called rice-paper, which is the pith or stem of a Malvaceous plant cut into thin slices. A branch with leaves of this latter plant has been figured in Bennet's *Wanderings in New South Wales*.

SOLAN GOOSE. [BOOBY, vol. v., p. 160.]

SOLANA'CEÆ, a natural order of plants belonging to the dicarpous group of monopetalous Exogens. This order is composed of herbs or shrubs, rarely of arborescent plants, with colourless juices, round or irregularly angled stems or branches, sometimes armed with thorns or prickles; their leaves alternate, simple, entire, or lobed. The inflorescence is variable, mostly axillary, sometimes terminal, pedicels without bracts, and the flowers regular and united. The calyx is 5-parted, persistent, inferior; corolla monopetalous, hypogynous, 5-cleft or 4-cleft, regular, deciduous, plaited or imbricated in æstivation; stamens inserted upon the corolla, as many as the segments of the limb, and alternate with them, anthers bursting, mostly longitudinally, sometimes by pores at the apex; ovarium 2- or 4-celled, style continuous, stigma simple; fruit either a capsule, with a double dissepiment parallel with the valves, or a berry with the placentæ adhering to the dissepiment; seeds numerous, sessile; embryo straight or curved, lying in fleshy albumen; radicle next the hilum.

This order is most closely allied to Scrophulariaceæ, but is distinguished by Brown from that order by the possession of a curved or spiral embryo, a plaited æstivation of the corolla, and the flowers being regular, with the same number of stamens as lobes. From the occurrence of many species in this order with a straight embryo, but with the other characters of Solanaceæ, Lindley, with Bartling and others, is inclined to look upon this as a secondary point, and a plaited corolla and symmetrical flowers to constitute the real character of this order. Solanaceæ and Scrophulariaceæ are however so nearly allied that scarcely any limits exist between them. They may be considered as the connecting groups of two larger masses of plants, of which one has a tendency towards regular flowers and symmetrical stamens, and the other a tendency towards irregular flowers and didynamous stamens.

The plants of this order are natives of most parts of the world, without the arctic and antarctic circles, and especially within the tropics.

This order is one of the most important and interesting in its class, from its bringing together plants of the greatest utility, yet possessing apparently opposite properties. It is a great advantage of a natural system that it brings together not only plants that are allied in structure, but in properties also; but this order seems to form an exception. The deadly nightshade, the esculent potato, the pungent capsicum, the mild tomato, the wholesome egg-plant, and the poisonous tobacco, are all found here. They will all however, on close examination, be found to possess the same properties in a greater or less degree. The potato, the tomato, and egg-plant possess, when uncooked, in a mild degree, the properties of the nightshade, the stramonium, and the henbane, confirming the remark of De Candolle, 'that all our aliments contain a small proportion of an exciting principle, which, should it occur in a much greater quantity, might become injurious, but which is necessary as a natural condiment.' In fact, when food does not contain some stimulating principle, we add it in the form of spices. Many of the plants of this order are used in medicine, amongst the most valuable of which are henbane [HYOSCYAMUS], deadly nightshade [ATROPA], bitter-sweet [SOLANUM], stramonium [DATURA], and tobacco [NICOTIANA]. The species of *Physalis* were formerly used in medicine, but are not now in repute in this country. *P. Alkekengi*, the common winter cherry, is grown as an ornamental plant; and in Arabia, and even Germany and Spain, the berries are eaten as a dessert. *Lycium barbarum* is known in this country as *tea plant*, and has been recommended as a substitute for the Chinese plant. The calabash-trees of the West Indies and the American continent are different species of *Crescentia*, which is often referred to this order. The fleshy pulp of the fruit of some is eaten, but in most species is deleterious. The most valuable part of the calabashes is their rind, which is tough, and it is applied by the negroes to a variety of purposes. Cups, mugs, bowls, basins, and saucepans are made from them, and, in fact, almost every other article of household use. Cayenne-pepper [CAPSICUM] is the produce of

Nicotiana crispa.

*a*, cutting, showing alternate leaves and monopetalous flowers; *b*, transverse section of capsule with many-seeded placenta; *c*, pistil; *d*, fruit; *e* seed with straight embryo surrounded with albumen.

this order, as well as the potato, tomata, and egg-plant [SOLANUM], which are used extensively as articles of diet.

SOLANDER, DANIEL CHARLES, a celebrated naturalist, the pupil of Linnæus, and the friend of Sir Joseph Banks. He was born in Nordland, in Sweden, where his father was a minister, on the 28th of February, 1736. He studied at Upsal, under Linnæus, and took his degree of M.D. at that university. After this he made a tour in Russia, and on his return was recommended by Linnæus to go to England. For this purpose he embarked on board a vessel of war, which was suddenly ordered to the Canary Isles, taking Solander far away from his destination. He however made the most of it, for he not only shared the prizes taken by the vessel on this cruise, but made great accessions to his knowledge of natural history whilst at the Canary Isles. Shortly after his arrival in England, which was in October, 1760, he was employed at the British Museum for the purpose of drawing up a catalogue of the collections in that institution. Three years afterwards he was appointed one of the assistants in the natural history department. In 1764 he was elected a fellow of the Royal Society. In 1766 he published a catalogue of the fossils presented to the British Museum by Mr. Brander. In 1768 Sir Joseph Banks proposed to Dr. Solander that he should accompany him in a voyage round the world, in search of discoveries in natural history. To this he assented, and the trustees of the British Museum having promised a continuance of his salary in his absence, the two naturalists started with Captain Cook in his celebrated first voyage round the world. During this voyage Dr. Solander probably saved a large party from destruction, in ascending the mountains at Tierra del Fuego, by advising them on no account to give way to sleep when they arrived at the cold regions. He himself was the first affected amongst them, and was with difficulty kept awake during their perilous excursion, which was attended with the death of a negro and an English seaman, from the effects of the cold. They returned from this voyage in 1771, laden with treasures, which are still in the collection at the British Museum. It does not appear that Solander received any remuneration for his services in this expedition, unless it was from Sir Joseph Banks, whose munificence knew no bounds when forwarding in any manner the study of natural history.

Sir Joseph Banks and Solander wished to accompany Cook on his second voyage, but some misunderstanding having arisen with regard to their accommodation in the vessel, they abandoned the project. On his return from his voyage the University of Oxford conferred on Solander the degree of Doctor of Common Laws. In 1773 he was appointed under-librarian at the British Museum. He died in a fit of apoplexy, in the year 1782.

The following papers were published with his name during his lifetime:—1, An account of the *Furia infernalis*, and the disease which it produces. It was published in Latin at Upsal, and appears to have been his inaugural dissertation; 2, An account of Cardenia, a plant belonging to the natural order Cinchonaceæ, in the fifty-second volume of the 'Philosophical Transactions;' 3, A botanical description of the plant producing the Cortex Winteranus or Magellanicus, published in the fifth volume of 'The Observations and Inquiries of a Society of Physicians.'

Although Dr. Solander published little with his name attached, his labours were by no means few or of little importance. He has left behind him a large mass of manuscripts, which are still existing in the British Museum, and containing, as they do, a vast store of information on all that passed under his observant eye, they afford abundant materials for the further prosecution of the subjects to which he devoted his attention.

The arrival of Dr. Solander in England may be looked upon as an important æra in the history of botany in this country, as by his means the sexual system of arrangement of plants, which was only imperfectly understood in Great Britain, became more widely extended. We will not stop here to inquire into the amount of benefit conferred on botany by this system, which is now nearly exploded, but from the perfect knowledge of it possessed by Dr. Solander, and the ease with which it was acquired by others, there can be no doubt that during his lifetime the cultivation of the Linnæan system had a very favourable influence in developing and extending a taste for botany in this country.

But botany was not the only department pursued by Dr. Solander. In 1786 the important work of Ellis, on the 'Natural History of Zoophytes,' was published, in the preface to which the editor thus expresses himself:—'For the arrangement and the descriptions, we are indebted to Dr. Solander, whose premature death prevented this and other valuable works from appearing in so complete a manner as they otherwise would have done, since it must be universally allowed that the world suffered in Dr. Solander the loss of one of the greatest naturalists ever known, while his more intimate friends that of an invaluable member of society.'

SOLANDRA, a genus of plants of the natural family of Solanaceæ, which has been thus named in compliment to Daniel C. Solander, LL.D. The name has been applied to other genera, but is now restricted to a small Solanaceous genus, which is remarkable for the beauty and great size of the flowers of its species, which are natives of Mexico, Jamaica, and Brazil, with a doubtful species in Ceylon, forming large scandent shrubs, with broad alternate leaves crowded at the extremities of the branches with the solitary extra-axillary or terminal flowers. The genus is characterized by having a sheath-like calyx splitting on one side, and 3-5 cleft at the apex. Corol funnel-shaped and ventricose, with a plicate quinquefid limb and undulated lobes. Stamens five; anthers versatile, opening longitudinally. Berry pulpy, covered by the split calyx, 4-celled, many seeded. These, being highly ornamental plants are cultivated in our hot-houses, but, requiring moisture and much room, are difficult to flower. Sweet says the best way is to plant them in a loamy soil, and allow them to grow fast at first, till they have made a great many shoots; then keep them very dry till their leaves drop off, and they will produce plenty of flowers. The best way to have plants flower young is to take the cuttings from the flowering shoots.

SOLANI'NA, a vegetable alkali obtained by Desfosses from the berries of the *solanum nigrum*, and the fruit of the common potato.

In appearance solanina resembles sulphate of quina, but the crystals are finer and shorter; it restores the blue colour of litmus when reddened by an acid; dissolves in acids, and is precipitated from them by the alkalis. The hydrochlorate and acetate of solanina have a gummy appearance when evaporated to dryness, but the sulphate and phosphate are crystallizable. It is extremely poisonous: a grain of it dissolved in dilute sulphuric acid killed a rabbit in six hours.

According to Blanchet this alkali consists of—

| | |
|---|---|
| Hydrogen . . . . . | 8·96 |
| Carbon . . . . . | 58·67 |
| Oxygen . . . . . | 30·73 |
| Azote . . . . . | 1·64 |
| | 100· |

SOLA'NUM, the name of one of the most extensive genera of plants, the type of the natural order Solanaceæ. This genus is distinguished by the following characters:—Calyx permanent, 5-10 parted. Corolla rotate. Anthers oblong, connivent, opening by 2 pores at the extremity. Fruit a berry, subglobose, 2-celled, sometimes 3 or 4 celled The species are herbs or shrubs, unarmed or prickly, rarely spiny. The leaves are entire, sinuated or lobed, mostly alternate.

Upwards of 400 species of plants belonging to this genus have been enumerated, including many with apparently very opposite properties. The esculent Tomato, the Eggplant, and the invaluable potato, with the various species of poisonous nightshades, are found united so closely by botanical characters, that it is impossible generically to separate them. The properties of these plants however do not differ in kind, but in degree, and the berries and leaves, and even the tubers when uncooked, of the potato, possess in a mild degree the narcotic properties of the poisonous nightshades. Many of them have also very handsome flowers, and are much cultivated in our gardens and greenhouses. From the immense list of species belonging to this genus, we shall select for description a few of those that are used as medicines or food, or are much cultivated.

*S. tuberosum*, the common potato, is known in the genus by its tuberous subterranean stem, herbaceous stems without thorns, unequally pinnate leaves, with entire leaflets, and articulated pedicels. It is one of the plants for which we are entirely indebted to America. It is found native in the greatest abundance on the western coast of South America. Like most plants which are much cultivated, an abundance of varieties have been produced from the original plant, and in the leaves, colour of the flowers, shape, size, and colour of the tubers, it has a great tendency to depart from its normal character. For an account of the introduction of this plant into Europe, its varieties, the mode of its cultivation and uses, see POTATO. Two other species of *Solanum*, viz. *S. Valenzuela* and *montanum*, produce edible tubers, but they are little used.

*S. nigrum*, common or garden nightshade: stem herbaceous without thorns; leaves ovate, bluntly toothed, and waved; umbels lateral, drooping. Throughout Europe, it is a weed in cultivated ground, and is also found in Africa and Asia. It is common in gardens, fields, and waste places in Great Britain. It has white flowers, producing small berries of a black colour.

*S. dulcamara*, woody nightshade, or bitter-sweet: stem shrubby, thornless, climbing, flexuous; leaves cordate, upper ones jagged; corymbs almost opposite the leaves. It is a native of Europe, Asia, and North America, in hedges and among bushes. It is plentiful in Great Britain. It has purple flowers and crimson berries, which latter may be mistaken by children for red currants, a mistake that has sometimes been attended with fatal consequences.

*S. Melongena*, egg-plant, mad-apple, Jew's-apple: stem herbaceous, woody at the base, clothed with star-shaped hairs; ovate, serrated leaves; flowering peduncles reflexed; fertile peduncle solitary, sterile one racemose; calyx campanulate; corolla angular. It is a native of the East Indies, and also said to be of Arabia. This plant has purple flowers, and bears large smooth shining berries, which are the shape and size of a small hen's-egg. Two varieties of this plant are recorded: the *S. M. ovigerum*, in which the stem, calyx, and leaves are without thorns; and the *S. M. esculentum*, in which these parts are more or less covered with thorns. Several subvarieties of both these are recorded, varying in the shape and colour of the fruit. The berries are mostly of a white colour, but in some of the subvarieties they are yellow, red, purple, and black. The fruit of this plant is used by the French and Italians in stews and soups. For this purpose the varieties used are the oval-shaped white, the globular-shaped white, and the purple or violet-coloured of both forms. In cultivating them they may be reared in hot-beds in a rich light soil, or in fine summers they will even produce their fruit in this country against a wall, if planted out in June after having been struck in a hot-bed.

*S. Sodomeum*, Sodom egg-plant, or apple of Sodom: stem shrubby, diffuse; prickles straight, dilated at the base; leaves oblong, sinuate, shining above, and rather scabrous and prickly on both surfaces; lobes obtuse angular; peduncles bifid. It is a native of the North of Africa and the South of Europe. The fruit of this plant is white, and about the size of a walnut. It is very subject to the attacks of an insect which deposits its eggs within the germen, and as the fruit enlarges, the larvæ of the insect, as in the case of many other fruits, destroy and pulverise the whole of the interior, whilst the rind is left unchanged and entire. When the fruit is gathered under these circumstances, it is crushed to pieces by the hand; or if conveyed to the lips, the mouth becomes filled with an ash-like powder, exceedingly bitter to the taste. To these berries remarkable properties have been assigned by Josephus, Tacitus, and others. Mandeville, an old English writer, says, speaking of the Dead Sea, 'And there besyden growen trees that baren fulle faire apples and faire of colour to beholden, butte whosoe breakethe them or cuttethe them in two, he shall find within them coles and cyndres.' Milton finely alludes to this fruit in the lines—

> 'Greedily they pluck'd
> The fruitage fair to sight, like that which grew
> Near that bituminous lake where Sodom flamed.
> This more delusive, not the touch but taste
> Deceived, they fondly thinking to allay
> Their appetite with gust, instead of fruit
> Chewed bitter ashes.'

*S. Sanctum*, Palestine egg-plant: stem shrubby, tomentose; leaves ovate, repand, oblique at the base, clothed with hoary tomentum on both surfaces; berries nearly globose. This plant is a native of Palestine; it is often found in collections of plants. There are several other species of Solanum, which, on account of the size, form, and colour of their fruits, are called egg-plants, as *S. Indicum*, the Indian egg-plant, &c.

*S. Æthiopicum*, Æthiopian nightshade: stem herbaceous; leaves ovate, repand, angular; peduncles usually 1-flowered, drooping; berries torulose. It is a native of Ethiopia, China, and Japan. There are two varieties recorded: the one the *S. Æ. violaceum*, is a native of China, and the fruit is frequently eaten in that country as a dessert. It has a large spheroid oval berry of a red colour. The other variety is the *S. Æ. aculeateum*, having a prickly stem, and small yellow berries of the size of peas.

*S. pseudo-quina*, false quina nightshade: stem shrubby unarmed; leaves oblongo-lanceolate, narrow, acute, entire, glabrous above, but with fascicles of villi in the axils of the nerves beneath; racemes extra-axillary, short; calyx glabrous. This plant is a native of Brazil in the district of Curitiba, in St Paul without the tropics. The Brazilians use this for the same purposes as the quina or Jesuits' bark. It is intensely bitter, and may with advantage be used as a substitute for that bark.

*S. verbascifolium*, mullein-leaved nightshade: stem shrubby; leaves ovato-oblong, acuminated, entire, tomentose, white beneath, without any leaves in the axils; corymbs nearly terminal, dichotomous; calyx semi-quinquefid. It is a native of Asia, America, and the tropical parts of New Holland. This plant is frequently cultivated. Every part is covered with a powdery white tomentum. The flowers are white, and the berries are of the size of small cherries.

*S. Lycopersicum* of Linnæus, common Love-apple or Tomato. This, with some other of the older species of Solanum, now form the genus *Lycopersicum*, which is distinguished by possessing a calyx 5-6 parted; corolla rotate, 5-6 cleft; stamens 5; anthers conical, connate at their extremities by an elongated membrane, and dehiscing lengthwise inside; berry 2-3-celled; seeds villous. The present species is called *L. esculentum;* it has herbaceous pilose stems; unequally pinnate leaves; leaflets cut, attenuated at the apex, glaucous beneath; flowers many, united; berries torulose. This plant is a native of South America, but it is much cultivated and well known in the United States of North America, and in France, Germany, and Italy. When ripe, the fruit has an acid flavour, and is added to soups, sauces, &c. It is also used in confectionary as a preserve, and sometimes as a pickle. It is not often used in this country, but in Italy, near Rome and Naples, whole fields are covered with it, and scarcely a dish is served up into which it does not enter as an ingredient. In the cultivation of these plants, the seed should be sown in March in a hot-bed, and when two inches high, they may be pricked out into another hot-bed. In May they should be transplanted into a warm south border, where they may have the full sun, and the fruit may ripen quickly. The stem runs up 6 or 8 feet high, and should be trained to stakes or nailed up a wall or pales. The fruit begins to ripen in August, and may be gathered in October, and, when kept dry, will keep good till November. There are several varieties cultivated; the best are called the large and small cherry and pear-shaped red, and the large and small or cherry-shaped yellow. The size of the fruit is seldom larger than a golden-pippin apple. (Don's Miller, vol. iv., p. 444.)

Several other species of Solanum are recorded as having medical properties. *S. Jacquini* is considered by the native practitioners of India as an expectorant; *S. bahamense* is used as a gargle for sore throat in the West Indies; *S. mammosum*, *paniculatum*, and *cernuum* have the reputation of being diuretic and astringent. (Lindley's *Flora Medica*, p. 512.)

SOLA'NUM DULCAMA'RA, an indigenous perennial climbing plant, common in wet and shady places, especially hedges. It has a remarkably zigzag stem, with alternate leaves, the lower ones lanceolate, entire, the upper hastate; the flowers resemble those of the potato, but are smaller, and are succeeded by a cluster of red berries. This plant is called *woody* nightshade, to distinguish it from the Atropa Belladonna, or *deadly* nightshade. The young twigs or tops are officinal, and they should be gathered in spring, before the flowering of the plant, or in autumn, while the leaves are yet *fresh*, as much activity seems to belong to the leaves, and the twigs are best from plants about three years old. When fresh, the plant has an unpleasant odour, which is in a great measure lost by drying, as is also a large portion of water. The taste is at first bitter and slightly acrid, then sweet; hence the name *bitter-sweet* given to it.

Ten pounds of the dried twigs yield two pounds of extract. According to Pfaff, 100 pounds of perfectly dried stems yield a bitter-sweet extractive (picroglycion), 21; vegeto-animal matter, 3; gummy extractive, 12; gluten with wax, 1; resin with benzoic acid, 2; gum, starch, salts (chiefly of lime), 6; and woody fibre, 62. Solanina has been found by Desfosses. Whether picroglycion is a distinct principle, or a combination of solanina with sugar, is doubtful.

Bitter-sweet, when taken fresh, has a slightly narcotic influence, causing also nausea, vertigo, and a dryness of throat, like other solanaceous poisons. If delirium display itself, it is always of a most frantic kind. Perspiration or an increased discharge of urine generally occurs, followed by gentle purging.

Bitter-sweet is chiefly employed in cutaneous diseases, especially of the scaly kind, such as lepra; it may be given internally, while a strong wash of it is applied externally. It is also useful in some vesicular diseases, such as herpes and eczema. In these its virtues as an external application may be increased by dissolving in it sulphuret of potass. This combination relieves most effectually the intolerable irritation of these complaints.

It is usually ordered in the form of decoction, but long boiling is destructive of its powers. Slow simmering is preferable. The extract, when prepared from the fresh plant with a low degree of heat, is a good form for internal administration, as it may be combined with antimonials.

In cases of poisoning by the berries, the stomach-pump should be used as speedily as possible, and moderate venesection is of service.

SOLAR CYCLE. [PERIODS OF REVOLUTION.]

SOLAR SYSTEM. We have given the elements of the planetary motions minutely in the several articles MERCURY, VENUS, &c., together with such physical peculiarities as belong to them severally, and independently of the System; the general phenomena of their motions have been deduced from the great principle of GRAVITATION; their history, as far as it is in the plan of this work to give it, has been treated in ASTRONOMY. It remains to bring together the dimensions of the various parts of the system, and to notice such points as could not properly find a place under any of the heads just mentioned.

By the Solar System is meant that collection of bodies which contains the sun, the planets which revolve round him, their satellites, and such periodic comets as have had their returns successfully predicted. The system of the antients includes the Earth as a fixed centre, with the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn. That of the moderns includes at this day the Sun as a governing body (but not as a fixed centre), Mercury, Venus, the Earth (with the Moon), Mars, Vesta, Juno, Ceres, Pallas, Jupiter and four satellites, Saturn (with the ring) and seven satellites, and Uranus with six satellites, besides the comets of Halley, Encke, and Biela. The following symbols are used to represent these bodies, to which we add the received explanation, without expressing any opinion about it:—

| | | |
|---|---|---|
| ☉ Sun | ♂ Mars | ♃ Jupiter |
| ☿ Mercury | ⚶ Vesta (modern) | ♄ Saturn |
| ♀ Venus | ⚵ Juno (modern) | ♅ Uranus (modern) |
| ⊖ or ♁ Earth (modern) | ⚳ Ceres (modern) | |
| ☽ Moon | ⚴ Pallas (modern) | |

The symbol for the Sun is all that modern abridgment has left of a face surrounded by rays: Mercury has the caduceus, or rod, entwined by two serpents: Venus a circular looking-glass with a handle: the Earth (a modern symbol) has a sphere with an equator, and also (with some) an inverted symbol of Venus. Those who first used it did not, we presume, know that they might be making a looking-glass turned upside down represent their planet. The symbol of the moon is obvious: Mars has what remains of a spear and shield: Vesta, an altar with fire on it: Juno, a sceptre: Ceres, a reaper's scythe: Pallas, the head of a lance: Jupiter, supposed to be a symbol of the thunder (arm and hand holding thunder?): Saturn, an altered form of a mower's scythe, the emblem of time: Uranus, the initial letter of Herschel, the discoverer's name, with a symbol of a planet attached. But others have thought that Mercury was designated by putting σ and τ together, the initials of στίλβων; Venus, from the first and last letters of Φωσφόρος; Jupiter, from the first and last letters of Ζεύς. These signs are found on very old manuscripts and gems, variously figured, but all with some general resemblance to the modern printed forms.

We are now to state the relative dimensions of the Solar System in a rough manner. This, we think, it may be useful to do in such a manner that any two planets may be compared with one another without computation.

And first, as to the relative distances from the sun, we have the following table:—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ☿ | 100 | 54 | 39 | 25 | 15 | 74 | 41 | 20 |
| ♀ | 187 | 100 | 72 | 47 | 27 | 139 | 76 | 38 |
| ⊖ | 258 | 138 | 100 | 66 | 38 | 192 | 105 | 52 |
| ♂ | 394 | 211 | 152 | 100 | 58 | 293 | 160 | 79 |
| ⚶ | 612 | 327 | 237 | 155 | 90 | 455 | 248 | 123 |
| ⚵ | 690 | 369 | 267 | 175 | 101 | 513 | 280 | 139 |
| ⚳ | 71·5 | 382 | 277 | 182 | 105 | 532 | 290 | 144 |
| ⚴ | 716 | 383 | 277 | 182 | 105 | 533 | 291 | 145 |
| ♃ | 1344 | 719 | 520 | 341 | 197 | 1000 | 545 | 271 |
| ♄ | 2464 | 1319 | 954 | 626 | 361 | 1833 | 1000 | 497 |
| ♅ | 4955 | 2652 | 1918 | 1259 | 725 | 3686 | 2010 | 1000 |

This table is a succession of columns, each of which represents the comparative mean distances of the planets from the sun. In each column one of the distances is made 100 or 1000, and the rest are expressed accordingly; except only in the fifth column, in which the mean distance of the four small planets is made 100. Thus we see by inspection that Uranus is about 12½ times as far from the Sun as Mars; about 19 times as far as the Earth; about 26½ times as far as Venus; and about 7¼ times the mean distance of the four small planets. Also, taking the mean distance of the small planets, we see that the distances from the sun are as the numbers 15, 27, 38, 58, 100, 197, 361, 725; and if we take the first away from all the rest we have 12, 23, 43, 85, 182, 346, 710: in which it will be observed that each is about double of the preceding. Kepler had observed a progression, without assigning a law; and had also noticed that one term appeared to be missing. Bode assigned the law which has just been noticed; noticing also the apparently missing term. The existence of a planet between Mars and Jupiter was accordingly suspected; and at last, to the astonishment of astronomers, four little bodies, looking more like fragments of a planet than planets, were discovered at a distance from the Sun so near to that which had been suspected, that their mean distance fills up its place in the series as well as that of any other planet. It was of course immediately suspected (when only two had been discovered) that these were remains of some planet which had been shattered by explosion or other cause; and the encouragement which this idea gave to look for further fragments, was perhaps one of the main causes of the discovery of the remaining two. This law of Bode, as it has been called from the astronomer who first noticed it, may be thus expressed: if $a$ be the distance of Mercury, and $a+b$ of Venus, then $a+2b$ is that of the Earth, $a+4b$ of Mars, $a+8b$ of the small planets, $a+16b$ of Jupiter, $a+32b$ of Saturn, and $a+64b$ of Uranus; all nearly.

To convert the above relative distances into actual ones, consider the distance from the sun to the earth as 23984 mean semidiameters of the earth, the mean semidiameter being 3956 miles; so that the distance in question is 95 millions of miles. The semidiameter of the sun is 111·454 times that of the earth; so that the distance of the earth from the sun may be called 215 semidiameters of the sun. One of our objects in this article is to correct the absurd notions derived from the playthings called orreries, and the diagrams exhibited in books and lectures. Let the capital letter O of the type which stands at the beginning of the article in this work represent the sun; then the earth is a speck which would need a good microscope to show it; and its distance from the sun is represented by 11 inches, or nearly two inches more than the length of one of our columns. Sir John Herschel describes the Solar System thus:—

| Planet. | Object which represents it. | Representative of its distance from the sun. |
|---|---|---|
| Sun. | Globe of 4 feet diameter. | |
| Mercury. | Grain of mustard seed. | 164 feet. |
| Venus. | A pea. | 284 feet. |
| Earth. | A pea. | 430 feet. |
| Mars. | A rather large pin's head. | 654 feet. |
| Juno, &c. | Grains of sand. | 1000 to 1200 feet |
| Jupiter | A moderate sized orange. | Half a mile. |
| Saturn. | A small orange. | ⅘ of a mile. |
| Uranus. | A full sized cherry, or small plum. | A mile and a half, |

The *excentricity* of a planet means the fractional part of a planet's mean distance by which its greatest or least distance exceeds or falls short of the mean distance. Arranging the planets in the order of their excentricities, we have

| | | | | | |
|---|---|---|---|---|---|
| For Venus | ·007 | For Saturn | ·056 | For Mercury | ·206 |
| „ Earth | ·017 | „ Ceres | ·078 | „ Pallas | ·242 |
| „ Uranus | ·047 | „ Vesta | ·089 | „ Juno | ·258 |
| „ Jupiter | ·048 | „ Mars | ·093 | | |

That is, if the mean distance of Venus were called 1000, its greatest distance would be only 1007 and its least 993. But if the mean distance of Juno were called 1000, its greatest distance would be 1258 and its least distance 742.

We now give a table for the times of revolution, similar to that given for the distances:—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ☿ | 100 | 39 | 24 | 13 | 6 | 20 | 8 | 3 |
| ♀ | 255 | 100 | 62 | 33 | 14 | 52 | 21 | 7 |
| ⊖ | 415 | 163 | 100 | 53 | 23 | 84 | 35 | 12 |
| ♂ | 781 | 306 | 188 | 100 | 44 | 159 | 65 | 22 |
| ⚶ | 1507 | 590 | 363 | 193 | 84 | 306 | 126 | 43 |
| ⚵ | 1810 | 709 | 436 | 232 | 101 | 368 | 151 | 52 |
| ⚳ | 1911 | 748 | 460 | 245 | 107 | 388 | 160 | 55 |
| ⚴ | 1917 | 751 | 462 | 246 | 107 | 389 | 160 | 55 |
| ♃ | 4925 | 1929 | 1186 | 631 | 276 | 1000 | 412 | 141 |
| ♄ | 11950 | 4680 | 2878 | 1531 | 669 | 2428 | 1000 | 343 |
| ♅ | 34880 | 13660 | 8401 | 4467 | 1952 | 7082 | 2918 | 1000 |

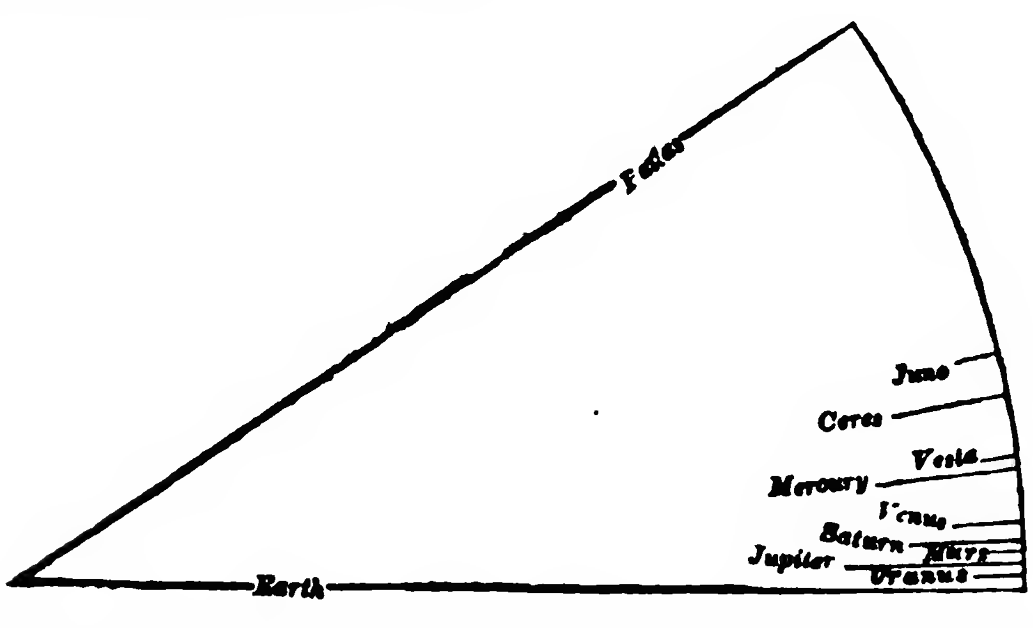
The explanation of this table resembles that of the preceding one, times, instead of distances, being the objects of comparison. Thus, if a revolution of Jupiter contain 1000 parts of time, that of Saturn has 2428 such parts: and the revolution of Uranus is 84·01 as long as that of the earth.

In the following table will be seen the absolute time of revolution in days, and also numbers expressive of the comparative angles moved over in a day by each planet, and the intervals (in days) between two conjunctions with the sun:—

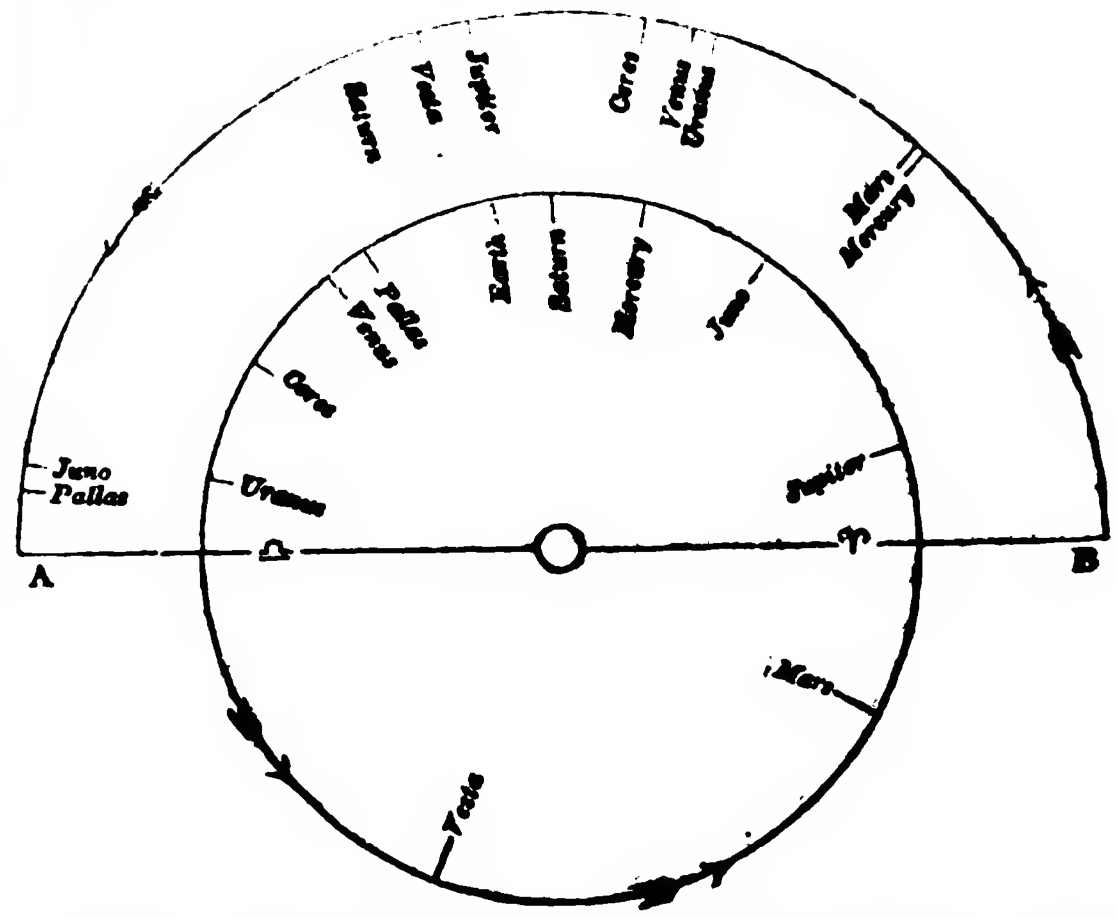
| | Rev. | Int. of Conj. | Comp. Ang. | | Rev. | Int. of Conj. | Comp. Ang. | | Rev. | Int. of Conj. | Comp. Ang. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☿ | 88 | 116 | 1137 | ⚶ | 1326 | 503 | 75·4 | ♃ | 4333 | 399 | 23·1 |
| ♀ | 225 | 584 | 445 | ⚵ | 1593 | 474 | 62·8 | ♄ | 10759 | 378 | 9·29 |
| ⊖ | 365 | —— | 274 | ⚳ | 1681 | 467 | 59·5 | ♅ | 30687 | 370 | 3·26 |
| ♂ | 687 | 780 | 146 | ⚴ | 1687 | 466 | 59·3 | | | | |

Thus, Venus revolves in 225 days (all the numbers in this article are more roughly given than in the articles specially devoted to the planets); is in conjunction with the sun at intervals of 584 days; and, with its mean motion, would describe 274° in the heavens while Jupiter describes 23°·1. Saturn moves 2·01 minutes daily; the earth, 59′ 8″·3.

The minor elements (in a general consideration) may be best described by diagrams; the inclinations of the orbits may be represented by the following lines, which show the slope or inclination of each orbit to the orbit of the earth or plane of the ecliptic. None of the old planets have an inclination of more than 7°, while in the new planets the same element varies from 7° to 35°.




In the next figure the plane of the ecliptic is represented: OB is the line which points to the astronomical first point of Aries, or the vernal equinox, and the arrows represent the directions of the planetary motions. On the outer circle are represented the longitudes of the ascending nodes of the different planets, or the lines in which they are found when they rise through the ecliptic from the southern to the northern side of it. On the inner circle are represented the longitudes of their perihelia, or points of nearest approach to the sun. The slow changes which take place in these elements are noted in the articles devoted to the different planets.




Jupiter and his satellites might be enclosed in a sphere having a radius of about 2½ times as great as that of the sun; Saturn and his satellites in a sphere of 7¾ the radius of the sun; and Uranus and his satellites in a sphere of 4½ the radius of the sun. The earth and moon [MOON] might be contained in a sphere of one-half the radius of the sun.

In apparent diameter Mercury* varies from 5″ to 12″; Venus from 10″ to 61″; Mars from 4″ to 18″; the small planets have diameters hardly measurable; Jupiter from 30″ to 46″; Saturn from 14″ to 18″; Uranus from a little less to a little greater than 4″.

If the radius of the sun were divided into 1000 parts, there would be as follows in the radii of the several planets: —Mercury, 3½; Venus, 8¾; the Earth, 9; Mars, 4¾; Jupiter, 97½; Saturn, 85; and Uranus, 39. If the bulk of the sun were divided into a *million* of parts, Mercury would be a little less than one-twentieth of one of the parts; Venus, two-thirds of a part; the Earth, three-quarters of a part; Mars, one-tenth of a part; Jupiter, 925 parts; Saturn, 720 parts; Uranus, 58 parts. The Moon is about the third part of Mercury in bulk.

The mass of the planets varies very much from what it would be if they were nearly of the same substance. From the effects of the planets in attracting their satellites, compared with the effects of the sun upon themselves, it is found that if, according to Cavendish's experiment, we take the earth to be, at a mean, 5½ times the density of water, or about half that of lead, the sun may be considered, as to density, to be made of asphaltum, or rather heavy coal; Jupiter of the same; Uranus of a material very little heavier; Saturn of maple-wood; the Moon of diamond or topaz. By other modes, of course, than that of their satellites, Mercury is found to be three times as dense as the Earth; Venus of about the same density; and Mars about three-quarters as dense as the Earth.

The sun revolves about its axis in about 25½ sidereal days; Mercury, Venus, the Earth, and Mars, all revolve in about the same time, from 23½ h. to 24½ h.; Jupiter and Saturn severally revolve in about 10 h. and 10½ h. About Uranus nothing is known in this respect.

From what precedes, a sufficient general notion may be collected of the dimensions of the Solar System, and we now proceed to some other points connected with it. As to its place among the fixed stars, it is only within the last two years that the distance of any star from our system may be said to have been positively measured. [PARALLAX.] The star 61 Cygni is shown to be more than 340,000 times as far from our system as its most distant discovered planet is from the sun. As to the question of the motion of the Solar System in space, no such phenomenon has been made apparent. Were any such motion to exist, of a degree sufficient to have a sensible effect, it is obvious that the stars which the system is leaving would appear to draw nearer together, while those to which it is approaching would appear to become wider apart. W. Herschel thought at one time that some such phenomenon was slightly perceptible, and that the system was in motion towards the constellation Hercules; but the fact has received no confirmation. That the whole System is in motion more or less, mechanical considerations make almost certain. Whatever motion the centre of gravity had at any one time, it is demonstrable that it must keep unaltered, except by the attraction of the fixed stars; and it is millions to one against there having been no motion whatever of this centre at the time when the system received its organization. And if there be *any* attraction from the fixed stars, however little, some motion must be produced. Centuries of close observation on double stars may, and probably will, detect the motion of our system. All that can be said up to the present time is, that, be it what it may, it is exceedingly small, compared with the distance of our System from these stars.

The next question may be, is there any evidence in our System of any secondary law of formation, indicating a connection between the mode of creation of one planet and another. The will and power of the Creator are the final causes both of the initiation and maintenance of this vast machine; but in the latter there are visible secondary laws, that of attraction, for instance: were there any in the former? Attempts at investigation on this point have been frequently considered atheistical; a foolish notion arising out of those views to which we have alluded in MOTION, p. 452. Those who can only think of the *Creator* and forget the *Maintainer*, and who virtually separate the office of the latter, and give it to the 'laws of nature,' may reasonably fear that they would have to give up also the former office to the 'laws of creation,' if such were found; which would be (but owing only to their own interpretation of the manner in which the world *continues* to exist) a renunciation of the idea of Deity in the contemplation of the manner in which it *began* to exist. But to those who keep constantly in view the fact which no modern theist disputes, that the same power which created continues to create in preserving, and that the 'laws of nature' are only expressions of the manner in which this preservation is seen to act, will look upon the 'laws of creation' to be as simple and natural an object of philosophical inquiry as those of the ascent of sap in a plant, or of the revolution of a planet. The proper reply to a charge of atheism brought against those who investigate any mode of action of the Creator of the universe, at any *past* time, is the retort of semi-atheism against those who make it.

Many speculations have been made upon the formation of the several planets, but none which has any appearance of connecting the phenomena of one planet with those of another, except by Laplace (*Système du Monde*, vol. ii., note 7), in what has been called the nebular hypothesis. This conjectural theory, which is well worthy of attention, never received any particular notice, to our knowledge, from any writer in this country, until Mr. Whewell's 'Astronomy and General Physics,' the third of the Bridgewater Treatises, appeared, in which it is announced that the nebular theory was ushered in with expressions which showed Laplace to be a professor of atheism. What Laplace really thought on these subjects, as we have said before [LAPLACE], we do not know, nor would it really matter if he were what he was represented to have been; for a conjecture may be ingenious, and a theory sound in its details, even though its author made it stand in the place of a Creator. But considering the collateral associations connected with such a charge, it will be well to examine into the fact whether there was any such announcement; and to do this fairly, we must quote both Mr. Whewell and Laplace. The former says,—'We have referred to Laplace as a profound mathematician, who has strongly expressed the opinion that the arrangement by which the stability of the Solar System is secured is not the work of chance; that "a *primitive cause* has directed the planetary motions." This author however, having arrived, as we have done, at this conviction, does not draw from it the conclusion which has appeared to us so irresistible, that "the admirable arrangement of the Solar System cannot but be the work of an intelligent and most powerful Being." He quotes these expressions, which are those of Newton, and points at them as instances where that great philosopher had deviated from the method of true philosophy. He himself proposes an hypothesis concerning the nature of the *primitive cause*, of which he conceives the existence to be thus probable.'

Here are two assertions:—1, That it is the doctrine of an intelligent Creator which Laplace 'points at' as a deviation from true philosophy; 2, That Laplace proposes his nebular hypothesis as a primitive cause. We pay a writer of Mr. Whewell's character the compliment of inserting here matter which would more appropriately appear in a review of his work: and we deny that Laplace has been well described in either assertion. Our object is to clear the nebular hypothesis from the unphilosophical character with which its first appearance is thus presented, and by no means to uphold the moral dignity of Laplace. Until the biting facts connected with his treatment of his benefactor [Vol. xiii., p. 325] are answered or explained, that great mathematician must be called a time-server; and we suspect that his 'Système du Monde' only treats the intelligent Creator whom his mind acknowledged, in the same manner as he afterwards treated Napoleon. It was published in 1796, a period which would well explain the mere suppression of all allusion to the Supreme Being: and one of these things must be true; either Laplace was what Mr. Whewell styles him, or he had not the courage to declare himself otherwise in his age and country. But what we have here to do with is the assertion that he did more—that he *attacked* the doctrine of a Supreme Being. His words are as follows, the passages to which we wish to draw attention being in Italics:—'I cannot here help observing how much Newton has departed on this point from the method which he elsewhere so happily applied. After the publication of his discoveries, this great geometer, abandoning himself to speculations of another nature, *inquired into the motives which made the Author of nature give to the Solar System* the constitution which we have described.' Laplace then quotes Newton's Scholium (PRINCIPIA, pp. 10, 11, where we have translated the whole) thus: '*And all these regular motions have no origin in mechanical causes*,'* &c. &c. down to 'all parts of the heavens.' He then further quotes, 'This most elegant group, &c. can only arise from the design and government of a powerful and intelligent Being.' He (Laplace) continues thus, speaking, so far as the mere notion of a Supreme Being is concerned, rather in approbation: 'He repeats the same thought at the end of his Optics, in which he would have been still more confirmed if he had known what I have demonstrated, namely, that the arrangement of the planets and satellites is precisely that which makes a certain provision for their stability. "Blind destiny," says Newton, "can never make the planets move thus with such small irregularities, which appear to come from the mutual action of the planets and comets, *and which will probably become greater and greater in the course of time, until at last the System will again require its author to put it in order*." But,' proceeds Laplace, 'may not this arrangement of the planets be itself a consequence of the laws of motion, and may not the Supreme Intelligence, which Newton makes *to interfere*, have already made it depend upon a more general law? *Are we to affirm that the* [unlimited] *preservation of the Solar System is a part of the intentions of the Author of nature?*' This we should sum up as follows: Laplace charges Newton with a departure from philosophical principles in—1, Speculating on the motives of the Creator;† 2, Assuming the probability that his works would not last his time without his own supernatural interference; 3, Assuming that he intended to preserve the Solar System for ever. But Mr. Whewell singles out only one part of Laplace's quotation, and without paying any attention to the remarks which explain his meaning, declares that Laplace 'pointed at' Newton's declaration of belief in God as a piece of bad philosophy; whereas this part of his quotation is only followed by the remark how much stronger he himself (Laplace) had been able to make the sort of evidence on which Newton rested; and the sentence selected by Mr. Whewell as 'pointed at,' coupled with the remark specially made on that sentence, has rather the appearance of being pointed at with approbation. With regard to the assertion that Laplace propounded the nebular theory as a *primitive cause*, it is true that he did so in his own sense of the words. Mr. Whewell means by primitive cause a first cause, as those words are usually understood: and he asks (and the question would have been much to the purpose if Laplace had really meant the same thing as himself by the words *primitive cause*), 'Was man, with his thought and feeling, his powers and hopes, his will and conscience, also produced as an ultimate result of the condensation of the solar atmosphere?' But Laplace speaks as follows: 'Quelle est cette *cause primitive?* J'exposerai sur celà, dans la note qui termine cette ouvrage, une hypothèse,' &c. And in the very first words of this note

* Laplace evidently thought that by mechanical causes Newton meant what we now call second causes. See the reference just made.

† Newton's Scholium does not seem to us to do any such thing; but that is not the question. Laplace's approval or disapproval is of course to be applied to his own interpretation of Newton's meaning, not to ours.

we find, 'On a, pour remonter à la *cause* des mouvemens *primitifs* du système planetaire,' &c. This then is what Laplace understood by *primitive cause*, a *cause* of the *primitive* motions;—an improper use of language, if the reader pleases; but when a man puts his own meaning on his own words, no one has a right to fix the consequences of another meaning upon him.

We now proceed to the nebular theory, which is a conjecture proposed with much doubt by Laplace, as a possible explanation of the manner in which the *motions* of the several planets obtained those remarkable resemblances which are found to subsist, without making the inquiry extend to anything except their motions. All the planets move in one direction round the sun, and their satellites move in the same direction round themselves; those that are known to revolve round their axes (and the contrary has been proved of no one of them) also revolve in the same direction, and their equators are not much inclined to their orbits. The excentricities of the planets and satellites are in no case very large, and generally very small; and the inclinations of their orbits to one another are generally small. Many nebulæ in the heavens appear, when examined, to consist of a bright nucleus surrounded by nebulous matter; in others it is found that the apparently nebulous matter consists of stars. This gave Laplace the idea that our System might originally, that is, previously to the establishment of its present order, have been a large nebula of which the sun was at the centre. Imagine a large nebulous mass in a state of revolution, with a solid or at least less nebulous centre, round which it revolves: call this central nucleus the sun. Assume the ordinary laws of matter to be true of this nebulous mass; and also that it extends as far as such an atmosphere can do; namely, until the attraction of the whole upon particles at the equator is equal to the centrifugal force of those particles. If condensation should begin to take place, arising from loss of heat, the mass would revolve more and more rapidly as it was condensed into less and less space; but it does not follow that the equatorial particles would fall in towards the centre: they are balanced by the equality of the centripetal and centrifugal forces; and might form a ring round the rest of the mass. If the process were conducted with great regularity, this ring and the mass of vapour might undergo continual condensation together, until the increasing velocity of rotation prevented the formation of the ring from continuing. The departures from complete regularity which might exist in the mass might cause disturbances in the formation of the rings, which might end in there being one or more (not many) permanently revolving round the rest of the mass condensed into a solid body, in the manner of Saturn and its rings. Such regular formation however might be rarely continued long enough; and if the rings got broken, each ring would become several masses, which would revolve nearly at the same distance, and nearly with the same velocity: such a result is seen in the four small planets. But as, generally speaking, these masses would, by irregularities in their velocities, be combined into one* at last, each broken ring would form a new nebulous mass, revolving round the diminished central nucleus: and if a number of such masses were formed, those nearer to the central mass would move with the greater velocity, and would be both smaller and denser than the external ones: the first circumstance certainly, the second and third most probably. Again, each mass would have a motion of revolution in the same direction [Motion, Direction of] as the motion round the primary; for when the ring becomes broken, its internal parts have a somewhat more rapid motion than the external ones, which would give the motion of rotation noticed. And the rotations thus created in the internal masses would probably be greater than those in the external masses. The orbits of the masses would necessarily be nearly circular, and not much inclined to each other: but for irregularities, quite circular, and in the same plane. In each of the nebulous masses, thus detached and revolving, condensation might again give rings or satellites or both; but in all probability the external masses would get more satellites than the internal ones: the orbits of the satellites must be also nearly circular, and not much inclined. All the preceding circumstances, both those which are certain and those which are probable (Laplace confined himself to the former), are actually existing in the Solar System: consequently this hypothesis, though subject to serious difficulties, deserves attentive consideration, as often as any new knowledge of the constituent parts of our system shall render a reference to it likely to produce evidence on one side or the other. As a substitute for intelligent creative power, if such a thing were intended, it would do no better than any other; for, as Mr. Whewell observes, a man with will, power, and conscience, cannot be admitted to be a necessary consequence of the cooling of a nebulous atmosphere. Nevertheless, as exhibiting a possible mode in which the Creator of mind and matter made the laws of formation resemble those of continuation, as far as the motions of the system are concerned, this hypothesis is strikingly explicative of what we really see. But even if we were to take it to be a true explanation, it would only be one step of the ascent, and the next question would be, what higher process distributed the parts of this nebulous mass in such a manner as to place those outermost which were fit to form a planet so distant from the source of light and heat as Uranus, and to support the appropriate forms of animal and vegetable life which analogy would induce us to suppose must exist there.

The history of astronomy teaches us that the system in which we live has not undergone any apparent change for more than 2000 years; and, on inquiring into the connection which exists between one planet and another, or the laws of gravitation, it is found that so far as their mutual actions are concerned, there is no reason why any change ever should take place. If the central body were the only one which attracted the rest, and as long as the laws of matter remained unaltered, it is certain that nothing could alter the revolutions of a system of planets, unless two orbits intersected, and the planets of those orbits happened to come to the intersecting part at the same time, and to strike each other. But the planets are subject to the action of each other as well as to that of the sun, and no instant elapses without every orbit undergoing a slight change from every one of the planets of the other orbits. Jupiter alone produces on the earth's orbit in one year more change than we have any right to say all the comets put together would do in a hundred. And yet the system not only continues without any sensible change, but, one circumstance alone excepted, to which we shall presently allude, is demonstrably formed to continue for a most enormous length of time, unless some new action should arise, or some external cause begin to operate. As it is sometimes stated that a complete mathematical demonstration has been given of the *eternal* stability of the Solar System, so far as the mutual actions of its parts are concerned—an assertion which is altogether incorrect—it may be worth while to enter a little on the details of this subject.

The disturbing forces of the planets on each other cannot have their effects calculated all at once; but each force must be divided into an infinite series of terms, the first of which contains all the terms of the first dimension, the second all those of the second, and so on. Of all these terms each is much less in its effect than the preceding; so that in fact the first two dimensions are all that produce any sensible effect in any time which it is worth while to consider. Occasionally it happens that terms of the third and fourth dimensions have been required to be used, but almost all the sensible perturbations of the system depend on terms of the first two orders. As far as any effects arising from such terms are concerned, Lagrange and Poisson are admitted on all hands to have demonstrated the stability of the Solar System: and considering the nature of the process employed, and there being no appearance of any circumstance which looks likely to lead to a different result in any of the remaining terms of the disturbing forces, it may be highly probable that a further investigation would show the same thing, if all the dimensions of the disturbing forces were employed. Sir J. Lubbock (*Phil. Mag.*, February, 1831) has pointed out the forms which further investigation would apparently produce, and which would (unless a detailed investigation should lead to something not discoverable *à priori*) bear out as certain what we have just stated to be probable. But though all the presumptions lie on the side of those who would assert the proposition absolutely of all dimensions of the disturbing force, it is not yet time to say that it is a certain mathematical consequence of the theory of gravitation.

* If any number of masses, capable of cohering, revolve in orbits so near to one another that they must cohere when they come to their minimum distance, nothing but an absolute and mathematical equality in their mean velocities can keep them permanently asunder; the smallest inequality must at last bring them all together.

When the effects of preturbation are examined, as far as the second dimension of the disturbing force, it appears that the immense mass of the sun compared with that of any planet, the great distance of the planets from each other as compared with their amounts of departure from spherical form, the small excentricities and inclinations of their orbits, and their motions being all in one direction, give the following mathematical consequences of the law of attraction:—First, the longest or major axes of the planets' orbits are not subject to any slow variations of very long period; all their variations being excessively small, and soon destroyed by the production of contrary variations. It is very often stated that the major axes are subject to no variation; this is to be understood only of *secular* variation (or of very long period). One year is not precisely the same as another to any fraction of a second; but the average year of one long period *is* precisely the same as that of another; or at least the mean years of the two periods become more nearly equal the longer the periods are made. But the excentricities and inclinations are subject to long periodic alterations, the times of their recurrences not being exactly settled, from the difficulty of their determination. How then is it known that they are periodic? For instance, the excentricity of the Earth's orbit is subject to a yearly diminution of ·00004, its value in 1801 being ·017. Had this diminution been an increase, as it is in Mercury and Jupiter, it might *à priori* appear possible that this increase should continue until the orbit (preserving the same major axis) should be so elongated that the ultimate approach to and recession from the sun should give our planet the alternate climates of Mercury and Mars, and thus no doubt destroy it as the abode of beings constituted like ourselves. It is found however that the following relation must exist:—If at any one moment the square of the excentricity of each planet be multiplied by its mass and the square root of its mean distance from the sun (represented in numbers), the sum of all these products must be the same as it was at any moment past, or will be at any moment future. And if in each product the tangent of the inclination to a fixed plane be substituted for the excentricity, the resulting equation is true. From such relations as these, and others connected with them, it is shown that so far as the mutual actions of the planets are concerned, no one excentricity nor inclination can increase indefinitely, but all their changes must be periodic, and confined within rather small limits. The approach of the ecliptic to the equator, for instance, which amounts to about half a second in a year (and which leads speculators sometimes to talk about a past time when the ecliptic passed through the pole, and a future time when it will coincide with the equator), must stop long before the ecliptic reaches the equator, and attain a minimum inclination, after which the two will begin to separate; the whole oscillation being less than three degrees. The whole result is summed up thus: As far as terms of the second order (inclusive) in the disturbing forces, and as long as only the mutual attractions of the planets act, there is a mathematical certainty that the Solar System will remain in its present state, the elements of the different orbits oscillating about certain mean values, from which they are never very distant: except only the longitudes of the nodes and perihelia, which change with velocities which are always very near to a certain mean velocities. The probability is very small that the higher dimensions of the disturbing forces would affect this result, and certainly only in a length of time to which the longest periods known are trifling in comparison.

This last point however is of the less importance, since it has become highly probable, within the last few years, that an external cause does exist, which must, unless there be a counteracting force of which we know nothing, in time cause the destruction of the System. If the planets move in any medium which resists their motions, however little, the consequence must be a gradual diminution of their mean distances from the sun, and a gradual increase of their velocities, ending in their absolutely falling into the sun. For the presumption in favour of the actual existence of such a resisting medium, see COMET, p. 394. This retarding agent seems to show a rapid effect upon so attenuated a mass as Encke's comet, though thousands of years have elapsed without its producing any sensible effect upon the planets. Little as it may concern us directly, these speculations have an interest, both as to the glimpse they give of the possible destiny of our System, and from their association with the history of past and the hope of future discovery. It is to be remembered that no science has drawn out so much of mathematical talent, or indirectly excited such an influence upon other branches of physical research, as the application of the theory of gravitation to the development of the planetary motions.

For more detail upon the subject, in a popular manner, the English reader may consult Sir John Herschel's 'Treatise on Astronomy,' in the *Cabinet Cyclopædia*, or Mrs. Somerville's 'Treatise on the Physical Sciences.'

SOLA'RIO, ANTONIO DE, called 'Il Zingaro,' or the Gipsy, was born in 1382, at Chivita, in the Abruzzi, according to Dominici (*Vite de' Pittori Napolitani*), but others have contended that he was a Venetian. He was a gipsy by birth, and in his youth was a sort of itinerant blacksmith. He was not a mere tinker, a mender of kettles and saucepans, for he is said to have been admitted into the house of the painter Colantonio del Fiore at Naples, on account of his skill in making implements of iron. Nearly the same story is related of Solario as of Matsys, the blacksmith of Antwerp. [MATSYS.] Solario fell in love with the daughter of Colantonio, and she fell in love with him. Solario made proposals, but Colantonio said that he would never consent that his daughter should marry any one but a painter of reputation at least equal to his own. The gipsey was not to be thus got rid of; he asked to be allowed ten years to study the art, and Colantonio, to satisfy his daughter, assented. Solario became a pupil of Lippo Dalmasi at Bologna, with whom he remained six or seven years, and afterwards travelled through the chief towns of Italy in order to study the works of other masters. In rather more than nine years he returned in disguise to Naples, and having presented to the queen of Naples a picture of the Virgin, with the infant Jesus crowned by angels, and also been permitted to paint a portrait of the queen, Colantonio was then invited to view the productions of the unknown artist, of which he expressed the highest admiration. Solario then discovered himself, and soon afterwards became the son-in-law of Colantonio. His reputation was immediately established, and he was much employed, especially at Naples, in painting altar-pieces, and in decorating the walls of convents and other religious houses with frescoes. In the fine expression of his heads, and in the richness and harmony of his colouring, he has been compared to Titian. He is also praised for the graceful action of his figures, but is said to be defective in the drawing of the hands and feet. Solario was also distinguished as an illuminator of manuscripts, especially Bibles. He died in 1455. Vasari has not included Solario in his 'Lives.'

(Dominici, *Vite de' Pittori Napolitani*; Moschini, *Memorie della Vita di Antonio de Solario, detto Il Zingaro, Pittore Viniziano*, Venezia, 1828.)

SOLA'RIUM. [TROCHIDÆ.]

SOLDA'NIA. [FORAMINIFERA, vol. x., p. 348.]

SOLDERING, according to Dr. Ure (*Dict. of Arts*, &c.), is 'the process of uniting the surfaces of metals, by the intervention of a more fusible metal, which, being melted upon each surface, serves, partly by chemical attraction, and partly by cohesive force, to bind them together.' In accordance with this, which is the ordinary acceptation of the word soldering, a solder may be defined as a metallic cement employed to unite, by being fused between them, two pieces of metal. Such an explanation however, though correct in most cases, does not apply to every kind of soldering; a process having been recently introduced by which pieces of metal may be perfectly united without the interposition of solder.

In the ordinary mode of soldering, the alloy used as a solder must be more fusible than the metal or metals which are to be united, and must have a strong affinity for them. The solder usually contains a large proportion of the metal to which it is to be applied, in combination with some more easily fusible metals. To insure perfect metallic union between the solder and the surfaces to which it is applied, it is essential that they be made perfectly clean and free from oxide, and that the atmosphere be excluded during the operation, in order to prevent the formation of any oxide while the process is going on. This is effected in various ways, but most commonly by the use of borax, sal ammoniac, or rosin, either mixed with the solder or applied to the surfaces to be joined. Mr. Thomas Spencer, of Liverpool, has recently made some interesting experiments, the results of which are given in a paper 'On the Theory and Practice of Soldering Metals,' which was read before the Liverpool Polytechnic Society in May, 1840, and published in the 'Mechanic's Magazine,' vol. xxxii., p. 729, &c. An almost infinite variety of alloys are used in different kinds of soldering, the principal of which, as recommended by the best authorities, will be described below, classified according to the metals which they are commonly used to unite.

*Platinum* is soldered, according to Dr. Ure, with fine gold.

For *gold* it is usual to employ an alloy of fine gold with silver or copper, or with both of those metals. These are sometimes used in the following proportions:—pure gold twelve parts, pure silver two parts, and copper four parts. The metals are fused together, beat into thin leaves, and then softened by annealing. Borax mixed to a thick consistence with water is applied to the joint, and the solder is melted by the blowpipe. It is stated in Brewster's 'Edin. Ency.,' that the borax may be removed by boiling water, or diluted sulphuric or muriatic acid; and that the paleness of the solder may be remedied by melting upon its surface a mixture of two parts of nitre and one of burnt alum, and then washing it off with hot water. The same authority states that gold articles may be cleaned after soldering by boiling them in urine and sal ammoniac, and those of silver by boiling in alum-water.

*Silver* solders usually consist of silver mixed with brass, and sometimes with zinc. Dr. Ure states that pure tin is occasionally used as a solder for silver, but that the solder commonly used is an alloy of five parts silver, six brass, and two zinc. Some authorities give nineteen silver, one copper, and ten brass, as the proportions in jewellers' silver solder; and two parts of pure silver to one of brass as the composition of solder for plating. Another solder for coarser silver has four parts silver to three of brass, with a little borax; and a hard silver solder is made of equal parts of silver and fine brass. The addition of zinc softens this alloy. Mr. Gill, in an article on soldering in jewellery, in the 'Technical Repository,' vol. ii., p. 63, states that the thin laminated solder is cut up into very small bits, and applied with borax and water. The article to be soldered is laid on charcoal ashes, and submitted to the jet of a blowpipe. To prevent the solder from spreading over the surrounding parts, they may, he observes, be coated with Indian ink laid on with a camel's-hair pencil. The fluid borax is also applied with a hair-pencil, and the solder with the end of the ivory handle on which the pencil is fixed. Filagree-work is soldered in a somewhat different manner; the minute parts being laid together in their proper position on a flattened piece of charcoal, which is smeared with a thick solution of gum tragacanth to hold them steady. The fluid borax is then brushed over, and the solder, reduced to a fine powder, is sprinkled upon it. In this as in all other kinds of soldering, whenever several parts must be successively put together, it is necessary to use solders of different degrees of fusibility; the least fusible being used first, so that the joints made with it may not be disturbed by the heat of the subsequent operations.

*Spelter* solder is used for brass, copper, and iron, and consists of zinc (spelter) mixed with copper or brass, and sometimes also with tin. The proportions vary greatly. Gill gives eighteen parts brass, three zinc, and two tin; or sixteen parts copper, sixteen zinc, and one tin. (*Technic. Rep.*, i., 432.) Dr. Ure says it consists of zinc and copper in nearly equal parts. Brewster's 'Edin. Ency.' describes it as consisting of two parts zinc and one brass, and observes that the addition of one dwt. of silver to each ounce is a great improvement. In the 'Dict. Technologique,' as quoted in vol. vi. of Gill's 'Technical Repository,' p. 181, the following solders for copper are mentioned:—eight copper and one zinc, which form a very hard yet fusible and malleable solder; three copper and one zinc; and ten copper and one zinc. The latter forms the hardest but least fusible solder. Generally the addition of copper increases the hardness and diminishes the fusibility of the alloy. For hard brass solders the same proportions are recommended, but brass is substituted for copper. The proportions may vary, it is stated, from two to sixteen parts of brass to one part of zinc. Six brass, one zinc, and one tin, form a soft solder for brass. An alloy of two parts copper and one part tin is sometimes used as a hard solder. All the above-mentioned hard solders are granulated, and applied to the joint in the form of a coarse powder.

Articles of *wrought-iron*, and some qualities of *steel* also, may be soldered with cast-iron; the cast-iron being repeatedly heated and quenched in water, by which it becomes sufficiently friable to be beaten to a coarse powder with an iron pestle and mortar. Several papers respecting this method of soldering were published in the 'Technical Repository,' vols. i., iii., and iv.; from which it appears that the process was, about sixteen or eighteen years ago, practised in such a way as to lead to the supposition that it was rather a welding than a soldering operation; the solder being applied in the form of a black shining composition resembling pitch, which Mr. Gill conceived to be cast-iron powdered and mixed with glass of borax; and the joints being subjected to a slight hammering. The parts united by this means are stated to be scarcely distinguishable. In making fine steel instruments, gold, either alone or with a slight alloy of copper, is often used as solder. Silver solder, being less expensive, and nearer the colour of the steel, is preferred by some for this purpose. An alloy of nineteen parts fine silver, one copper, and two brass, has been recommended for steel joints. In larger articles of iron and steel, a solder consisting of equal parts of tin and iron is sometimes used.

Common *plumbers'* solder is made of two parts lead and one part block tin; or of the same metals mixed in nearly equal quantities; bismuth is added when it is desired to make the alloy more fusible. Soft solder has two parts tin to one lead; and other alloys of tin, lead, and bismuth, are used for uniting various articles of lead, tin, pewter, and other soft compounds. Such highly fusible solders are usually cast in ingots or strips, and melted as they are used by means of an instrument called a soldering-iron, which is tipped with copper—that metal being preferred for its greater affinity for tin. In soldering tin plates together, their edges are made to overlap; but in almost every other case the edges to be joined are made only to meet, the solder being run between their abutting edges.

The 'Technical Repository' (vol. iv., p. 57) gives an account of a curious mode of soldering resorted to in order to fix upon the back of the dial-plate of a watch the small copper studs by which it is attached to the plate which encloses the wheel-work. The heat required for melting spelter solder would be injurious to the enamel, and therefore the studs are made of wire plated with silver, and fixed by melting the silver on their sides, and causing it to run down to their base, where borax and water is previously laid. Thus the studs are fixed without applying the jet of the blowpipe immediately to the back of the enamelled plate.

A kind of soldering, called *burning-to*, has been long practised in some cases with sheet-lead, where it has been desirable to make a vessel entirely of that material; the junction being effected by pouring melted lead on to the edges to be united, until they fuse together. Somewhat similar to this is the process recently introduced under the name of *autogenous soldering*. This process, which is the invention of a French gentleman, M. de Richemont, consists in the union of two pieces of metal without the interposition of any solder, by fusing them at the point of junction by jets of flame from a gas blowpipe. The apparatus used for the purpose contains a hydrogen gas generator, bellows for atmospheric air, and valves for regulating the proportion in which the gas and air are to be mixed. A complete description, with cuts, of this machine, is given in the 'Mechanic's Magazine' (vol. xxxii., p. 546). The invention has been rewarded in Paris by a gold medal, at the National Exhibition of Arts, and is patented in this country. It has hitherto been applied chiefly to lead, but appears suitable for metals more difficult of fusion. By its adoption lead may be applied very extensively in chemical vessels, in which the use of solder has been inconvenient or impossible, owing to its degree of expansibility differing from that of lead, and its greater liability to be acted upon by acids. The joints formed in this way are also much neater and less liable to flaws than those made by the common process. It appears by the paper referred to at the commencement of this article, that Mr. Spencer discovered this process about the same time as M. de Richemont; and his experiments lead him to suppose that, by varying the admixture of gases, a jet of flame may be produced of intensity suitable for any metal to which it may be desired to apply the new mode of soldering.

**SOLDIER** is a term applied now to every man employed in the military service of a prince or state, but it was at first given to such persons only as were expressly engaged for pay, to follow some chief in his warlike expeditions.

Cæsar mentions a band of 600 men called 'soldurii,' who bound themselves to attend their leader in action and to live or die with him (*De Bello Gallico*, iii. 22), but it does not appear that they served for pay. By some the word has been thought to come from 'solidus,' the name of a coin under the Roman empire, which may have been received as the payment for the service.

The troops which formed the armies of the Crusaders were engaged to serve for pay, for though the nobles voluntarily entered into the war, their vassals were not obliged by the tenure of their fiefs to accompany them. Père Daniel (*Hist. de la Milice Fr.*, tom. i., p. 103) expresses his belief that Philip Augustus, near the end of the twelfth century, was the first of the French kings who had hired troops, at least in any considerable body, in his service; and the practice of retaining such troops appears to have been afterwards very general. It is probable that men hired for the wars were, from the time of that prince, called soudoyers or souldyours, that is, stipendiaries; but the name appears for the first time in the 'Chronicles' of Froissart, where it is applied to the hired troops both of France and Germany. It is stated that Jaques Dartvell (von Artaveld) of Ghent (1339) kept a guard of 60 or 80 souldyers, each of whom was paid four Flemish groats daily (liv. i., c. 29). About the same time Philip de Valois, in revenge for an inroad which had been made into his country, gave leave to the soudyers of France to plunder the lands of Sir John of Hainault (liv. i., c. 44); and the name occurs in many other parts of the work. This class of troops at that time engaged themselves to fight for any party which would employ and pay them; and when not occupied in the wars, they used to wander about the country in large bodies, plundering the people and committing every enormity. The terms 'routiers' and 'brigands,' as words of reproach, were applied to them, and they appear to have been as formidable to those who hired them as to the enemy. In the reign of Charles V. of France, Bertrand du Guesclin led them into Spain to serve against Peter the Cruel, and in that country great numbers of them remained, yet the disorders which they caused in France did not terminate till Charles VII., in 1445, and Louis XI., in 1480, established a regular militia, which was paid by the state.

In the wardrobe account of Edward I. (1300) the term soldier occurs frequently, and Grose considers that the persons so designated were of a different class from the other troops. Some of them are called 'soldiers scutifers,' or esquires; some, 'soldiers constables;' and others, simply 'soldiers;' but the pay of all was the same, viz. one shilling per day. (*Mil. Antiq.*, vol. i., p. 326.) From the time of Edward I. to the end of the reign of Edward III. the daily pay of a banneret was 4*s.*, and of a knight, 2*s.*; that of a hobiler, a sort of light horseman, was 6*d.*; of a crossbowman, 4*d.*; and of an archer, 2*d.* In that age the stipendiary troops, or soldiers, were raised in England by commissions granted by the king to persons who undertook to enlist men for a certain pay (which was made to depend on the nature of the service), and for a certain portion of the ransom-money which might be obtained in the war.

Little change seems to have taken place in the pay of the English soldiers between the times of Edward III. and Mary. We find that during the reign of this queen the daily pay of a captain of heavy cavalry was 10*s.*, and of a cavalry soldier 1*s.* 6*d.* The pay of a captain of light cavalry was 6*s.*, and of a soldier 1*s.* The pay of a captain of foot was 4*s.*, of a lieutenant 2*s.*, of an ensign 1*s.*, and of a foot soldier 8*d.*; a halbardier and a hackbutter, on horseback, had each, 1*s.* daily. In the times of Elizabeth, James I., and Charles I., the pay of the officers was a little raised, but that of a private foot-soldier was still 8*d.* per day: during the civil wars the pay of the latter was 9*d.*, but in the reign of William III. it was again reduced to 8*d.* At that time the pay of a private trooper was 2*s.* 6*d.*, and that of a private dragoon was 1*s.* 6*d.*, including in both cases the allowance for the horse. It is evident that the pay of the private soldier in later times is far from having been raised in the inverse ratio of the value of money.

While armour was in general use, the common soldiers of England were distinguished only by scarfs or by badges, on the latter of which were impressed the arms of their several leaders; but in the reign of Henry VIII. something like a uniform was worn, and it appears that the colour of the men's upper garments was then generally white; the soldiers in the king's particular service only, had on their coats a representation of the cross of St. George. However, on an army being raised in 1544, the soldiers were ordered to wear coats of blue cloth bordered with red. White cloaks marked with red crosses continued to be the uniform of the troops during the reign of Queen Mary; but in the time of Elizabeth the infantry soldiers wore a cassock and long trowsers, both of which were of Kentish grey: the cavalry were furnished with red cloaks reaching down to the knee and without sleeves. Grey coats, with breeches of the same colour, continued to be the uniform as late as the end of the reign of William III., but soon after that time red became the general colour for the coats of the British infantry soldiers.

The low condition of the first soldiers in France has been mentioned in the article INFANTRY: with respect to those of England in the times of Henry VIII. and Edward VI., we have a more favourable account; for Sir John Smithe, in the preface to his tract on 'Military Instruction' (1591), observes that the order and discipline in the armies during the reigns of those kings were so good, that the men, on being discharged, were never seen to become rogues or to go begging under pretence that they had been soldiers, as, he observes, they now most commonly do. In the preface to his 'Discourses on the Forms and Effects of Weapons' (1590), he complains that, in his time, the commanders of troops serving abroad, instead of publishing regulations for the conduct of the men, gave a few laws artfully tending to deter the soldiers from demanding their pay, but in no way prohibiting them from plundering the people of the country: he adds that they esteemed those soldiers to be the best who, by robbery, could live longest without pay. He complains also that while the commanders were gallant in appearance, and had their purses full of gold, the soldiers were without armour, ragged, and barefooted; and that when money was to be received, they used to send the men on desperate enterprises, in order that they might obtain the pay of those who were killed. He adds that, in the summer before the earl of Leicester went over (to Holland) the commanders devised a manner of paying the soldiers which had never before been heard of; instead of money, the men were paid in *provand*, under pretence that they knew not how to make purchases; by which means, the food supplied being of an inferior kind, great part of the soldiers' pay was put in their own pockets. It appears that Queen Elizabeth, on being informed of these abuses, caused the practice of paying in provand to be abolished. We find that subsequently, even so late as the time of George I., the pay both of officers and private soldiers was frequently postponed for years, and was sometimes entirely withheld. Happily such injustice no longer exists in the British army; the pay of the soldier is assured to him by the nation; and a well-appointed commissariat provides, as far as possible, for his wants while in the field.

It must be admitted that, till lately, the condition of a private soldier, both in this country and on the Continent, was unfavourable for inspiring a love of the service in his mind. Obliged to be furnished with good clothing and to preserve a becoming appearance, that which remained of his scanty pay scarcely sufficed for procuring the food necessary for his support. In his barracks he was subject to numerous petty details of duty, which produced weariness and even disgust; and, at all times, to the restraints of discipline, which deprived him of the recreations enjoyed by other classes of men. It may be added, moreover, that the soldier had too often the mortification to find himself despised for his poverty by persons with whom men of his condition are accustomed to associate. These disadvantages are now however in a great measure removed; and the pay of the soldier suffices to afford him the means of obtaining the comforts of life in a degree, at least, equal to those which are enjoyed by an ordinary peasant or mechanic. With the improvement of his condition, a corresponding improvement in the character of the soldiers has taken place: men of steady habits are induced to enlist, and officers are enabled to select the best among those persons who present themselves as recruits for the army.

The duties of the soldier are now rendered as little burthensome as is consistent with the good of the service; and the regulations, promulgated by the highest authorities, prescribe that he shall at all times be treated with mildness and humanity: even the non-commissioned officers are required to use patience and forbearance in instructing the recruits in their military exercises. When breaches of discipline on the part of the soldier oblige a commander to order the infliction of punishment, attention is paid as much as possible to render it a means of promoting a reformation of character: the lash is now very sparingly used. Wherever a regiment be now quartered, there is established for the soldiers a school, which the men are obliged, as part of their duty, to attend, and which is generally furnished with a library for their use. The library and school are formed and supported by the subscriptions of the officers, and both have been found to contribute greatly to the preservation of sobriety and good conduct among the men, by weaning them from the haunts of idleness and dissipation, and giving them a taste for useful knowledge.

In time of peace the soldier, being surrounded by the members of civil society, must, like them, conform to its laws; and, being under the influence of public opinion, he is, unconsciously to himself, held in obedience by them; so that no extraordinary coertion is necessary to keep him within the bounds of civil or military law. But in the colonies the soldier, even though he be serving in a time of peace, has many temptations to fall into a neglect or breach of discipline: he is far removed from the friends of his early life, who may have exercised upon his mind a moral influence for good: he sees around him only the conduct, too frequently licentious, of the lower orders of people in the country where he is stationed; and it may be that he is not fortified with the principles which should have been implanted in his mind by a sound education. The probability of a return to his native land before many years have passed is small, and the diseases to which he is exposed from the unhealthiness of the climate frequently terminate fatally: hence he becomes reckless from despair, and the facilities with which wine or spirituous liquors may often be obtained lead him into excesses which, while they accelerate the ruin of his health and render him unfit for duty, cause him to commit offences both against discipline and morals. Thus in the colonies there arises a necessity for greater restraints on the freedom of the soldier, and for the infliction of heavier punishments than are required at home. (Maj.-Gen. Sir Chas. Napier, *Remarks on Military Law.*) Lastly, in time of war and on foreign service a vigorous discipline is essentially necessary: the privations to which soldiers are then exposed strongly induce those who are not thoroughly imbued with moral and religious principles to plunder the country-people, in order to supply their immediate wants, or to drown the sense of their sufferings in liquor. It ought also to be observed that, in war-time, many turbulent spirits are induced to enter the army in the hope of enjoying the licence which the military life abroad appears to hold out. These men are the ring-leaders in all excesses, and they too commonly cause many of those who are weak in principle to join them; in such cases therefore the most severe coercive measures must be immediately applied, if discipline is to be preserved in the army. The efforts made by the British commanders, during the war against the French in Spain, to maintain order, and prevent the people of the country from being injured, were great and praiseworthy; and perhaps fewer crimes were committed by the British troops than by those of their allies or their enemies; but it is to be lamented that there were still too many occasions in which the national character was disgraced by the misconduct of its soldiery.

SOLE. [PLEURONECTIDÆ.]

SOLECISM (*soloecismus*, σολοικισμός), a grammatical term which is used by the later Greek and Roman writers, and by modern grammarians also, though in a somewhat different sense. It is defined by Sinnius Capito (Gell., v. 20) as an unequal and improper arrangement of the parts of speech, that is, as a violation of the rules of syntax. Quinctilian (i., s. 28, &c.) specifies four kinds of solecisms: the first consists in the addition of a superfluous word; the second, in leaving out one that is necessary; the third, in perverting the order of the words of a sentence; and the fourth, in using an improper form of a word. The antients also used the word in a wider sense, understanding by it any kind of fault, error, or mistake, whether made in speaking, writing, or acting. Modern grammarians designate by solecism any word or expression which does not agree with the established usage of writing or speaking. But as customs change, that which at one time is considered a solecism, may at another be regarded as correct language. A solecism therefore differs from a barbarism, inasmuch as the latter consists in the use of a word or expression which is altogether contrary to the spirit of the language, and can, properly speaking, never become established as correct language.

The term solecism was supposed by antient grammarians to be derived from Soli, a town of Cilicia, where the language of the original Greek settlers, who were few in numbers, became corrupt through the influence of the people by whom they were surrounded.

SOLEN. [PYLORIDIANS, vol. xix., p. 145, *et seq.*]

SOLENA'CEA, Lamarck's name for a family of bivalve testaceous mollusks, including the genera *Solen*, *Panopæa*, and *Glycymeris*. [PYLORIDIANS, vol. xix., pp. 145, *et seq.*]

SOLENE'LLA, Sowerby's name for a genus of testaceous bivalve mollusks apparently belonging to the family *Arcacea* of Lamarck, and partaking of the characters of the genus *Nucula* [POLYODONTA, vol. xviii., p. 363], and of the family SOLENACEA.

*Generic Character.*—*Shell* oval, equivalve, sub-equilateral, compressed, covered with a thin shining olive-green epidermis. *Hinge* with many teeth, three or four of which are anterior, and the numerous rest sharp, posterior, lateral, and arranged in a straight line. Two lateral *muscular impressions*. The *pallial impression* with a large sinus. *Ligament* external, prominent, and elongated.

Example, *Solenella Norrisii*. A few specimens of this, the only known species, were dredged up by Mr. Cuming at Valparaiso.

SOLENIMY'A, or SOLEMY'A. [PYLORIDIANS, vol. xix., p. 146.]

SOLENOCURTUS, or SOLECURTUS. [PYLORIDIANS, vol. xix., p. 144.]

SOLE'NODON, a genus of insectivorous mammals established by Brandt on a specimen sent from the island of Hispaniola by Jaeger.

*Generic Character.*—Habit generally between that of *Sorex* and *Didelphys*. Muzzle elongated, the snout smooth, produced, and with nostrils at the sides of its apex. Eyes minute. Ears large, rounded, nearly naked. Body hairy. Stern and upper part of the rump beset with a few very short silky hairs. Feet ambulatory, plantigrade, pentadactylous; claws falcular, those of the fore feet the longest. Teats inguinal? Tail long, smooth, and for the most part scaly.

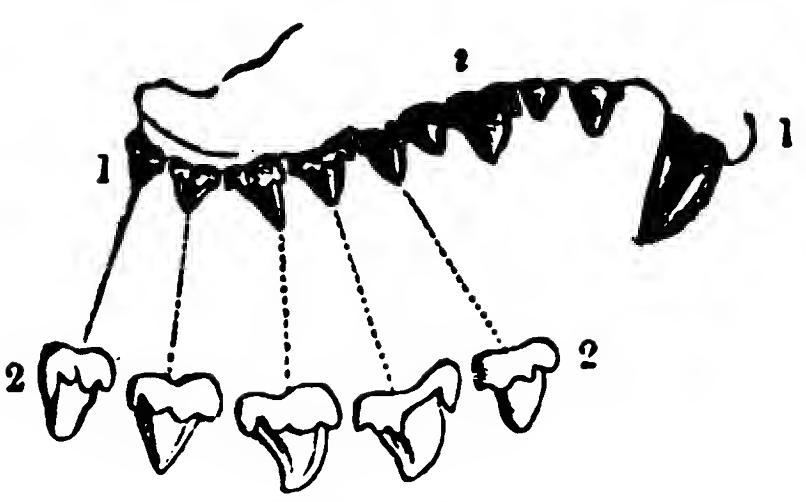
*Dental Formula* —Incisors, $\frac{6}{6}$; molars (spurious $\frac{6}{6}$, true $\frac{8}{8}$) = 40.

The skull of *Solenodon* is considerably elongated: the occipital, parietal, and temporal bones are moderately convex; and the condyles of the occipital are prominent. There is an obtuse crest on the sagittal suture, but none on the coalesced frontal bones. The internal pterygoïd processes alone are conspicuous, thin, and joined by a suture with the perpendicular parts of the palatal bone. There is no bony *bulla*, and, consequently, the interior wall of the tympanic cavity is only closed by skin. There is no zygomatic arch. The coronoïd process of the mandible is dilated and directed outwards. The angle of the mandible is dilated, subtetragonally rounded, and prominent above the condyloïd part.

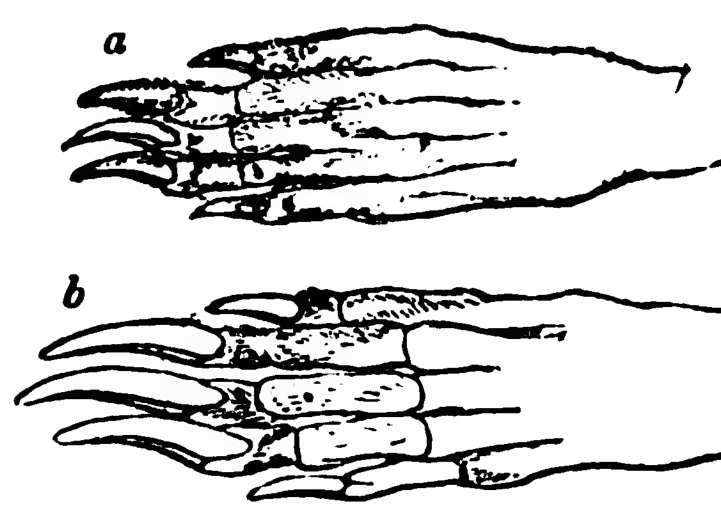
The two anterior upper incisor teeth are the largest, disjoined from the others, perpendicular, and unicuspid: the two anterior lower incisors are very short and very narrow; the two middle are the longest, and conical, and excavated on the internal surface with a rather deep triangular canal. Brandt remarks that the structure of the teeth manifests a greater similitude to that of *Myogale* (Mygale) than any other genus.

Example, *Solenodon paradoxus*.

*Description.*—Sides of the head and neck dilute yellow-brown, mixed with ferruginous, and, occasionally, with grey. Abdomen and feet dilute yellow-brown, with hardly a mixture of grey. Space upon the breast between the anterior limbs dilute ferruginous, extended to the internal side of the feet, and, anteriorly, to the cubit. A similarly coloured space occupies the inguinal region, and also extends upon the anterior part of the legs. Upper part (dorsum) of the muzzle, forehead, vertex, middle of the nape, and anterior part of the back, tinged with black-brown: the rest of the back black-brown, the colour (more diluted) extending towards the posterior part of the sides and towards the external surface of the thighs. The basal and middle part of the scaly tail grey; the apical part white.




a, skull of Solenodon (profile): b, seen from above; c, seen from below: d, mandible or lower jaw; e, anterior part of the intermaxillary bone, with the two anterior incisor teeth; f, anterior surface of an anterior upper incisor tooth; g, anterior parts of the mandible, with the four anterior incisor teeth; h, the crown of a second or middle incisor tooth of the mandible, seen on its internal surface, and exhibiting its triangular canal. The foregoing figures are nearly of the natural size. i. teeth of the upper jaw seen laterally; 1, 1, nat. size; 2, 2, magnified. (Brandt.)




Feet of Solenodon. (Brandt.)

a, anterior part of the anterior foot, seen on the dorsal or upper side; b, a similar view of the anterior part of the posterior foot.

*Habits, &c.*—Brandt remarks that nothing is known of the mode of life of this animal; but from the structure of the proboscis and claws, he concludes that it must burrow. The form of the nose and of the cribriform plate seems, he observes, to indicate a well-developed organ of smell.

The true place of this animal is, most probably, among the SORICIDÆ.

Solenodon paradoxus. (Brandt, 'Memoirs of the Imperial Academy of Sciences of St. Petersburg, 1832-3.)

SOLETELLI'NA. [PYLORIDIANS, vol. xix., p. 144.]

SOLEURE. [SOLOTHURN.]

SOL-FA-ING. [SOLMISATION.]

SOLFATA'RA. [PHLEGRÆI CAMPI.]

SOLICITOR. [ATTORNEY; SIX CLERKS.]

SOLID, SOLIDITY. (Mechanics.) A solid body is one which is composed of matter so connected together that the relative positions of its parts cannot be altered without the application of sensible force. The force which resists the alteration of the relative positions is called force of COHESION: the perfect absence of this force constitute fluidity. [FLUID.]

SOLID ANGLE, a name given to the idea of opening conveyed by three planes which meet at a point. The properties of a solid angle are considered under the head SPHERICAL TRIANGLE.

SOLID, SURFACE, LINE, POINT. (Geometry.) We have thought it best to bring together the remarks which it is necessary to make upon these fundamental terms of geometry. According to Euclid, a point has no dimensions; a line, length only; a surface, length and breadth; a solid, length, breadth, and thickness. No one has the least doubt about each of these terms conveying a clear and distinct notion; in spite of this however, the propriety of the definitions has been made matter of much discussion.

Space being distinctly conceived, parts of space become perfectly intelligible. Hence arises the notion of a boundary separating one part of space from the rest. That a material object, a desk or an inkstand, occupies a certion portion of space, separated by a boundary from all that is external, needs no explanation: this boundary is called surface, and possesses none of the solidity either of the desk or inkstand, or of the external space. Surface itself, when distinctly understood, is capable of division into parts, and the boundary which separates two parts of a surface has none of the surface, either on one side or the other: it therefore presents length only to the imagination. Again, length itself is capable of division into parts: the boundaries do not possess any portion of length, either on one side or the other: they are only partition marks or points. Euclid reverses the order of our explanation, requiring first the conception of a point, then of a line, then of a surface, then of a solid.

That when we think of a point, we deny length, breadth, and thickness; that when we think of a line, it is length without breadth that we figure to ourselves; that in the same manner the surface of our thoughts possesses no thickness whatever—are, to us at least, real truths. We cannot, for instance, imagine what Dr. Beddoes meant when he said (*Obs. on Demonstrative Evidence*, p. 33), 'Draw your lines as narrow as you conveniently can, your diagrams will be the clearer; but you cannot, and you need not, conceive length without breadth.' *Why* are diagrams the clearer, the narrower the lines of which they consist? Diagrams have no clearness in themselves, the comprehension of them is in the mind of the observer. If diagrams having (so called) lines of one-hundredth of an inch in breadth be clearer than others of five-hundredths of an inch, it is because the former approach nearer than the latter to a true representation of that which is in the mind, or of that which the mind desires to see portrayed. If the smaller the breadth the better the diagram in the clearness which it gives to the mind, it must be because the mind would have no breadth at all.

It matters nothing that the point, line, and surface are mechanical impossibilities, that no point or line, if they actually existed, could reflect light to show them, and that no surface could continue to exist for any perceptible time, even supposing it to have one moment of existence. Neither does it signify whether the ideas are necessary, or acquired from the senses; the question in geometry is, Have you got them? not, How did they come? There may be danger that some students should need at first to be frequently reminded of the abstract limits of which the conceptions must be made permanent, lest they should accustom themselves to rest in the imperfect approaches to these conceptions which are realised in their diagrams; but it is always found that a moment's recollection will produce a satisfactory answer to any question upon this point.

There is, it is true, one circumstance in which the pupil may acquire a permanently false notion of the object of geometry. If an instructor should require what is called a very well drawn figure in every case, with very thin *lines* and very small *points*, he may perhaps succeed in giving the learner some idea that geometry consists in that approach to accuracy which constitutes practical excellence in the applications of the science. No idea can be more false: let the good line be examined under a microscope, and it is seen to be a solid mound of black lead or ink, as the case may be. Hence it is perhaps desirable that the demonstrations should be frequently conducted with what are called ill-drawn figures, in order that no reliance may be placed on the diagram, further than as serving to remind the student of the ideal conception which is the real object of his demonstration. This of course is recommended without prejudice to his learning the accurate use of the ruler and compasses for another distinct purpose, namely, the intention of producing *avowedly* approximate practical results.

It is to be noted that these definitions, so called, are in Euclid more than definitions. They appeal to conceptions supposed to exist, in words which are considered sufficient not to give, but to recal, the necessary ideas. This they actually do, to the satisfaction of the learner, who would never dream of their containing anything dubious, if it were not for the ill-advised interference of the metaphysician. Whatever of pleasure or profit there may be in the subsequent union of the sciences, there is, we think, no doubt that the young geometer should not be required to take lessons of the ontologist.

**SOLID, SUPERFICIAL, AND LINEAR DIMENSIONS.** A solid, a surface, and a line, when they come to be the objects of arithmetic, are things as distinct as a weight and a time. That a surface is included by lines, or a solid by surfaces, makes no more of necessary connection between them than exists between weight and time, because the former can never be made sensible without the latter. Length only can measure length, a surface only a surface, a solid only a solid. Reasons of arithmetical convenience, not of necessity, make it adviseable that whatever length may be chosen to measure length, the SQUARE on that length should be the surface by which surface is measured, and the CUBE on that length the solid by which solidity is measured. Unfortunately, if a foot be the measure of length, the square on a foot and the cube on a foot have no other names than *square foot* and *cubic foot*. The farmer with his acres, and the distiller with his gallons, have an advantage which is denied to the young mathematician. Ask the first how many acres make a gallon, and the second how many gallons make an acre, and both would laugh at the question; the third is allowed an indistinct conception of measuring surfaces and solids in feet or inches, as if they were lines, from the occurrence of the same word in all his measures.

Length is said to be a quantity of one dimension, surface of two, and solidity of three. The right line, the right surface or RECTANGLE, and the right solid or rectangular PARALLELOPIPED (the figure of a box, a die, a plank, a beam, &c.), are the implements of mensuration. Every surface must be reduced to the second form, and every solid to the third, before it can be measured. The rules (which tacitly contain these reductions) for measuring different superficial or solid figures will be found under the several heads: the two fundamental theorems by which measurement becomes practicable, are as follows:—

1. The numbers of linear units in the two sides of a rectangle, being multiplied together, give the number of superficial units, square units, or squares on the linear unit which the rectangle contains. Thus a rectangle of $2\frac{1}{2}$ by $4\frac{1}{3}$ feet contains $\frac{5}{2} \times \frac{13}{3}$, or $\frac{65}{6}$, or $10\frac{5}{6}$ *square* feet.

2. The numbers of linear units in the length, breadth, and thickness of a right solid, being multiplied together, give the number of solid units, cubic units, or cubes on the linear unit, which the right solid contains. Thus a plank of $2\frac{1}{4}$ inches broad, $1\frac{1}{2}$ inch thick, and $10\frac{1}{3}$ inches long, contains $\frac{9}{4} \times \frac{3}{2} \times \frac{31}{3}$, or $\frac{279}{8}$, or $34\frac{7}{8}$ *cubic* inches.

**SOLIDS, REGULAR.** [REGULAR FIGURES, &c.]

**SOLIMAN, EBN ABD-AL-MALEK**, the seventh caliph of the race of the Ommiyades, succeeded his elder brother Walid I., A.D. 715 (A.H. 96). He acquired high popularity at the commencement of his reign by dismissing the various governors whom the inertness of Walid had suffered to oppress the people at their pleasure; and Katibah, the first Moslem conqueror of Transoxiana, who alone refused to acknowledge his authority, was seized and put to death by his own soldiers. Another of his lieutenants, Yezid Ebn Mohalleb, reduced the rugged and impenetrable provinces of Tabrestan and Jorjan, on the south coast of the Caspian, which had never before been completely subdued. But the principal military undertaking of his reign was the siege of Constantinople, commenced the year after his accession, by a vast fleet and army under his brother Moslemah. (Gibbon, c. 52.) But the Saracen fleet was destroyed by the Greek fire; the strength of the fortifications reduced the siege to a blockade; and the caliph was preparing to lead a second army to reinforce his brother when he died of a surfeit at Chalcis in Syria, A.D. 717 (A.H. 99), nominating in his last moments his cousin Omar Ebn Abd-al-Azez as his successor, to the exclusion of his own sons and brothers. The reign of Soliman is said to have been the epoch of the first rise of the Barmecides, who afterwards became famous as the ministers of the Abbasides.

**SOLIMAN, EBN AL-HAKEM**, a Moorish chief, who, in the civil wars preceding the extinction of the caliphate of the Ommiyades at Cordova, possessed himself of the capital by the aid of the African troops whom he commanded, and proclaimed himself king, A.D. 1009 (A.H. 400), under the title of Al-Mostain Billah. Though soon expelled by Mohammed, one of the Ommiyan competitors, he recovered Cordova in 1112, dethroning Hesham II., who had been replaced on the throne on the death of Mohammed: but his valour and abilities were not able to maintain him in his usurped authority: the *walis*, or governors of the African and Spanish provinces, refused obedience; and after various changes of fortune, he was overthrown and slain, A.D. 1016 (A.H. 407), by Ali Ebn Hamid, *wali* of Tangier, who was proclaimed king in his room, but speedily perished by another revolution. The first discovery of the Azores has been attributed to the reign of this prince, on the authority of a passage in the 'Geography' of Sherif-Al-Edrisi; but it is not very clear that the Azores are the islands there alluded to as discovered by some Moslem adventurers from Lisbon. D'Herbelot erroneously mentions Soliman as the nephew of Hesham II., whereas he was a stranger to the blood of the Ommiyades.

**SOLIMAN EBN CUTULMISH**, a Seljookian prince who founded the first Turkish dynasty in Room, or Asia Minor. His father had perished in a revolt against Alp-Arslan, the great Seljookian sultan of Persia; and Malek-Shah, the son of Alp-Arslan, was glad to rid himself of the turbulent ambition of Soliman by furnishing him with an army for the conquest of the West, A.D. 1074 (A.H. 467). The internal dissensions of the Greeks facilitated his progress. In a few years he had subdued nearly all Asia Minor except the districts on the western coast and the isolated city of Trebizond; his capital was fixed at Nicæa, within 100 miles of Constantinople, and his Turkoman followers spread themselves all over the country, which was thenceforward permanently lost to Christendom. Antioch (which had been held by the Greeks since its capture by John Zimisces in 968) was betrayed to him (1084) by the son of the governor; but this acquisition brought on a rupture between Soliman and Moslem-Ebn-Koreish, prince of Aleppo, to whom the Greeks had paid a tribute for Antioch, which Soliman refused to continue. Moslem was defeated and killed; but in attempting to pursue his advantage and occupy Aleppo, Soliman was opposed and overthrown by Sultan Tutush, viceroy of Syria for his brother Malek Shah (whose vassal Moslem had been), and either fell in the battle, or, as some say, perished by his own hand, A.D. 1086 (A.H. 479). His sons were however restored by Malek-Shah to the kingdom of Room, where one of them, Kilidj-Arslan, was reigning at the appearance of the first Crusaders, who erroneously call him Soliman.

SOLIMAN (often mentioned with the surname of Tchelibi, 'gentle or noble,' which is however the general title of the sons of the Ottoman sultans) was the eldest surviving son of Bayezid I. After the fatal battle of Angora, in which his father was defeated and made prisoner by Timour, A.D. 1402 (A.H. 804), he effected his escape to Europe with the vizir Ali Pasha, and reigned several years in tranquillity at Adrianople, while the fragments of Asia Minor were disputed by his three brothers. He was frustrated however in an attempt to possess himself of the Asiatic provinces (1406) by an insurrection excited against him at home by his brother Mousa, which recalled him to Europe. Mousa was defeated, and fled into Wallachia, but he returned in 1410 with a fresh army, and Soliman, surprised in Adrianople, was slain in his flight. Mousa was himself dethroned three years later by Mohammed I., under whom the Ottoman dominions were reunited.

Soliman is not generally included in the list of the Turkish sultans, the interval between the death of Bayezid and the final establishment of Mohammed being regarded as an interregnum. He was a brave and generous prince, and the first of the line of Othman who patronised literature; but his good qualities were obscured by his excessive indolence and indulgence in wine.

SOLIMAN (surnamed by the Turks *Kanooni*, or 'the Legislator,' and by European writers 'the Magnificent'), the tenth and greatest of the Ottoman sultans, succeeded his father Selim I., A.D. 1520 (A.H. 926), in the twenty-seventh year of his age; and as he was an only son, his succession was not disturbed, like those of his father and grandfather, by civil wars. His first exploit was an invasion of Hungary (1521), in which he captured Belgrade, the key of that kingdom, a conquest often attempted in vain by his predecessors; and in the following year Rhodes, which had defied all the efforts of Mohammed II., was surrendered to him after an arduous siege, by the knights of St. John. The suppression of a rebellion in Egypt, and of a revolt of the Janissaries (as a counterpoise to whom the corps of Bostandjis was instituted), occupied the next three years; but in 1526 Hungary was again invaded; the king, Lewis II., and nearly all his army, slain in the fatal battle of Mohacz, and the whole kingdom overrun by the Turks. The Hungarian crown was conferred by Soliman on John Zapolya, who received it as a vassal of the Porte: but the rival pretensions of Ferdinand of Austria kindled the first of the long wars between the sultans and the German emperors; and in 1529 Vienna was besieged without success by Soliman in person. A war with Persia followed, in which Armenia and Irak, with the cities of Tabreez and Bagdad (1534), were subdued by the Ottomans; while Yemen and the Arabian coast were subjugated by the pasha of Egypt, and armaments sent even into Guzerat to aid the Indian Moslems against the Portuguese: the fleets of the vassal states of Barbary, under the famous corsair Khaireddin, or Barbarossa, at the same time swept the Mediterranean, and laid waste the Italian coasts; and Croatia was conquered (1537) after a great victory over the Imperialists at Essek. The Turkish arms were everywhere triumphant, and the powerful friendship of Soliman was courted by Francis I. of France, the alliance with whom (1536) was the first between the Porte and any Christian power. The death of John Zapolya (1541) wrought a fresh change in the affairs of Hungary, great part of which was seized by the Turks; Buda became the seat of a pasha; and the war continued, generally to the advantage of the Sultan, till a truce was concluded in 1547, by which Austria agreed to pay a tribute of 30,000 ducats for her remaining possessions in Hungary. In the same year a fresh invasion of Persia led to the capture of Ispahan; but this conquest was not long retained. The war with the house of Austria for Hungary again broke out in 1552; and Transylvania was subdued and made a principality under the suzerainte of the Porte. Persia was again attacked, and Erivan taken in 1554; but a peace was concluded with the Shah in the following year, which became the basis of all subsequent treaties between the two powers.

A great naval victory was gained in 1560, over the combined fleets of the Christian powers at Djerbeh, on the African coast, by Piali, who had succeeded, on the death of Barbarossa, to the command of the Turkish navies; and a fresh truce with the empire (1562) left the Turks in possession of their Hungarian conquests. But the martial glories of Soliman were clouded by domestic dissensions. His eldest son, Mustapha, had been put to death in 1553, at the instigation of his stepmother Roxalana, who was solicitous to secure the succession for one of her own children; and jealousies of the two surviving princes, Selim and Bayezid, having ended in the rebellion of the latter, he was defeated and driven into Persia; but the Shah surrendered the fugitive on the demand of Soliman, and he was put to death with his children (1561).

The united fleets of the Porte and of Barbary had ruled the Mediterranean since the battle of Djerbeh; but they were repulsed with great loss in the siege of Malta (1565) by the heroism of the grand-master John de la Valette. The war in Hungary meantime continued, notwithstanding frequent partial pacifications; and in 1566 Soliman headed his armies for the last time for its invasion; but he died in his tent before the walls of Szigeth, September 5, 1566 (Safar 20th, A.H. 974), the day before the capture of the town, at the age of 72 solar (or 74 lunar) years. His only surviving son, Selim II., succeeded him.

Though the Ottoman empire did not fully attain its greatest territorial extent during the reign of Soliman, its military power was undoubtedly during this period at its greatest height and most complete organization, and declined irrecoverably in both these respects under his indolent and voluptuous successors. The personal energy of the Sultan himself, and of the ministers and generals selected by him and trained under his eye, maintained the efficiency of every branch of the administration; and the Kanoon-Nameh, or code of regulations, which was drawn up under his own superintendence, completed the reform which his exertions had commenced. The finances, the military fiefs, the functions of the pashas and other employés, the police and administration of justice, are all treated at length in this elaborate compilation, which long formed the basis of both the jurisprudence and political science of the Ottomans. But Soliman was not less distinguished as a patron of literature and the arts than as a warrior and a legislator; the erection of the noble mosque of the Solimaneyeh, and of numerous public buildings both in the capital and the provinces, attest his architectural magnificence; and he is the only one of the Ottoman sovereigns who facilitated the internal communications of his dominions by the construction of roads and bridges. He was himself a poet of no mean rank; and the encouragement which he afforded to the employment of the Turkish language in place of the Persian, which the Ottomans had generally chosen as the vehicle of their sentiments, forms an æra in the literature of the country. In an age remarkable for the eminent greatness of the monarchs filling the thrones of Europe, few of them equalled Soliman the Magnificent either in the union of princely qualities or in the glory and good fortune of their reigns.

SOLIMAN II., a younger son of Sultan Ibrahim, was placed on the Ottoman throne A.D. 1687 (A.H. 1098), on the deposition of his elder brother, Mohammed IV. He was nearly forty-six years of age at his accession, and had passed his whole life secluded in the seraglio and occupied by the study of the Korán. A prince thus unacquainted with active life was little fitted to stay the progress of the Imperialists, who in the last years of the preceding reign had almost expelled the Turks from Hungary. In the campaign of 1688 Belgrade and Agria were lost; and in 1689 the vizir Ragib was twice signally defeated by the Austrians, who penetrated into the heart of Servia and took Nissa. An abortive negotiation for peace followed; but the appointment of Mustapha-Pasha Kuprilu to the vizirat changed the face of affairs, and in the two succeeding campaigns the Ottomans recovered Belgrade and most of the frontier fortresses. Soliman however died at Constantinople in June, 1691 (A.H. 1102), after a reign of three years and nine months; and leaving no children, was succeeded by his next brother, Ahmed II.

SOLI'NUS, CAIUS JU'LIUS, a Roman writer of whose life and period nothing is known. It is however certain that he did not write in the Augustan age, as some have supposed, for his work, entitled 'Polyhistor,' is merely a compilation from Pliny's 'Natural History.' Indeed Salmasius says (*Prolegomena*) that the work contains nothing which is not found in Pliny, and that he got together all that he could out of Pliny's work, and put it in his compendium, keeping the same arrangement and nearly the same words. Solinus however never mentions Pliny, though he cites near one hundred authors. Salmasius endeavours to show that he lived about two hundred years after Pliny. The first writers who mention him are Hieronymus and Priscian. It has often been said, and even in very recent works, that the researches of Salmasius prove that there were two editions of the 'Polyhistor.' But we certainly do not need the testimony of Salmasius to this point, as it is correctly observed in the article 'Solinus' (*Biog. Univ.*); for Solinus, in his address to his friend Adventus (according to some readings) says that the first edition was a hasty performance, and that it appeared under the title of 'Collectanea Rerum Memorabilium;' and that he gave the name of 'Polyhistor' to his second and improved edition. The work of Solinus contains a great variety of miscellaneous matter, of which a large part is geographical. His style deserves no great commendation, but it is sufficiently perspicuous. Some fragments of a poem entitled 'Pontica' have been attributed to him, but it has recently been attempted to be shown that this poem is the work of Varro Atacinus.

The first edition of Solinus is probably that of Rome about 1473; but one also appeared about the same date at Milan, edited by Bonini Mombriti. The pains that have been taken with a work of little value are shown by the number of editions. The principal edition is that of Salmasius, 2 vols. fol., Paris, 1629; and 2 vols. fol., Utrecht, 1689; a work, says Morhofius (*Polyhistor*, ii., c. 2), accompanied with a most enormous commentary, in which the editor has collected all that he could find in the antient writers on the topics which Solinus discusses, and has given also his own opinions; but the editor, as usual, did his work in a hurry, and made various blunders, which a little more attention might have prevented.

There is an English translation of Solinus, by Arthur Golding, London, 1587 and 1590. The title of the former edition is, 'The Excellent and Pleasant Worke of Julius Ca. Solinus, Polyhistor, containing the Noble Actions of Human Creatures, &c.'

SOLIPE'DES, Cuvier's name for his third family of PACHYDERMATA, which have only one apparent toe and a single hoof on each foot, although under the skin these quadrupeds have on each side of their metacarpus and metatarsus *stylets* which represent two lateral toes. The genus *Equus* of Linnæus is the only recent form belonging to this family known. [HORSE.] The extinct HIPPOTHERIUM may find a place under it.

SOLI'S, JUAN DIAZ DE, a Spanish navigator, was born at Lebrixa, the antient Nebrissa, in the province of Seville. In 1506 he sailed, in company with the celebrated pilot Vicente Yañez Pinzon, on an expedition, the object of which was to endeavour to find the strait or passage supposed by Columbus to lead from the Atlantic to a southern ocean. As no such passage exists, this of course proved unsuccessful, as did also another voyage which was undertaken by them for the same purpose in 1508. They however explored the northern coast of South America, and are supposed to have discovered Yucatan. On their return to Spain, Solis and Pinzon were appointed royal pilots, and again entrusted with the command of an expedition for the discovery of new lands. This time they doubled Cape St. Augustine, and sailing southwards along the coast, reached the 40° of S. lat. However, on their return to Seville in 1509, the court was so much displeased with the unprofitable result of the expedition, that they were both deprived of their offices and emoluments, and Solis was put in prison. In 1512 Solis applied for and obtained permission to sail on a voyage of discovery; but as the government would not grant him any assistance, he was obliged to raise among his friends the funds required for the expedition. After touching at Teneriffe, he surveyed Cape St. Roque, then Cape St. Augustine; continuing his route to the South, he discovered Cape Frio, and entered the Bay of Rio Janeiro. Thinking this to be the strait in search of which he had sailed, Solis took possession of the northern coast in the name of the king of Castile, and gave the name of Mar Fresca (Fresh sea) to that portion of the Atlantic which lay before him. Proceeding farther along the coast, he saw several Indians, who told him of a river called Paraguaya, *i.e.* great water, on the banks of which gold was said to be found in large quantities. Satisfied with this information, Solis returned to Spain, and having obtained the requisite leave to undertake the conquest of the lands watered by that river, he sailed on the 8th of October, 1515, with three caravels, having seventy soldiers on board. On his arrival at Rio Janeiro, Solis left two of his ships behind, and sailed with the third in a south-western direction in search of the Indians with whom he had conversed on his first voyage. He found them; but scarcely had he landed with the greater part of his crew, when they were surrounded and put to death by the Indians. This catastrophe happened near a small river between Maldonado and Montevideo, which to this day is called 'El Rio de Solis.'

SOLI'S, ANTONIO DE, was born at Placenzia, July 18, 1610, of an antient and illustrious family. His parents sent him to Salamanca to study the law; but having a natural turn for poetry, he gave it the preference, and cultivated the muses with great ardour and success. At the age of seventeen, and when still a student, he wrote a comedy called 'Amor y Obligacion' (Love and Duty), which was received with the highest applause. This introduced him to the notice of Calderon, with whom he was afterwards very intimate, occasionally writing the preludes to his dramas. At six-and-twenty Solis applied himself to ethics and politics, as well as to the history and antiquities of his native country. His great merit procured him a patron in the count of Oropesa, then viceroy of Navarre, and who appointed him his secretary. Solis seems to have taken particular delight in recording the virtues of his Mæcenas, whom he highly praises in several of his poems. On the birth of one of his sons he composed an heroic drama called 'Orpheo y Eurydice,' which was acted at Pampeluna during the festivities celebrated by the municipality on that occasion. In 1642 Solis was appointed to a lucrative office in the secretary of state's department, and subsequently raised to the honourable post of secretary to Philip IV. It was then, and in order to celebrate the birth of a son of this king, that Solis composed one of his best comedies, 'Triumfos de Amor y Fortuna' (Triumphs of Love and Fortune), which met with the most brilliant success. After the death of Philip, Solis was named to the office of *cronista de las Indias*, or first historiographer of the transactions of the Spaniards in both Indies. In this capacity he wrote his 'Historia de la Conquista de Mexico,' a work which has ranked him among the best prose writers of Spain, and which was greatly esteemed at home and abroad. It contains an account of the conquest of Mexico by Hernando Cortés, written with great spirit and in very elegant style, though it is deficient in the criticism which belongs to a true historical writer. The work is considered by the Spaniards as the last relic of their classic literature. It appeared for the first time at Madrid in 1682, folio, and went subsequently through several editions, of which the principal are: Barcelona, 1691, fol.; Madrid, 1777 and 1783, 4to.; Venice, 1704, 4to.; London, 1808, 2 vols. 8vo. We have an English version of it by Townsend (Lond., 1724), and there are besides French and Italian translations.

Solis is better known out of Spain as an historian than as a dramatic writer, yet he occupies a prominent place among the poets of that nation. His plays do not display so much invention as those of Calderon, but his dramas are more regular than those of that poet, because he was less liable to be led away by the force of his imagination. Among his comedies, 'El Alcazar del Secreto' (the Castle of Mystery), and 'La Gitanilla de Madrid' (the Gipsy-girl of Madrid), which is partly founded on Cervantes's novel of the same title, are justly much valued. His comedy 'Un Bobo haze Ciento' (One Fool will make a Hundred) has, with many others, been imitated by the French dramatic writers. A volume of Solis's plays and dramas, in all fourteen, appeared at Madrid in 1732, 4to. There is also a volume of Lyric Poems written by him on various subjects, 'Varias Poesias de Don Antonio de Solis,' Madrid, 1682, 4to.; and some letters published by Mayans in 1732. At the age of fifty-six Solis entered into holy orders, and devoted himself almost exclusively to exercises of devotion. He now renounced all profane compositions, and wrote nothing but some dramatic pieces upon sacred subjects. He died April 19, 1686. His friend Juan de Goyeneche wrote an account of his life and writings, which appeared for the first time at Brussels in 1704, with the 'History of the Conquest of Mexico,' and has been prefixed to almost every subsequent edition of the same work.

SOLITA'RIUS (the Hermit), an obscure constellation of Lemonnier, which, having been admitted into the Astronomical Society's lists, appears here. It is situated a little above Centaurus, near the tail of Hydra. Its principal stars are as follows:—

| Character. | No. in Catalogue of Piazzi. | No. in Catalogue of Astron. Society. | Magnitude. |
|---|---|---|---|
| | (68) | 1633 | 6 |
| α | (116) | 1647 | 7 |
| | (190) | 1566 | 7 |
| | (206) | 1576 | 7 |
| ι | (282) | 1716 | 6 |

SO'LLYA, a genus of plants of the natural family of Pittosporeæ, named by Dr. Lindley in compliment to R. H. Solly, Esq., a gentleman versed in the anatomy and physiology of plants, and well known as a patron of science and art. The genus is closely allied to Pronaya and Billardiera, and the species are highly ornamental plants, which are indigenous in New Holland and Van Diemen's Land, with voluble stems, oblong alternate, shining, dark-green leaves, with the flower-stalks terminal, or opposite to the leaves, and bearing bunches of bright-blue nodding flowers. *S. heterophylla* and *S. angustifolia* are two common species cultivated in our greenhouses, and were very common everywhere until the severe winter of 1837-38.

SOLMISATION, or *Sol-fa-ing*, in singing, is the art of applying to the seven notes of the scale certain syllables, having no meaning in themselves, but containing the five first vowels, according to the French method, and the four first according to the system adopted by the Italians and English.

This art was practised by the Greeks; but the six syllables now in use are generally attributed to Guido d'Arezzo. [GUIDO D'AREZZO.] These he selected, on account of their furnishing all the vowel sounds, from the following stanza of a monkish hymn to St. John the Baptist:—

'*Ut* queant laxis,
*Re*sonare fibris
*Mi*ra gestorum
*Fa*muli tuorum
*Sol*ve polluti
*La*bii reatum
SANCTE JOANNES.'

In what is called the hexachord system [HEXACHORD], these syllables were found sufficient. When, however, that perplexing and absurd method began to be disused, the addition of a name for the seventh of the scale became necessary, and Le Maire, a French musician of the seventeenth century, has the credit of having introduced for this purpose the syllable *si*. The Italians rejected the French *ut*, and substituted the more euphonous syllable *do*, which is also adopted in England. The syllables therefore now used by the Italians and English—at least by such masters as understand and know how to value the art of Solmisation—are as follows:—

Do, Re, Mi, Fa, Sol, La, Si, Do.
C, D, E, F, G, A, B, C.

To these syllables the English give the Italian pronunciation.

SOLOMON (שְׁלֹמֹה, Σαλωμών, Σολομῶν), the son of David and Bathsheba, was born B.C. 1033, and was named by God, through the prophet Nathan, 'Jedidiah,' that is, 'beloved of the Lord.' (2 *Sam.*, xii. 24, 25.) In the old age of David, his son Adonijah attempted to seize the kingdom, upon which David had Solomon proclaimed and anointed king, B.C. 1015. (1 *Kings*, i.; 1 *Chron.*, xxiii.) In the same year David died, after giving certain charges to Solomon. (1 *Kings*, ii.) The first acts of Solomon were to punish the enemies of David, and especially Adonijah and his adherents. He then contracted a close alliance with Pharaoh, king of Egypt, whose daughter he married. Being thus strengthened in his kingdom, he assembled all the congregation of Israel at Gibeon, where the Tabernacle stood, and offered burnt offerings to God. In the same night God appeared to him, and commanded him to ask what he would. Solomon asked for wisdom and knowledge, that he might judge the people. God was pleased with the request, and promised him not only the wisdom which he asked for, but also riches and long life, and power over his enemies. Solomon's wisdom was soon displayed in his decision of a singular case which came before him for trial. (1 *Kings*, iii.; 2 *Chron.*, i.)

The kingdom of Israel was now at its highest pitch of prosperity and extent. It reached from Egypt and the borders of the Philistines to the Euphrates, and southward as far as the head of the Red Sea. With the neighbouring kings of Egypt and Tyre, which city then held the supremacy of Phœnicia, Solomon was in close alliance. The people of Israel were very numerous and prosperous, and enjoyed profound peace; and the court of Solomon was maintained on a scale of the greatest splendour, which was supported by the encouragement that he gave to commerce, by which 'he made silver and gold as stones, and cedar-trees made he as the sycamore-trees that are in the vale for abundance.' The fame of his wisdom spread abroad, and people and kings came from all countries to hear it, for 'he spake three thousand proverbs, and his songs were a thousand and five. And he spake of trees, from the cedar-tree that is in Lebanon even unto the hyssop that springeth out of the wall: he spake also of beasts and of fowl, and of creeping things, and of fishes.' (1 *Kings*, iv., x.; 2 *Chron.*, ii., 13-17; ix.)

In the fourth year of Solomon's reign, having secured the co-operation of Hiram, king of Tyre, he began to build the Temple of God at Jerusalem, for which David had already formed a plan and collected treasures, but which he had not been allowed to build because he was a man of blood. (1 *Chron.*, xxii., xxviii.) In seven years (B.C. 1005) the building was finished and dedicated to God. (1 *Kings*, v., viii.; 2 *Chron.*, ii.-vii. [TEMPLE.] On this occasion God appeared to Solomon in a vision the second time, and promised that if he continued in piety and uprightness, his family should be established on the throne; but that if he or his children should fall into idolatry, Israel should be cut off out of their land, and both they and the Temple itself should be made a proverb and by-word among all people. (1 *Kings*, ix. 1-9; 2 *Chron.*, vii. 12-22.)

Josephus (*Antiq.*, viii. 2, 8) states that copies of the letters which passed between Solomon and Hiram concerning the building of the Temple were preserved in his day among the archives of Tyre.

Solomon adorned Jerusalem with other magnificent buildings. He built a palace for himself, which took thirteen years to complete; and another palace, which was called the House of the Forest of Lebanon, probably on account of the quantity of cedar used in it, with porticoes where he sat in judgment; and also a palace for his wife, the daughter of Pharaoh. (1 *Kings*, vii. 1-12; 2 *Chron.*, viii. 1.) He also built several cities, and among them Tadmor in the wilderness, which was afterwards called Palmyra; but the splendid ruins which still exist belong to the age of the Roman empire. (1 *Kings*, ix. 15-19; 2 *Chron.*, viii. 1-6.) In all these buildings he used as workmen the descendants of the Canaanites who remained in the land, whom also he made to pay a tribute: the Israelites he employed in his armies, and in superintending the works. (1 *Kings*, ix. 20-23; 2 *Chron.*, viii. 7-10.) He built a navy at Ezion-geber, which brought him the produce of Arabia and India. (1 *Kings*, ix. 26-28; x. 11, 12; 2 *Chron.*, viii. 17-18. [OPHIR.] He had also another navy in the Mediterranean, in company with a navy of Hiram, which made a voyage to Tarshish every three years, bringing gold, silver, ivory, apes, and peacocks. (1 *Kings*, x. 22, 23; 2 *Chron.*, ix. 21.) From Egypt he imported horses and linen-yarn. (1 *Kings*, x. 28, 29.)

While Solomon was thus at the height of his prosperity, he received a visit from the queen of Sheba, or Saba, in Ethiopia, who had heard of his wisdom and came to prove it with hard questions, to which Solomon gave such answers that she confessed that the half of his wisdom had not been told her, and departed after an exchange of presents. (1 *Kings*, x.; *Matt.*, xii. 42.)

Solomon's prosperity was at length too much for him. Among his magnificent establishments was a large harem, composed, in direct opposition to the divine command, of women from the remnant idolatrous nations of Canaan. These women seduced him into idolatry, as a punishment for which God threatened to divide his kingdom after his death; and even during his life signs were given of the coming calamity in the rebellion of Hadad the Edomite, Rezon, king of Syria, and Jeroboam, the son of Nebat, who afterwards became king of the ten revolted tribes of Israel. (1 *Kings*, xi.; *Nehem.*, xiii. 26.)

It is generally supposed that this threat had the effect of recovering Solomon from his idolatry, and that he then recorded in the book of *Ecclesiastes* his confessions of the vanity of worldly wisdom, riches, and honour. This supposition is rather favoured by the internal evidence of the narrative in the book of *Kings*, and by that of the book of *Ecclesiastes* itself Among the other works ascribed to him are the 'Book of Proverbs,' of which he must be regarded as the compiler rather than the author [PROVERBS], the SONG OF SOLOMON, the *Wisdom of Solomon* [SOLOMON, WISDOM OF], the *Psalms* lxxii and cxxvii, and also a collection of eighteen psalms, entitled 'The Psalter of Solomon,' which was found in Greek, in the library at Augsburg, by Schott, and translated into Latin by De la Cerda, and which are generally supposed to be the composition of some Hellenistic Jew, in imitation of the Psalms of David. Other writings ascribed to Solomon are mentioned by Suidas (s. v. 'Εζεκίας), by Euseb. (*Praepar. Evang.*, ix. 31). See also Fabric., *Cod. Pseudepigraph.*, I. 914, &c.; 1014, &c.; Bartolocc., *Bibl. Rabb.*, i. 490, &c. Solomon died in the year 975 B.C., after a reign of forty years. (1 *Kings*, xi. 42, 43; 2 *Chron.*, ix. 30, 31.)

The reign of Solomon was the period of the highest prosperity of Israel and the commencement of its decline, both in its religious and civil state. At its commencement the kingdom had reached its utmost boundaries, and was in the enjoyment of profound peace and plenty, and the temple of God was built and dedicated; but before its close the king had turned idolater, rebellion had broken out, and the kingdom was on the eve of a partition. The causes of this decline are obvious. They were in part judicial, for in the magnificent establishments of Solomon, especially in his treasures, his horses and chariots, and his concubines, he had transgressed the fundamental law which defined the duties of the king. [MOSES, p. 441.] But natural causes also may easily be found. The government of Solomon was calculated rather to promote the splendour of the court than the prosperity of the people. The wealth derived from commerce went into the king's treasury, and the people were even taxed in addition. (1 *Kings*, xii. 4, 10, 11.) The court set the example of luxury, which weakened and depraved the whole nation, besides training up that race of insolent young nobles whose bad advice to Rehoboam was the immediate cause of the partition of the kingdom. (1 *Kings*, xii. 6-11.) The subject nations were of course ready, especially after forty years of peace, to throw off the yoke, and it has even been doubted whether the splendid scale on which Solomon established the Temple worship was likely to support the national religion. On the whole, therefore, this period of the history of Israel must be regarded as far less solid than splendid.

Solomon has always had an extensive fabulous reputation in the East. As early as the time of Josephus magical powers were ascribed to him (*Antiq.*, viii. 2, 5: comp. Origen, *Ad Matth.*, xxvi. 63; Nicet. Chon., *Annal.*, iv. 7). The similar traditions of the Arabians concerning him have been collected by Mr. Lane (*Thousand and One Nights*, Index, under *Suleymán Ibn Dáood*).

(Winer's *Biblisches Realwörterbuch;* Calmet's *Dictionary.*)

SOLOMON, THE WISDOM OF (Σοφία Σαλώμων), an apocryphal book of the Old Testament, ascribed to Solomon, but manifestly written long after his time. It is not known to have ever existed in Hebrew, and it contains Greek ideas and expressions which prove it to belong, if to a Jew at all, to one of the Alexandrian school. There are in it historical references utterly at variance with the state of things in Solomon's reign, and quotations from Isaiah and Jeremiah. Internal evidence would point to the end of the second or beginning of the first century B.C. as the time of its composition. It is commonly ascribed to Philo the Jew, but the style is quite different from his genuine writings. It was badly translated into Latin before the time of Jerome, who did not revise the version. The fathers of the church considered it apocryphal; but it was pronounced canonical by the third council of Carthage (A.D. 397) and again by the council of Trent.

It consists of two parts. The first part (chap. i.-ix.) contains the praise of wisdom, an exhortation to all, and especially to kings, to seek it, and the manner in which it is to be obtained. The second part (chap. x.-xix.) brings forward examples from history of the happiness that springs from wisdom and the misery entailed by folly. Throughout the book Solomon is represented as speaking; and the work is evidently an imitation of his proverbs. It is remarkable as being the earliest Jewish work extant which contains a clear statement of the doctrine of rewards and punishments in a future state.

Bishop Lowth says (*Praelec.*, xxiv.): 'The style is very unequal; it is often pompous and turgid, as well as tedious and diffuse, and abounds in epithets, directly contrary to the practice of the Hebrews; it is however sometimes temperate, poetical, and sublime. The construction is occasionally sententious, and tolerably accurate in that respect, so as to discover very plainly that the author had the old Hebrew poetry for his model, though he fell far short of its beauty and sublimity.' (The *Introductions* of Jahn and Horne.)

SOLOMON, THE SONG OF, or THE BOOK OF CANTICLES (שִׁיר הַשִּׁירִים; Ἄισμα ᾀσμάτων, 'Canticum Canticorum,' which titles mean 'The Song of Songs,' that is, 'the most beautiful song'), a canonical book of the Old Testament.

The canonical authority of this book has been much disputed. It is now admitted on all hands that it formed part of the Jewish canon. It is found in the oldest Christian catalogues of the sacred books, and in all the antient versions. The argument that it is not quoted in the New Testament is of little weight against this mass of external evidence. The same objection would apply to other parts of the Old Testament. And although the book is not actually quoted, yet the canonical writers of both Testaments employ the same imagery which is used in it to describe the connection between Christ and the church. Some critics have indeed found passages in the New Testament which they conceive to contain designed allusions to passages in the *Canticles*, but it must be confessed that in most of these examples the allusion is not very obvious. The objections to its canonical authority are now therefore derived solely from its internal character, and may be summed up in the following argument: that the book cannot form a part of Holy Scripture, since it contains no religious truth, unless we interpret it after a fashion for which there is no authority.

The book is a poem, or collection of poems, describing in imagery, which is certainly warm, but to an Oriental taste perfectly delicate, the chaste loves of a bridegroom and his bride. It bears the name of Solomon in its title, 'The Song of Songs, which is Solomon's;' and is supposed to be the only remaining one of the thousand and five songs which we are told that that monarch composed. According to the common opinion it was composed as an epithalamium at the marriage of Pharaoh's daughter with Solomon, who are respectively the bride and bridegroom of the poem; but under the guidance of divine inspiration it was so constructed as to form a mystical allegory representing the relation between Christ and his church.

First then with respect to its date and author. An attempt has been made, supported by the authority of Kennicott, to prove the poem later than the Babylonish captivity simply from the insertion of the letter *Yod* in spelling the name of David, which was the spelling adopted after the Captivity, but not before. But as the name in question occurs only once, and as all our MSS. of the Hebrew Bible are comparatively modern, what is more probable than that the *Yod* was inserted by mistake in an early copy, and afterwards retained by transcribers? Whether this be the true explanation or not, Kennicott's argument is of no weight against the clear allusions to Solomon in the poem, and the circumstances connected with his history, which prove that it must have been written in his time (i. 5, 9; vi. 12; iii. 9, 10, &c.).

The style and language are not more different from that of the 'Book of Proverbs' than might be expected from the difference of the subjects. But the structure and content of the poem are alleged as presenting insuperable obstacles to the supposition that Solomon was the author. It is contended that the scene is laid among the beauties of the open country, and not amongst courts and palaces; and that so far from the bridegroom's portions of the poem being an expression of Solomon's feelings, they are the language of an humbler and happier man, who only refers to Solomon to contrast his numerous concubines and unbounded wealth with the treasure he himself possesses in his sole and undefiled spouse. (vi. 8-10; viii. 11, 12.) But besides those passages which appear to place the scene in the country, others might be quoted which refer to the splendours and luxuries of a royal palace; and some which seem to have a direct allusion to Solomon's establishment, as it is represented to us in history; and the passages which are thought to cast reflections upon Solomon are quite capable of a different interpretation. Again, with reference to the bride, it is contended that the poem itself proves her to have been not an Egyptian princess, but an Israelite. This point is very strongly if not conclusively brought out by Dr. Mason Good. On all these points the difficulty is much increased by the highly coloured imagery of the poem. But the first difficulty may perhaps be explained by supposing one or more changes of scene: there seem in fact to be several. The question respecting the person designed to be represented by the bride, it has been attempted to solve in various ways. A writer in the 'Foreign Quarterly Review' (vol. xvi., p. 321) has adduced certain Egyptian hieroglyphics in support of the common opinion that Pharaoh's daughter is referred to. Dr. Mason Good imagines that the poem describes a *love-match* which Solomon made with some Israelitish woman after his *political* marriage with Pharaoh's daughter. A third mode of explanation, which if adopted would cut the knot, is that of Dr. James Bennett, who supposes that the poem never had any literal reference at all to an actual marriage, but is purely an allegory descriptive of the mutual love of Christ and his church. The reasons which Dr. Bennett adduces to prove that the poem would be most unsuitable to the circumstances of an actual marriage, are, to say the least, extremely fanciful but the great principle for which he contends is one which the generality of critics admit in a case very nearly parallel to the present, namely, the 45th Psalm. But the minute allusions, especially those to Solomon, which are contained in this poem, are a most formidable objection to such an explanation; and even those critics who contend most strongly for the purely allegorical character of the 45th Psalm, maintain as strongly that the 'Song of Solomon' has a literal as well as a spiritual meaning. (See especially Bishop Horsley's 5th *Sermon*.) The distinction however between the two questions of who was the author and who the parties described, ought not to be lost sight of, as it too often has been. Finding the book in the Jewish canon, the presumption is that it is a genuine part of Holy Scripture, and is intended to teach religious truth. This presumption is strengthened, if it can be proved that Solomon was the author, since we have at least one other book of his in the sacred canon; but it is not disproved even if the poem should be found to have nothing to do with Solomon either as its author or its subject.

But this argument is met in another way, namely, by denying that the book is intended to convey any religious truth. This objection seems to proceed in a wrong direction; for inasmuch as Christ and the Apostles referred to the Jewish Scriptures, as they existed in their day, as containing the great body of religious truth, and we know that this book did form a part of the Jewish canon at that time, we ought to conclude that the diligent inquirer will find a religious meaning in it, rather than first deny the existence of any such meaning, and then argue from this assumption against its canonical authority. But the objection can be met upon its own merits. The composition, it is said, is a mere love-song; it bears nothing on its face to mark it as allegorical, nor have we any inspired authority for so regarding it.

Now it is admitted that from a very early period the Oriental nations have been accustomed to express religious sentiments allegorically under the guise of amatory poems, of which the Gitagovinda is an example. To this day the Egyptian Arabs, at their religious festivals, sing songs resembling this, in which the prophet is the beloved object, and which are only intended to have a spiritual sense. (Lane's *Modern Egyptians*, vol. ii., p. 195.) Mr. Lane in fact gives passages from these songs strikingly parallel to passages in Solomon's Song. Neither is it denied that similar imagery is used with a similar meaning in other parts of the Bible (*Psalms*, xlv.; *Isaiah*, liv.; lxii. 4, 5; *Rom.*, vii. 4; 2 *Cor.*, xi. 2; *Ephes.*, v. 23-32; *Rev.*, xix. 7; xxi. 2-9), and also the opposite figure of representing idolatry and apostasy under the image of adultery or whoredom. But it is said that in all such passages the allusions are more distant, and enter less into detail than is the case in Solomon's Song, and that in them the religious sense is made so prominent that one can scarcely fail to perceive it. The first part of this assertion does not appear to be sustained by fact. Any one who examines the passages carefully, especially those which relate to spiritual adultery, will find allusions inferior in delicacy to the grossest which can be produced from Solomon's Song. The latter condition does not appear to be necessary (as has been argued above) to establish the allegorical meaning of such imagery, when occurring in a canonical book; neither is the spiritual sense always so obvious. For example, there is nothing in the 45th Psalm, except one or two expressions which could not by the greatest hyperbole refer to a human being, to lead us to suspect its spiritual meaning. Passages of the same kind might perhaps be adduced from Solomon's Song; but even if not, does not the admission that one love-poem which we find in the sacred canon is to be interpreted spiritually, furnish a presumption for putting a similar interpretation upon another? The fact that the 45th Psalm is quoted in the New Testament, and that the Song of Solomon is not so quoted, is no objection, for the quotation of the one sanctions the general principle of interpretation, while the silence respecting the other proves nothing, knowing as we do that the New Testament writers adopted the Old Testament canon as it existed in their day, and that this Song was in that canon. Nearly all expositors, both Jewish and Christian, have adopted the allegorical interpretation, though they have explained the allegory in different ways. The Chaldee Targum considers it as a figurative description of the love of God to Israel, as shown in delivering them from the Egyptian slavery, supporting and comforting them in the wilderness, and bringing them into the promised land. Christian expositors, from Origen downwards, have generally understood it as descriptive of the union between Christ and the church; but some few have explained it in a different way. Those who acknowledge its canonicity, but reject the idea of a reference either literally to Solomon or figuratively to Christ, take its admission into the canon to be a divine recommendation and praise of a single virtuous marriage as opposed to polygamy and concubinage. This appears to be now the opinion of the most distinguished modern opponent of its canonicity in England, Dr. J. Pye Smith. Various opinions are held as to the structure of the Song, the best of which appears to be that which takes it to be a series of Idyls.

(The *Introductions* of Eichhorn, Augusti, Jahn, and Horne; Dr. Smith's *Scripture Testimony*, vol. i., c. 1, note A; *Papers* by Dr. Smith, Dr. Bennett, and others, in the 'Congregational Magazine' for 1837 and 1838; Calmet's *Dictionary*, art. 'Canticles,' with fragments in Taylor's edition; *The Song of Songs*, by Thomas Williams, Lond., 1801; *The Song of Songs*, by Mason Good, Lond., 1803; other *Commentaries* in Horne, vol. ii., part ii.; Lowth's *Prælections*.)

SOLOMON'S ISLANDS. [New Georgia.]

SOLON, son of Execestides, and a descendant of the royal house of Codrus, was born about B.C. 638, in the island of Salamis. His father is said to have considerably diminished his property by his liberality, and that Solon in his youth engaged in mercantile undertakings in order to better his circumstances. For this purpose, or, according to others, in order to satisfy his thirst for knowledge, he visited various countries. The time when he returned and settled at Athens is not quite clear, but it seems very probable that it was soon after the Cylonian conspiracy (612 B.C.), when he must have been about twenty-six years old. Athens at this time was in a deplorable condition: it was distracted by internal feuds, and unable to maintain itself against its hostile neighbours. It had shortly before been deprived of the island of Salamis by the Megarians, and in the ensuing war Athens had suffered such losses, that at last a decree was made that any one who ventured to propose the continuance or renewal of the war should be punished with death. (Plut., *Sol.*, 8; Diog. Laert., i. 45.) Solon, indignant at the humiliation of Athens and the pusillanimity of her citizens, devised a plan by which he hoped to rouse the Athenians to renewed activity without incurring the penalty of the law. Being endowed by nature with considerable poetical talents, as appears from the fragments of his works, he composed an elegy upon the loss of Salamis (Müller, *Hist. of the Lit. of Antient Greece*, i., p. 117), and assuming the appearance of a madman, he rushed into the Agora, where a crowd soon gathered around him. Here he recited his poem to the multitude, and its inspiriting influence, together with the probably preconcerted assistance of some of his friends, had such an effect upon the people, that they not only repealed the law respecting Salamis, but resolved to try once more to recover that island. Solon was placed at the head of the Athenian forces, and led them to victory by a stratagem which is differently described by antient writers. (Plut., *Sol.*, 8, 9.) All the Megarians in Salamis were either slain or dismissed to their homes, and Salamis again came into the hands of the Athenians. This successful undertaking, in which the Athenians also appear to have gained possession of Nisaea, raised Solon to a very high degree of popularity. In the war between Delphi and Cirrha (about 600 B.C.), Solon advised the Athenians to support the former city against the sacrilegious Cirrhaeans. His advice was followed and crowned with success, for Cirrha was destroyed, and Solon's fame now spread through all Greece.

In consequence of the massacre of the friends of Cylon, notwithstanding their having taken refuge in the temples and at the altars of the gods, the republic was at this time divided between two parties, which were as much the result of religious fears and scruples as of the political state of the country. A part of the Athenians were enraged against Megacles and his associates for their violation of all religious feelings, and the surviving friends of Cylon did their utmost to foster this hostility against their enemies. The Megaclids were looked upon as a cursed race, and the Cylonids were gaining fresh strength every day. It was evident that peace could not be restored until the Megaclids had atoned for their crime, and delivered the city from the curse they appeared to have brought upon it. Solon, who appears to have belonged to neither party, enjoyed the full confidence of his fellow-citizens, and when the dissensions had reached their highest pitch, he persuaded the Megaclids to submit their case to the decision of a commission of 300 persons to be chosen from among the nobles. The sentence of this court was that the surviving Megaclids should be sent into exile, and that the bodies of those who had died should be taken from their graves and be carried beyond the frontiers of Attica. During these troubles at Athens the Megarians renewed their attempts upon Salamis with success. Both the Megarians however and the Athenians were unwilling to engage again in a long and tedious warfare, and both agreed to request the Lacedaemonians to appoint a commission of five men to investigate the claims of the two states. Solon, who was the spokesman on the part of the Athenians, established by various means the legitimacy of the claims of his country, which thus again came into the possession of Salamis. (Plut., *Sol.*, 10, 12; Diog. Laert., i. 48.)

Notwithstanding the removal of the Megaclids from Athens, the party feuds continued to rage as before. For besides the religious scruples arising from the crime of the Megaclids, which still seemed to call down the divine wrath upon the city, there were other causes, which could only be removed by a reform of the constitution. This however could not be effected with any degree of success, unless all religious fears and apprehensions were allayed by a complete purification of the city. This was done by Epimenides of Crete, whom the Athenians invited for this purpose. The way was thus prepared for the legislation of Solon.

The three antient local divisions of the country, the lowlanders (Πεδιεῖς or Πεδιαῖοι), highlanders (διάκριοι), and the inhabitants of the coast (Πάραλοι), formed three distinct political parties; the highlanders being the most democratical, the lowlanders the most oligarchical, and the men of the coast, who took a middle course, wishing to reconcile the two other parties. Besides these political parties, a struggle was going on between the wealthy and the poor. Many of the latter had not only lost their property, but, not being able to pay their creditors, had become the bondsmen of their wealthy oppressors, and some had even been sold as slaves into foreign countries. (Plut., *Sol.*, 13.) The most moderate and wisest among the Athenians saw that this state of things could not last, and that if no remedy was applied, the time would soon come when the people would take the power into their own hands. Solon appeared to be the only man who was impartial and skilful enough to mediate between the hostile parties. In the year B.C. 594 he was invested with the office of archon, and requested to act as mediator and to frame a new code of laws. In considering the legislation which he undertook, it should constantly be borne in mind that he received from both parties full power to arbitrate between them; and he acted in the name and on behalf of his country. The sincerity with which he acted is manifest from the fact that he resisted all temptations and exhortations of his friends to make himself tyrant of Athens, which he might undoubtedly have done without much difficulty, and that he himself lost a considerable part of his property by his own legislation.

The legislation of Solon consisted of two main parts: the one embraced those measures by which he intended to remove the evils under which the republic was actually labouring; the object of the second was to establish the constitution upon such a basis as would prevent the recurrence of these evils. The first step he took was to relieve those who were oppressed by debts. This was done in a manner which did not cause too great loss to the rich, and was yet a great relief to the poor, by a measure called σεισάχθεια, or a disburdening ordinance, by which he not only established a reduction of the rate of interest (which was probably made retrospective), but also lowered the standard of the silver coinage in such a manner that 73 old drachmæ became worth 100 new ones. (Plut., *Sol.*, 15.) He also released the pledged lands, and restored them to their owners, but it is not clear whether this was effected by a particular measure, or whether it was included in his disburdening ordinance. Those citizens who had been enslaved by their creditors were restored to freedom, and those who had been sold into foreign countries seem to have recovered their liberty at the expense of those who had sold them. Finally, the law which gave to the creditor a right to the person of his insolvent debtor was abolished. Some of the antient writers state that he cancelled all debts, but the best authorities do not mention any such measure, which is the more improbable, as we read that the most violent democrats, who would certainly have been pleased with it, were not satisfied with his disburdening ordinance. If we except the extreme of both parties, the relieving measures of Solon were received with universal approbation, and sacrifices were offered to the gods for the happy change. Thus encouraged, Solon proceeded to the second and more difficult part of his task. The first thing he did was to abolish the bloody laws of Draco, with the exception of those relating to murder. The characteristic feature of his new constitution was, that he substituted property for birth as a title to the honours and offices of the state. The change brought about by this new standard could not at first be great, as the eupatrids were undoubtedly the wealthiest citizens. According to their property, he divided the whole population of Attica into four classes, and regulated their political rights and duties according to the amount of their income from their landed property. The first class comprised all those citizens whose estates yielded a yearly income of 500 medimni (a medimnus is a bushel, six pints and a fraction) of dry or liquid produce, whence they are called πεντακοσιομέδιμνοι; the second, those who had 300 medimni, and could keep a war-horse, whence they were called ἱππεῖς, and formed the Athenian cavalry; the third contained those whose estates yielded 200 medimni. They were called ζευγῖται, from the yoke of cattle for the cultivation of their fields, and formed the heavy-armed infantry in the Athenian armies. All the remaining population whose income did not amount to 200 medimni constituted the fourth class, with the name of θῆτες, that is, hired labourers, who were excluded from all the offices of the state, and formed the light-armed infantry in the armies, as subsequently they also manned the fleets. They had however the right of voting in the popular assembly, as well as the exercise of the judicial power, which Solon placed in the hands of the people. The archonship and the other great civil and military offices, which had before been held by the nobles alone, became now accessible to all the citizens contained in the first class, while the second and third classes had access to all the minor offices. The public burdens were distributed according to the classes; but as the lower classes had fewer political rights than the higher, the contributions to the necessities of the state were for the lower classes proportionately light, for the second and third classes were not taxed according to the real value of their property, but that of the second class was reduced by one-sixth, and that of the third class by one-third below its real value. (Böckh, *Staatshaush*, ii., p. 29, &c.) The fourth class was altogether exempted from direct taxes. This distribution of power and duties was, as Solon himself expressed it, intended to give to the people as much power as would enable them to protect themselves, and to the wealthy as much as was necessary to maintain their dignity. (Plut., *Sol.*, 18.)

The four old tribes into which Attica was divided were left unaltered by the new constitution. The magistrates also appear to have retained the same power which they had had before, with the exception that they were now made responsible for the exercise of it to the people, and not, as before, merely to the order of the nobles. From the judicial sentence of a magistrate an appeal also was left to the popular courts of justice, which were numerously composed of citizens of all classes indiscriminately. (Thirlwall, *Hist. of Greece*, ii., p. 39, &c.) Two other institutions, which were intended as bulwarks against democratical extravagance, the senate of four hundred and the council of the Areopagus, are almost unanimously ascribed to Solon. But as regards the senate, there can be no doubt that it existed previous to the legislation of Solon, and was composed of the nobles, but its number cannot be ascertained with any accuracy. Solon raised it to the number of four hundred, and threw it open to all citizens belonging to the first three classes, in such a manner that each of the four tribes was represented in it by one hundred members. Whether these members were elected, as Plutarch states, or whether they were appointed by lot, as in subsequent times, is uncertain. Each member however had to give evidence of his qualification by an examination called δοκιμασία, and no person was eligible who had not attained the age of thirty. All members of the senate were changed every year, at the end of which they were liable to give an account of their conduct during the time of their administration. The senate was divided into sections, called prytanies, which succeeded each other in the management of the affairs throughout the year, and held their assemblies in the Prytaneum. The most important part of their business consisted in preparing those measures which were to be laid before the popular assembly, which had the power to accept, reject, or modify them. The senate however had other powers connected with the finances and other branches of the administration. Concerning the council of the Areopagus, see Areopagus.

As regards the rights which Solon gave to the popular assembly, no measures could originate in it, but its discussions were confined to such measures as had been prepared by the senate. Every citizen, to whatever property-class he belonged, had a right to take part and to speak in it, so that the vote of the wealthiest nobleman had no more weight than that of the poorest labourer. No one however was allowed to speak who had not attained the age of twenty, and the oldest persons were called upon by the crier to vote first. Though the political power of the assembly was limited, the judicial power with which Solon invested it was considerable. Out of the popular assembly 6000 men above the age of thirty were chosen every year by lot, to form a supreme court of justice called the ἡλιαία, to which appeals were made from the sentence of magistrates, and which had in certain cases to take cognizance, independently of any other court, and in subsequent times assumed all judicial power in the state. The importance and influence of the Heliaea appears from the oath which the heliasts had to take at the time of their appointment, and which is preserved in Demosthenes (*c. Timocrat.*, p. 746).

It would be impossible to give any detailed account of the civil and criminal legislation of Solon, although there are many materials for such a purpose. It may suffice here to state, that although he did not in the same degree as Lycurgus interfere with and regulate the private affairs and the mode of living of his fellow-citizens, yet, like most antient legislators, he did not think any part of the life of the citizens unworthy of his attention. The education of the young, and the conduct of women as well as of men, were to him as important as any of those subjects which in modern times alone engross the attention of legislators. Plutarch (*Sol.*, 18) states that Solon clothed his laws intentionally in obscure language, for the purpose of increasing the influence of the courts of justice. But surely nothing is more contrary to the whole spirit of his legislation than such a scheme, and the alleged obscurity, if it existed at all, was probably nothing more than the natural consequence of the state of the language in the days of Solon, in comparison with what it was two centuries later.

The Attic tribes had from early times been divided into forty-eight naucraries, and Solon is said to have established the law according to which each of these naucraries was charged with the equipment of a trireme and the mounting of two horsemen. If this is true, he must be regarded as the founder of the Attic navy. (Phot., s. v. ναυκραρία.) Solon also encouraged the arts and manufactures, and for this purpose he invited foreigners to settle at Athens. (Plut., *Sol.*, 24.) The calendar likewise received some improvements from Solon.

He had made such arrangements in regard to the observations of his laws, and their constant revision, that it is impossible to place any confidence in the statement of Plutarch, that he enacted them to remain in force unaltered only for a century. The laws were inscribed upon wooden tablets, put together in pyramidal blocks, which turned upon an axis. They were at first kept in the Acropolis, and afterwards in the Prytaneum. These axes were called ἄξονες and κύρβεις, and according to some authors the former contained the civil, and the latter the religious laws. (Plut., *Sol.*, 25.)

When his legislation was completed, Solon is said to have been so much annoyed at Athens by the remarks of the discontented, and the importunate inquiries of the curious, that he asked permission to leave Athens for ten years, hoping that during this period the people would become familiar with their new institutions. The permission was granted, and Solon is said to have visited Egypt, Cyprus, and Asia Minor. The beautiful story of his interview with Croesus, king of Lydia, which is told by Herodotus, Plutarch, and others, is inconsistent with chronology, as even some of the antients have observed, for Croesus did not come to the throne till about 560 B.C., some twenty or thirty years later than the time at which Solon must have visited Asia Minor. (Voemel, *Exercitat. Chronolog. de Aetate Solonis et Croesi*, Frankf., 1832.) On his return he found Athens again distracted by factions. The three parties, of the highlanders, the men of the plain, and of the coast, were again engaged in hard struggles. The first of these parties was headed by Pisistratus, the friend of Solon, the second by Lycurgus, and the third by Megacles. Solon exerted all his powers to avert the threatening danger, and to reconcile the heads of the parties. But he laboured in vain, and although Pisistratus listened to him respectfully, he secretly continued to work out his plan. [Pisistratus.] When Pisistratus had established himself as tyrant of Athens, Solon, who was probably convinced that the mild rule of one man was, after all, greatly preferable to the continuance of party struggles, is said to have supported the tyrant with his advice. At the same time, he withdrew from public life. How long he survived the ascendency of Pisistratus is not certain, but according to the most probable account he died soon after, in the year B.C. 559. (Clinton, *Fast. Hell.*, ii., p. 301.) Respecting the constitution of Solon, see Thirlwall, *Hist. of Greece*, ii., pp. 23-58.

From the numerous works ascribed to Solon, it appears that he must have devoted all his leisure hours to the muses; and he is said to have done so to the last moment of his life, for at the time when he died, he is said to have been engaged in writing a poem upon the state of Attica previous to the Ogygian flood, and its wars with the inhabitants of the island Atlantis, which was afterwards swallowed up by the Atlantic Ocean. (Plut., *Sol.*, 31, &c.) We are enabled to judge of his poetical powers from the few fragments which are still extant. They are distinguished by a graceful simplicity and great vigour. They have been collected by Fortlage, in a work entitled 'Solonis Carminum Fragmenta, Græce, cum variis lectionibus notisque,' Lipsiæ, 1776; and by N. Bach, in 'Solonis Carmina quæ supersunt, emend. atque annot. instr.,' Bonn., 1825, 8vo.

SOLOR. [Sunda Islands, Lesser.]

SOLOTHURN (*Soleure*, in French), a canton of Switzerland, is bounded on the north by Basle, on the east by Aargau, on the south by Bern, and on the west partly by Bern and partly by France. Its shape is extremely irregular, the boundaries being conventional, and not marked by natural limits: the area is about 270 square miles. It is crossed in the direction from south-west to north-east by the Jura, which forms several parallel ridges, and covers the greater part of the canton. The principal valley is that of the Aar, which runs in the same direction, flowing eastward of the Jura. The highest summits of the Jura in the canton of Soleure are the Weissenstein and the Hasenmatt, which latter is about 4400 feet above the sea. The canton of Soleure is one of the most productive in Switzerland, especially in corn, fruit, and vegetables. The vine thrives only in certain localities. The mulberry-tree is cultivated, and some silk is made. There were in 1835 about 28,000 head of horned cattle, 19,000 sheep and goats, 19,000 pigs, and 4700 horses, the average value of which is from twelve to eighteen pounds sterling each. The horse-fair of Soleure is one of the principal in Switzerland. A considerable quantity of cheese is made, both of cow's milk and goat's milk, and part of it is exported. Part of the mountains are covered with timber-trees, especially fir and beech. The canton abounds in iron-mines, and the ore is smelted in the furnaces of St. Joseph, and worked at the iron-works of Klus. The other manufactures consist of leather, paper, woollens, and kirschwasser. There are also quarries of marble and gypsum.

The population of the canton, according to the census of 1835, amounted to 62,400, distributed among 134 communes. A dialect of the Swiss-German is the language of the country. The inhabitants are Roman Catholics, with the exception of those of the district of Bucheggberg, and a small congregation in the town of Soleure, which profess the Helvetic reformed communion. Most families are possessed of landed property. Every commune has now an elementary school, and a normal school, or school for teachers, has been established at Soleure. Most of the communes have a bourse, or fund for the relief of their own poor.

The constitution of Soleure was for a long time aristocratical, as in most of the Swiss cantons, but in January, 1831, a new constitution was framed, on a more popular system. The mode of election of the members of the legislature is by means of electoral colleges, as in France.

The canton is divided into ten electoral circles, each having its electoral college, which names a certain proportion of members to the great council or legislature. The town of Soleure returns 34 out of the 109 members who compose the great council. A little council, chosen from among the members of the great council, constitutes the executive. The members of the great council are renewed every six years.

Solothurn, or Soleure, a bishop's see, and the head town of the canton, is built on both banks of the Aar, 1320 feet above the sea, and is surrounded by walls. The population is 4200. The cathedral is reckoned the finest church in Switzerland; the tower is 190 feet high. The canons of Soleure receive about 2600 francs a year, and the emoluments of the bishop are 10,000 francs. The other remarkable buildings of Soleure are the town-house, which is very old, the arsenal, the theatre, the hospital, the fountain in the market-place, the former church of the Jesuits, and several convents. Soleure has a gymnasium with six professors, a lyceum with three professors, and a faculty of theology divided into three classes. The town library has 15,000 volumes. There are also the library belonging to the cathedral, which is said to contain some valuable manuscripts, and several libraries belonging to convents and to the gymnasium. Soleure has a botanical garden, a cabinet of natural history, a society for the natural sciences, founded in 1823, a medical society, a literary society, a dramatic society, and a military society. Soleure is nineteen miles north of Bern, and twenty-six miles south of Basle.

Olten, on the left bank of the Aar, about twenty miles north-east of Soleure, is the second town in the canton, and is a bustling, thriving place. It has several manufactories, some good buildings, and above 1500 inhabitants. (Leresche, *Dictionnaire Géographique de la Suisse.*)

**SOLSTICES**, the points of the ecliptic which are highest above the equator, at which, the sun's motion in declination being imperceptible, the days remain sensibly unaltered in length for several days together, as they would do if the sun absolutely stood still: whence the name. [Sun.]

**SOLUTION.** (Mathematics.) By the solution of a problem should be meant the method of finding that which the problem requires to be found; but the word is frequently understood to apply to the answer itself.

A solution is given when the problem is reduced to any other which was supposed to be known before the first was presented: the difficulty peculiar to the given problem is removed as soon as it is shown to be capable of reference to another and a lower class. Thus, though properly speaking a problem is not solved until the answer is presented in numbers, yet it is not thought necessary to require that such a result should be attained, provided the steps which are left are such as are well known and generally admitted. Thus an equation would be said to be solved were it found that the roots required are those of a given quadratic; for no one is supposed ignorant of the mode of then finding them.

A *geometrical* solution, in the strict sense of the word, is one in which only the means of construction admitted by Euclid, or others deducible from them, are employed in its attainment. This is the least finished of all solutions; for a mode of laying down the various points which terminate lines is not, generally speaking, a mode of ascertaining their ratio. Nor must it be forgotten by the admirers of geometry that the most important part of a result, the expression of the ratios which the answer bears to the several data, is only indirectly obtained in their favourite method.

When more means than those allowed by Euclid are employed, the solution used to be called *mechanical*. It is rarely that such a solution is now employed.

An algebraical solution is one which employs algebra and arithmetic, to the exclusion of geometrical construction; that is, one in which the answer can always be directly calculated from a formula. Geometrical construction may be necessary for the demonstration of the solution: it is enough that the answer contain no directions to find lines or surfaces by construction.

An approximate solution is one which has an amount of inaccuracy necessarily. Thus if $3 + \sqrt{2}$ were the root of an equation, this solution would not be called approximate; for though $\sqrt{2}$ cannot be perfectly represented in a finite form, the symbol itself contains the mode of attaining the result with any degree of exactness short of perfection. But if $\sqrt{2}$ were found to five decimal places, the answer $1 \cdot 41421$ would be called an approximate answer. Most solutions must terminate in an approximate representation. [Transcendental.]

**SOLVENT** is that which has the power of rendering other bodies liquid; and chemically, a menstruum. Of all solvents, water is the most universal and useful; it dissolves a great number of neutral vegetable products, as gum, sugar; and of saline bodies, as common salt, sulphate of soda, &c. The resins are not soluble in water, and oils do not combine with it, nor has it the power of dissolving any metal whatever while it retains its metallic properties; it is only the oxides even of the lately discovered metals of the alkalis and alkaline earths which are taken up by it, except indeed such metallic oxides as were previously known to possess acid properties. The solvent of resinous bodies is alcohol, and of some similarly constituted substances; while caoutchouc is insoluble in it, but is dissolved by naphtha, oil of turpentine, and æther.

The metals are insoluble in any solvent until they have suffered some change by its action, or by a similar change differently produced; thus, when zinc is put into nitric acid, that acid acts as a solvent, because the metal, by decomposing a portion of the acid, is converted into an oxide: and after this, whether it be effected by the acid or by the action of heat and air, the metal, or rather metallic oxide, becomes soluble not only in nitric acid, but in an aqueous solution of the alkali ammonia and of potash.

Heat has great power in altering the solvent power of bodies; in most cases it increases it, and hence, when it is required to crystallize certain salts, they are dissolved in hot water, and the solvent power of the water diminishing as the solution cools, the salt is deposited in crystals.

There are exceptions however to this increased solvent power by heat: thus lime is more soluble in water at 32° than at 60°, and at this latter temperature than at its boiling point. Sulphate of soda is more soluble in water at 32° than at 92°. There is a remarkable difference between the solvent power of hot and cold water with respect to all gaseous bodies; owing to their disposition to resume the elastic state, gases are readily expelled from solution by heat, and, as might be expected, in many cases, the solvent power is increased by cold.

It has been already mentioned that gum is soluble in water, while rosin is taken up by spirit, and each is insoluble in the other, so that when we mix an aqueous solution of gum with a spirituous solution of resin, both are rendered insoluble and precipitated together, owing to the combination which takes place between the spirit and the water. When any solvent has taken up as much of any particular substance as it is capable of, the solution obtained is termed a saturated one; and what shows that the change of form from solid to fluid is the result of chemical affinity, is the fact that water which is saturated with one substance will take up another; thus a saturated solution of common salt will still dissolve sulphate of soda, and *vice versâ*.

We shall conclude this subject with adducing an example of the chemical nature of solution, and the extent to which it is applied in chemical researches connected with the insolubility of some substances.

Thus yellow copper is a compound of sulphur, copper, and iron. Put it into water, no action takes place, the component parts being quite insoluble in it; put it into dilute nitric acid and apply heat, and it is totally dissolved. The sulphur, acquiring oxygen, becomes sulphuric acid; the copper, combining also with oxygen, becomes oxide of copper; and the iron from the same cause becomes peroxide of iron; and both these oxides combine with the sulphuric acid formed, and remain in solution as sulphates of copper and iron. The next operations are to determine the quantity of the acid formed, and of the oxides with which it is combined, and this is effected by a solution of nitrate of barytes, the base of which combines with the sulphuric acid, and the sulphate of barytes, being an insoluble salt, is precipitated. The oxides of copper and iron are now held in solution by the nitric acid of the decomposed nitrate of barytes; and these oxides are separated by finding a substance which acts as a solvent upon one and not upon the other; ammonia dissolved in water is such a body; when added to the mixed solution in excess, it dissolves the oxide of copper and leaves the peroxide of iron unacted upon.

Thousands of analogous and of more complicated cases might be adduced, but the above, without carrying out the analysis, or showing how the quantity of sulphur is estimated from that of the sulphate of barytes, or the quantities of copper and iron from their oxides, is sufficient to prove the important action of solvents, and of the varied application of solubility and insolubility in chemical investigations.

**SOLWAY FRITH**, an æstuary or inlet of the sea, on the western side of the island of Great Britain, separating, in one part, England from Scotland. This æstuary extends inland, from a line drawn between Rayberry-Head in Kirkcudbrightshire to St. Bees' Head in Cumberland, 41 miles north-east to Solway Moss at the mouth of the Esk. The line between the two above-mentioned headlands, which may be regarded as measuring the mouth or entrance of the Frith, is more than twenty miles long. About seventeen miles up, between Southerness Point, Kirkcudbrightshire, and the Cumberland shore near Allonby, the width is diminished to seven miles: it afterwards expands, then again contracts; and fifteen miles farther up, between the mouth of the Annan, Dumfriesshire, and Bowness, Cumberland, is reduced to two miles: this continues to be the width of the æstuary for the remaining nine miles to its termination.

On the north-west or Scottish shore, the Solway Frith is bounded near its entrance by the stewartry or shire of Kirkcudbright, from which it receives the river Urr, and in its upper part by Dumfriesshire, from which it receives the Nith and the Annan. On the south-east or English shore, and at its head, the frith is bounded by the county of Cumberland, from which it receives the Esk, with its tributaries the Liddle and the Line; the Eden, with numerous tributaries; the Wampool, the Waver, the Ellen, and the Derwent. It receives in fact the drainage of the district, bounded on the north-west by the higher grounds of East Galloway, on the north by the Lowthers and the connected hills; on the north-east by the heights which unite these to the Cheviot and other border hills; on the east by that part of the Penine chain which extends from the border hills southward to the heads of the Eden and the Yore or Ure, including Geltsdale, Milbourn, Lune, and Stainmoor forests; and on the south by the mountains of the Cumbrian group.

The shores of Solway Frith are for the most part low. At St. Bees' Head are lofty cliffs; and there are cliffs again for a short distance between Whitehaven and Workington, and between Maryport and Allonby; but all the Cumbrian shore from Allonby to the head of the frith is low and sandy. The shore of Dumfriesshire is also low and sandy, and lined in several parts with marshes, locally termed 'mosses' or 'flows.' The shore of Kirkcudbrightshire is loftier; and in this part, not far inland from the shore of the frith, Criffel mountain rises to the height of 1830 feet. A considerable part of the frith within Southerness Point and Allonby is occupied by broad sands, dry at low water, and intersected by the channels formed by the streams which flow into the frith. The frith is navigable through the greater part of its extent for vessels of 300 tons, and for those of 100 tons up to the head. It affords a supply of different kinds of fish, especially salmon, of which there is a valuable though declining fishery. The tide sets into it with great force, the flood sometimes advancing with a head three or four feet high. The water has a whitish colour from the great extent of sand over which it flows.

At the head of Solway Frith is Solway Moss, a tract of bog in the parish of Kirk-Andrews-upon-Esk, in Cumberland. In 1771 this bog burst, and overflowed several hundred acres of fertile land, sweeping away the tenants' houses with its black stream. The damage was at first thought to be irreparable; but by great exertion and expense the land was again brought into cultivation, and all trace of the catastrophe obliterated.

Solway Moss is memorable for the defeat of the Scots, A.D. 1542. A body of 10,000 men, under Lord Maxwell and the Earls of Cassilis and Glencairn, entered England; but the leaders were corrupt, and the men mutinous; and on being attacked by a force of 1400 English, the whole army took to flight, leaving nearly 1000 prisoners, of whom 200 were lords, esquires, or gentlemen. Lord Maxwell, the commander-in-chief, was among them. James V. of Scotland died of vexation at this defeat, about a month after it took place.

**SOLWAY MOSS.** [SOLWAY FRITH.]

**SOMATE'RIA.** [FULIGULINÆ, vol. xi., p. 5.]

**SOMBRERE'TE.** [MEXICAN STATES.]

**SOMERS, JOHN, LORD SOMERS**, was born at Worcester, where his father, of the same name, was an attorney in good practice. His mother was Catherine Ceaverne, of a good family in Shropshire. The year of Somers's birth is supposed to have been 1650; but some accounts make it to have been 1652. We are not aware upon what authority it has been sometimes stated, or assumed, that the day on which he was born was the 4th of March.

Somers's father, who was a zealous Commonwealth man, and had commanded a troop under Cromwell in the civil war, intended to breed his son to his own profession. He managed the estates of the earl (afterwards duke) of Shrewsbury, who often visited him, and in that way had his attention early attracted to the promising qualities of young Somers. He was also connected by electioneering services with the member for the city, Sir Francis Winnington, afterwards solicitor-general, in whom his son found another useful patron when he entered the profession of the law. He died in 1681, when the subject of the present article inherited a small estate in Gloucestershire, which had been for some generations in possession of the family.

Young Somers however is said to have been educated at the expense of his father's sister, who had married Mr. Blurton, an opulent Worcester clothier, and who, having no children of her own, had adopted him from his birth. At her house, and not at that of his father, he resided throughout his boyhood. He appears to have been placed first at the cathedral school of Worcester, and afterwards at a private school at Walsall in Staffordshire; and it has also been supposed that after leaving school he may have spent a year or two in his father's office. While at school he is said to have been remarkable for his gravity of demeanour, as well as his studious habits. It is stated, on the authority of his friend Winnington, that at this time, 'by the exactness of his knowledge and behaviour, he discouraged his father and all the young men that knew him; they were afraid to be in his company.' This beginning would not lead us to expect the robust heartiness of character by which Somers was distinguished in after-life, nor the somewhat free or lax system of private morality as to certain points, of which indeed we have not a hint in the common formal biographies of the distinguished lawyer and statesman, but which nevertheless he is very well known to have adopted and practised.

Winnington has the credit of having advised that he should be sent to the bar. With this view he entered himself of the Middle Temple, and in 1674 was admitted a commoner of Trinity College, Oxford. In 1676 he was called to the bar, but although he never took any further degree than that of B.A., he continued to reside at the University for five or six years longer. To the latter part of this interval, between the completion of his studies and his removal to London and entrance upon the practice of his profession, belong the principal literary performances which he sent to the press:—1, 'The Memorable Case of Denzil Onslow, Esq., tried at the Assizes in Surrey, July 20, 1681, touching his election at Haslemere in Surrey;' 2, 'A Brief History of the Succession of the Crown of England, collected out of Records and the most authentic Historians,' 1681; reprinted 1714; 3, 'A just and modest Vindication of the Proceedings of the two last Parliaments,' [in which the question of the exclusion of the Duke of York had been agitated,] 1681, (a reply to the king's declaration,) at first penned, according to Burnet, by Algernon Sidney, but afterwards drawn out anew by Somers, and finally corrected by Sir William Jones, who had been attorney-general a few years before; but, adds Burnet, 'the spirit of that side was now spent; so that this, though the best writ paper in all that time, yet had no great effect;' 4, 'The Security of Englishmen's Lives; or the Trust, Power, and Duty of the Grand Juries of England, explained according to the fundamentals of the English government,' 1681, written on the failure of the charge against the earl of Shaftesbury; 'it passed,' says Burnet, 'as writ by Lord Essex, though I understood afterwards it was writ by Somers, who was much esteemed and often visited by Lord Essex, and who trusted himself to him, and writ the best papers that came out in that time.' He had before this time contributed poetical versions of Ovid's 'Epistles of Dido to Aeneas, and of Ariadne to Theseus,' to Tonson's edition of Ovid's 'Epistles' in English; and a translation of Plutarch's 'Life of Alcibiades' to the English Plutarch, 'by various hands,' produced by the same publisher. And there is also attributed to him an original English poem, of some three hundred lines, entitled 'Dryden's Satire to his Muse,' a libellous attack on that poet, which, from several allusions in it, must have been written early in 1682. It has a considerable portion of the strength, as well as the coarseness, of Dryden's most prosaic manner. Walpole, in his 'Royal and Noble Authors,' expresses his opinion that 'the gross ribaldry' of this poem 'cannot be believed to have flowed from so humane and polished a nature as Lord Somers's;' but this, we apprehend, is to carry out too strictly, or too far, the figure with which Walpole introduces his notice of Somers—that he was 'one of those divine men, who, like a chapel in a palace, remain unprofaned, while all the rest is tyranny, corruption, and folly.' The poem is printed in part ii. of the 'Supplement to the Works of the Minor Poets,' pp. 3-11.

Somers, whose ability and professional learning were already well known to a circle of influential friends, at last came up to London in 1682, and commenced practice at the bar. The first cause of public importance in which he was engaged was the prosecution of Pilkington and Shute, sheriffs of London, and other members of the Whig party, who were tried and convicted, in May, 1683, for a riot at the last election of sheriffs, in which he appeared as junior council to his friend Winnington for the defendants. From this time, it is stated by the writer of the Memoirs of his Life, 8vo., London, 1716, that his practice increased daily, so that in the reign of James II. his professional income already amounted to 700*l.* a year, which was in those days a large sum for a barrister of his standing; and, according to this authority, 'he was looked upon as one of the most rising counsel in England, before he appeared at the trial of the Bishops.'

But no doubt his being selected to be one of the counsel for the defence in that celebrated case, tried in the Court of King's Bench, in June, 1688, was what first brought him prominently before the public eye. He was selected, it is stated, on the strong recommendation of Mr. Pollexfen, one of the leading counsel for the bishops, and a lawyer of the highest eminence. 'I have heard one of the bishops declare,' says Bishop Kennett, in a note to his 'Complete History,' 'that objection was made among themselves against Mr. Somers as too young and obscure a man; but old Pollexfen insisted upon him, and would not be himself retained without the other; representing him as the man who would take most pains, and go deepest into all that depended on precedents and records.' Somers's speech occupies only about a column in the 'State Trials' (vol. xii., p. 396); but it is probable that his seniors were indebted for much of their matter to his learning and research.

From this time Somers is to be regarded as one of the leading political persons of his time. He is understood to have been associated with his friend Shrewsbury and the other chiefs of the Whig party in the negociations and arrangements which resulted in the coming over of the Prince of Orange; and he was taken into the confidence of William from the first. He was returned as one of the representatives for Worcester to the Convention, which met in January, 1689; and he took a distinguished part in the debates in the Commons and the conferences with the Lords, which terminated in the adoption, by both houses, of the decisive resolution that the late king had 'abdicated' the government. Somers indeed was a member of the first and chairman of the second of the two committees which prepared the Declaration of Right; and it was perhaps mainly drawn up by him, as is hinted by Burke, who, in his 'Reflections on the Revolution in France,' says, 'I never desire to be thought a better Whig than Lord Somers, or to understand the principles of the Revolution better than those by whom it was brought about; or to read in the Declaration of Right any mysteries unknown to those whose penetrating style has engraved in our ordinances, and in our hearts, the words and spirit of that immortal law.'

Under the new government preferment flowed fast upon Somers. In the beginning of May, 1689, he was made solicitor-general and knighted; on the 2nd of May, 1692, he was made attorney-general; and on the 23rd of March, in the same year, he was promoted to the office of lord-keeper of the great seal. This last appointment, of course, though he was not yet raised to the peerage, removed him both from Westminster Hall and from the House of Commons. 'All the people,' says Burnet, 'were now grown weary of the great seal being in commission; it made the proceedings in Chancery to be both more dilatory and more expensive; and there were such exceptions made to the decrees of the commissioners, that appeals were brought against most of them, and generally they were reversed. Sir John Somers had now got great reputation, both in his post of attorney-general and in the House of Commons; so the king gave him the great seal. He was very learned in his own profession, with a great deal more learning in other professions—in divinity, philosophy, and history. He had a great capacity for business, with an extraordinary temper; for he was fair and gentle, perhaps to a fault, considering his post; so that he had all the patience and softness, as well as the justness and equity, becoming a great magistrate. He had always agreed in his notions with the Whigs, and had studied to bring them to better thoughts of the king, and to a greater confidence in him.' The most remarkable occasion on which Somers distinguished himself while holding the office of lord keeper, was what is called the case of the Bankers in the Court of Exchequer, in 1696. He delivered a judgment against the bankers, and reversing the decision of the barons of the Exchequer, which has been characterised by Mr. Hargrave as 'one of the most elaborate arguments ever delivered in Westminster Hall,' and in collecting books and pamphlets for which he is said to have expended several hundred pounds. It is contained in the report of the case in Howel's 'State Trials,' vol. xiv., pp. 39-105. This judgment however, in which he was supported by Treby, chief justice of the court of Common Pleas, but opposed by Holt, chief justice of the King's Bench, was afterwards reversed by the Lords; and Lord Dartmouth, in a note to Burnet's 'History,' asserts that when the decree which he had made was, after a very warm debate, set aside, Somers fell ill, and never appeared upon the woolsack more. This was in 1700.

Meanwhile, in 1697, Somers had been appointed lord-chancellor, and raised to the peerage by the title of Baron Somers of Evesham in the county of Gloucester. He appears to have had a seat in the cabinet from the time of his promotion to the place of lord keeper; and he was now generally regarded as one of the chiefs of the ministry, as well as one of the most attached and influential of the king's friends. This made him a principal object of attack on the part of the Tory opposition in the second, or last, session of King William's fourth parliament, which commenced in November, 1699. After two successive charges brought against him had been negatived—the one for his having improperly, as was alleged, dismissed many persons from the commission of the peace; the other, founded on the affair of Captain Kid, who, after having been sent out in the command of an armament to destroy certain pirates in the West Indies, the expense of which had been very patriotically contributed by Somers, Shrewsbury, and some other noblemen, had taken to piracy himself,—a motion was made on the 10th of April, 1700, the day before the king came down to prorogue the parliament, that his majesty should be addressed to remove Somers from his presence and councils for ever. But this attempt also failed: the numbers, according to Lord Hardwicke, in a note to Burnet, were 106 for the motion, and 167 against it. Immediately before this, the bill for resuming the king's Irish grants had been carried through both Houses, in spite of the most strenuous opposition by the court, and the determination which William was at one time understood to have come to rather to risk everything than give his consent to the measure. 'While the bill was in suspense,' writes Lord Dartmouth, in a note upon Burnet, 'the whole city of London was in an uproar; Westminster was so thronged, that it was with great difficulty anybody got into either House. . . All seemed under the greatest distraction. I heard the king was come to the Cockpit, and had sent for the crown, with a resolution to dissolve us immediately, which I communicated to the earl of Shaftesbury, who ran full speed with it to the House of Commons; upon which they adjourned in great haste.' It was this apprehension, according to Burnet, of the king's resorting to the violent measure of a dissolution in order to quash the bill, that provoked the second of the above-mentioned attacks of the Commons upon Somers. But the chancellor did not please either party in this unfortunate business. 'During the debates about the bill,' says Burnet, 'he was ill, and the worst construction possible was put on that: it was said he advised all the opposition that was made to it in the House of Lords; but that, to keep himself out of it, he feigned that he was ill; though his great attendance in the Court of Chancery, the House of Lords, and at the council-table, had so impaired his health, that every year about that time he used to be brought very low, and disabled from business.' Lord Hardwicke tells us, in a note on this passage, that for this conduct of Somers, in absenting himself from the house, and taking little or no share in the debates about the bill, 'it is said the king was angry with him, and made easy to part with so wise a servant soon after.' It is certain at any rate, that, shortly after this, William resolved to endeavour to rid himself of the incessant annoyance and obstruction he received from the aversion the Commons had taken up against the chancellor by the dismissal of Somers. Tindal, who says that the account was given to Mr. Oldmixon by a gentleman who had it from Somers's own mouth, tells us that the first time Somers came to court after his illness, the king stated that it seemed necessary for his service that he should part with the great seal, and expressed his wish that he would make the delivering of it up his own act. Somers replied, that he knew this was what his enemies were striving after; that the seal was his greatest crime, and that if he quitted that, he should be freed from their abuse and persecution; but that he was resolved, with his majesty's permission, to keep it in defiance of their malice; adding, that 'he did not doubt but, if his majesty would be as firm to his friends as they would be to him, they should be able to carry whatever points he had in view for the public welfare in a new parliament.' His majesty however shook his head, and said 'It must be so.' But Somers persisted in declining to offer the surrender of the seal; so that a few days after, on the 17th of April, the king sent Lord Jersey for it, with a warrant under his hand, on which, of course, it was immediately given up. About a month after it was given to Sir Nathan Wright, with the title of lord keeper.

After all, his ejection from office neither saved Somers from the enmity of the Commons, nor lost him the favour and confidence of the king. In the new parliament, which met in February, 1701, the Tories found themselves in a majority in the Lower House; and they had not sat long before they proceeded to direct their power against the chief of the king's friends and ministers, the Duke of Portland, Lord Somers, the Earl of Oxford, and Lord Halifax, all of whom it was resolved to impeach. The resolution to impeach Somers was carried at a late hour on the night of the 14th of April, by a majority of 198 to 188, after he had come down to the House, and been heard in his own defence. The principal, and indeed at this stage of the proceeding, the only crime laid to his charge, was the concern he had had in the two treaties for the partition of the Spanish monarchy [PARTITION TREATIES] which had been negociated in 1698 and 1699 by King William, without consulting with his ministers, and for which Somers had forwarded, at the king's desire, the necessary powers in blank under the great seal. We suppose there can be no question, but that, according to the modern practice of the constitution, no minister would be held to be justified in acting as Lord Somers admitted he had done in this case; but ministerial responsibility was not so well understood or so completely established in those early days of the system introduced by the Revolution as it now is. The precise charge against Lord Somers too, as stated in the resolution for impeaching him, was, that he had advised his majesty to the treaties; and that certainly was not and could not be made out, being in truth contrary to the fact. Afterwards fourteen distinct articles of impeachment were drawn out and sent up to the Lords, which charged his lordship distinctly with having presumed to affix the great seal to the blank commissions, contrary to the duty of his office, and in violation of the great trusts reposed in him, 'without communicating the same to the rest of the then lords justices of England, or advising in council with his majesty's privy council thereupon.' His conduct in the affair of Captain Kid, which surely was the very reverse of blameable, was also made the subject of one of the articles; but the most remarkable of the charges brought against him related to various personal grants of land and money which he was asserted to have begged and obtained from the crown—'many great, unreasonable, and exorbitant grants,' as they were styled, 'of several manors, lands, tenements, rents, hereditaments, and revenues,' besides the annual salary, or pension (as it is called), of 4000*l.*, which, 'through his majesty's most abundant grace and bounty,' he had received during all the time he was lord keeper and lord chancellor, over and above 'the fees, profits, and perquisites of or belonging to the great seal, established by law as a sufficient and ample recompense and reward for the faithful discharge of that high station.' The grants were alleged to consist of the manors of Ryegate and Howleigh, granted in 1697, to Joseph Jekyl, Esq., in trust for Lord Somers and his heirs—of certain fee-farm rents to the value in all of 33,000*l.*, granted at various times by pretended contracts, under which 'there was not any sum of money whatsoever really and *bonâ fide* paid as the consideration of the conveyances of the said rents' from the trustees to whom they were granted for Somers's benefit—and of certain other rents to the yearly value of nearly 400*l.* obtained in a similar manner. Somers in his answer stated that the 4000*l.* a year was the same allowance that had been made to several of his predecessors; and as to the other grants, he pointed out certain deductions from their value to which the Commons had not adverted, and denied that there had been anything unlawful in the transactions, or that the grants had been obtained either in deceit of his majesty or in elusion of any acts of parliament. The affair ended, after many messages and conferences between the two Houses, by the Commons declining to appear to prosecute their impeachment on the day appointed by the Lords, under the pretence that the Lords had refused them justice in the matter; on which their Lordships pronounced him acquitted, and dismissed the impeachment. (See Howel's *State Trials*, xiv. 311.)

In October of this same year a negociation was opened by the king with Somers, through Lord Sunderland, for bringing him again into power; but his majesty's death, in March, 1702, put an end to the project after everything had been arranged. The speech with which William opened his last parliament, on the 31st of December, 1701, called by Burnet 'the best speech that he, or perhaps any other prince, ever made to his people, was written by Somers; Lord Hardwicke mentions that he had seen the original in Somers's handwriting.

In 1702 Somers, unoccupied by the cares and toils of office, was elected president of the Royal Society. In 1706 he introduced and carried through parliament a bill 'for the amendment of the law, and the better advancement of justice,' which, although deprived of some useful clauses by the Commons, corrected various abuses in the courts both of Chancery and of Common Law. He also took a leading part in the discussion and arrangement of the great measure of the Union with Scotland, which was now at last brought to a conclusion, after having been again and again unsuccessfully attempted during more than a century. [SCOTLAND, UNION WITH.] It may also be mentioned, that the learned and able statement of the famous Aylesbury Election Case, ordered to be printed by the House of Lords in 1703, was, according to Mr. Speaker Onslow, drawn up by Lord Somers. He too, it is stated by Lord Hardwicke, was the author of the act passed in 1705, for the security of the Protestant Succession. [GEORGE I., vol. xi., p. 157.]

On the return of his party to power in 1708, Somers was made president of the council; and he held that office till the recovery of the cabinet by Harley and the Tories in 1710. He succeeded in making himself very acceptable to Queen Anne, notwithstanding her original prejudice against him. It is affirmed by Lord Dartmouth that he impressed her with a deep and grateful sense of his fidelity and integrity by his acquainting her with and putting her on her guard against a scheme entertained by the Duke of Marlborough to get himself made captain-general, or commander of the forces, for life, which, without having so much as mentioned it to her majesty, his grace tried in 1709 to get proposed in the House of Commons, and expected the Whigs should all come into, in return for the great services he had lately done them. The following year, on occasion of the proposals for peace made by the French at Gertruydenberg, Somers strongly recommended the continuance of the war. He had of course gone along, apparently, with his colleagues in the prosecution of Sacheverell, in 1709; but Swift, in his 'History of the Four Last Years of Queen Anne,' tells us that he had heard from Lord Somers himself that he was against engaging in that foolish business, as foreseeing that it was likely to end in the ruin of the Whig party.

There is a curious note to Burnet's 'History of his own Time,' by Mr. Speaker Onslow, in which he relates some negociations that were carried on with Harley by Somers, Halifax, and Cowper, a short time before the change of ministers in 1710, on the basis of an overture made by Harley for keeping them in place, if they would consent to the substitution of himself and some of his friends for the lord treasurer (Godolphin) and his dependants. Onslow says that he had his information from Sir Joseph Jekyl, 'who,' he adds, 'had it very likely, and I think he said so too, from the Lord Somers, to whom he was brother-in-law.' The negociation was broken off in consequence of the opposition of Lord Wharton, who expressed his detestation of having anything to do with Harley.

Somers continued to take part occasionally in the debates of the House of Lords after his second dismissal from office; but the infirm state of his health is said by this time to have somewhat affected his intellect. In 1713 we find him joining in support of the factious motion brought forward by a section of the opposition, for leave to bring in a bill to dissolve the Union. 'I had it,' writes Onslow, 'from good authority (the late Sir Robert Monroe, then of the House of Commons), that at a meeting upon it at my lord Somers's house, where Monroe was, nobody pressed this motion more than that lord!" He resumed his place at the council-board after the accession of George I.; but his faculties were now almost gone. It is related, however, that he took an interest in the progress of the Septennial Bill, which he declared 'he thought would be the greatest support possible to the liberty of the country.' At last a stroke of apoplexy occasioned his death, on the 26th of April, 1716.

Lord Somers was never married, though it is stated by the author of the Memoirs of his Life, that when he was solicitor-general he paid his addresses to a daughter of Sir John Bawdon, a London alderman, and that he went so far in the matter as to deliver in a rental of his estate, after several meetings with the lady's friends; 'but,' concludes the story, 'the treaty broke off on account of a difference about the marriage-portion and settlement, to the great regret of the lady, when she found him made lord keeper of the great seal in two years' time.' His estates descended to the family of his sister, who was married to Charles Cocks, Esq., M.P., whose grandson, the father of the present Earl Somers, was created Baron Somers in 1784.

The character of Lord Somers has been elaborately drawn by Addison in one of the numbers of the 'Freeholder' (published 14th May, 1714), but with considerable wordiness, and something perhaps of the air of insincerity which commonly attaches to a formal panegyric. He had been an early and zealous patron of Addison, who had obtained his notice by inscribing to him his early poem on the campaigns of King William, and who afterwards dedicated to him his 'Travels in Italy,' and the first volume of the 'Spectator.' There is much more force in the more shaded picture of him which Swift has given in his 'History of the Four Last Years of Queen Anne;' nor perhaps, taken with the proper allowance, does it convey a less correct notion of the man.

The collection commonly called the 'Somers Tracts,' which has been twice printed, first in 1748, in 16 volumes, 4to., secondly, in 1809-15, in 13 volumes, 4to., under the superintendence of the late Sir Walter Scott, consists of scarce pamphlets selected, as the title intimates, principally from the library of Lord Somers. A valuable collection of original letters and other papers left by his lordship was unfortunately consumed in a fire which happened in the chambers of the Honourable Charles Yorke, then solicitor-general, in Lincoln's Inn Square, on the morning of Saturday, the 29th of January, 1752. Mr. Yorke's father, the Lord Chancellor Hardwicke, married Lord Somers's niece, Miss Margaret Cocks.

SOMERSET, EARL OF. [JAMES I.]

SOMERSET, EDWARD SEYMOUR. [EDWARD VI.]

**SOMERSETSHIRE**, an English county, situated on the shore of the Bristol Channel, by which it is bounded on the north and north-west sides. On the north-east it is bounded by Gloucestershire, from which it is in part separated by the river Avon; on the east by Wiltshire; on the south-east and south by Dorsetshire, and a small detached part of Devonshire; and on the south-west and west by Devonshire. Its form is irregular; the greatest length is from east by north to west by south, from the neighbourhood of Bath to Exmoor on the Devonshire border, 70 or 71 miles; the greatest breadth at right-angles to the length is from the coast at the mouth of the Avon to the Dorsetshire border between Milborne Port and Stalbridge, 40 miles. A small detached portion of the county is entirely surrounded by Dorsetshire; it lies between Sherborne and Blandford. The total area of Somersetshire is 1645 square miles: it is the seventh English county in respect of size, ranking next below Lancashire, and next above Hants.

The population by the different enumerations of the present century was as follows:—

| Year of census. | Population. | Increase per cent. |
|---|---|---|
| 1801 | 273,750 | — |
| 1811 | 303,180 | 12 |
| 1821 | 355,314 | 17 |
| 1831 | 404,200 | 13 |

The last enumeration gives 246 inhabitants to a square mile. In amount of population it is the eighth English county, being below Staffordshire, but above Norfolk; and in density of population the eleventh, its place being being between Nottinghamshire and Leicestershire. Taunton, which has the best claim to be regarded as the county town, is 133 or 134 miles in a direct line west by south of the General Post-office, London; or 141 miles by the road through Basingstoke, Andover, Amesbury, Bruton, Castle-Cary, Somerton, and Langport.

*Surface, Coast-line, and Geology.*—Somersetshire is a hilly county; but the ranges of hills are separated by low marshy flats; so that, hilly as it is, it yet exceeds most counties in the extent of its fens. The north-eastern part is occupied by the eminences round Bristol and Bath, through which the Avon makes its way. These eminences are irregularly grouped, and extend along the north-eastern border, from Pill on the Avon below Bristol into Wiltshire: many of the valleys or 'combes' which separate the hills are drained by small streams which flow into the Avon. The principal heights in this part of the county are, Falkland Knoll near Norton St. Philip, between Bath and Frome; Lansdown (813 feet high), and Claverton, Combe, and Odd downs, near Bath; Dundry hill (790 feet high); Mays knoll, Cadbury, Sims, and North hills, which are summits of Broadfield down, south of Bristol; and Leigh down, west of that city.

The summits of the hills in the immediate neighbourhood of Bath are of the oolitic formations. The great oolite, the most important of these, which furnishes the fine-grained freestone commonly known as Bath stone, has a thickness probably of 130 to 150 feet. Masses-of this rock are found scattered on the slopes of the hills which it crowns, covering the subjacent clays and fullers'-earth, which, with the inferior oolite and calcareous sand, constitute the lowest members of the oolitic group, and form a terrace projecting into the subjacent valleys, beyond the great oolite and connected rocks which crown the summits of the hills. Sometimes these lower oolitic beds form outlying eminences, such as Stantonbury hill, Dundry hill, and Mays knoll. The inferior oolite is extensively quarried in Dundry hill, where it yields a good freestone. The general inclination of the strata of all these formations is to the south-east, but with a very small angle. Some remarkable derangements and dislocations are observable.

The oolites rest on a platform of the lias formations, which appear on the lowest part of the slope of the oolite hills, or form detached hills to the south-west of them.

The valley of the Avon, and the other valleys which separate these hills, and are drained by streams flowing into the Avon, are occupied by the formations of the red marl or new red sandstone group. In some places the newer magnesian or conglomerate limestone, which underlies the new red sandstone, rises to the surface: it occasionally crowns the summit of the hills, but more usually is found in horizontal strata resting against the elevated beds of the coal-measures or of the mountain limestone, which latter, with the old red sandstone, forms the constituent mass of Leigh down and Broadfield down near Bristol. These two masses of mountain limestone are surrounded by the magnesian limestone conglomerate. The mountain limestone of Leigh down is prolonged across the Avon, and forms the well-known precipices of St. Vincent's rocks, Clifton, between which that river flows. Broadfield down has two precipitous combes or valleys, Cleve and Brockley, less magnificent than the defile of Cheddar, but possessing, from the abundance of wood, more beauty.

The coal-measures, mountain limestone, and old red sandstone belong to the carboniferous group of the Somersetshire and South Gloucestershire coal-field, and occupy the northern part of the county extending to the Mendip hills, though covered in most places by more recent formations. In this field are numerous coal-pits: the chief of them are in those parts (Bedminster, Nailsea, and the valley of the Chew above Keynsham) where the coal-measures have been denuded; but several are in the valley of the Midford brook, which extends from Combe Monkton near Bath to High Littleton, and in the adjacent valley, which extends from Combe Monkton to Radstock, where they are sunk through the superincumbent strata of the red marl, the lias, and even the lower oolite: this last is the case in a pit near Paulton, which is probably unequalled in the number of formations through which it passes before it reaches the coal: it penetrates through strata which in other parts would probably have an aggregate thickness of 2000 feet, but are here reduced, in consequence of the thinning out of many of the beds, to less than 500 feet.

The eastern side of the county, extending from Bath by Frome, Bruton, and Castle Cary to Yeovil, and the southern side, from Yeovil by Ilminster to Wellington, are occupied by hills of similar geological character to those around Bath, and uniting with them in the neighbourhood of that city. The lower slopes, with some outlying eminences or ranges projecting to the west or north-west, consist of lias, upon which rest the lower oolitic formations, and upon these again the great oolite, with its connected beds. Rocks of the middle system of the oolitic formations and of the green-sand formation, and even chalk, are found in several places along the border of the county. This range is divided into detached parts by the transverse valleys of the Brue, the Yeo or Ivel, the Parret, and the Isle; and that portion which lies west of Ilminster overlooks to the north the vale of Taunton, which is occupied by the new red sandstone, and is watered by the Tone. Among the eminences of this range are Barrow hill, north-west of Frome; Roddenbury hill, near Longleat park; Long Knoll (chalk); and the site of Alfred's tower, south of Frome in Selwood; May's down, near Shepton Mallet; Lamyat beacon, near Bruton; Ash beacon, near Milborne port; Hamden hill and St. Michael's hill, between Ilchester and Crewkerne; Shave Lane hill, near Crewkerne; and Buckland down, Staple hill, and the Black Down hills (green sand and chalk marl), south of Taunton. Good freestone is quarried in the inferior oolite, near Shepton Mallet, and at Norton-under-Hamden, between Ilchester and Crewkerne; and the lias is much used for building cottages in the neighbourhood of Ilchester.

The Mendip hills are a distinct range stretching from west by north to east by south, and separated from the hills about Bath and Bristol by the narrow valley of the Yeo or Yow, a small stream which flows into the Bristol Channel near Weston. They extend at their western end to the coast, and unite at their eastern extremity with the hills near Frome. The length of the Mendips may be estimated at 25 miles, their breadth between Stoke Rodney and West Harptree at 6 or 7. 'This chain consists of a central axis of old red sandstone, flanked on its opposite declivities by parallel bands of mountain limestone, dipping from it in opposite directions in angles varying from 30° to 70°. This central axis is not however visible throughout its whole course, being occasionally overarched and concealed by the calcareous strata; but it appears in four ridges, forming the most elevated points of the chain, and disposed at nearly equal distances through its length. The cavern of Wokey hole, and the defile of Cheddar cliffs, with its long line of stupendous mural precipices, certainly among the most magnificent objects of this kind in Britain, are the well-known features of this chain.' (Conybeare and Phillips.) The cavern at Wokey, or Wookey, is not in the mountain limestone, but in the calcareo-magnesian formation which abuts against it, near the foot of the chain, on every side; of English caverns it yields in extent only to those of the Peak in Derbyshire. It is described in Dr. Maton's 'Observations on the Western Counties,' vol ii., p. 136, &c. The mineral treasures of the Mendips are important; zinc and calamine are obtained abundantly in the central and western part of the range. Lead was formerly procured; but the works, from the exhaustion of the ore, or the difficulty of procuring it, have been given up. There are numerous coal-pits in the villages which lie north-west of Frome. The argillaceous beds of this coal-formation have been remarkably contorted, apparently by the force which elevated the adjacent harder rocks (mountain limestone and old red sandstone) in mass. The coal-seams are all thin, hardly any exceed three feet; nor could they be profitably worked, but for the highly improved state of the machinery. The Mendips rise in some parts to more than 1000 feet. Their principal summits are —Worle hill, near Weston-super-Mare; Banwell hill, Sandford hill, Dolberry warren, and Burrington Ham, between Worle and Blagdon, overhanging the valley of the Yeo, north of the chain; Bleadon hill, Wavering down, and Shutshelve hill, overhanging the valley of the Ax, below Cheddar; Black down (old red sandstone), in the axis of the range, north of Cheddar; West hill, North hill, and Egar hill (all in the old red sandstone), between Cheddar and Chewton Mendip; Pen hill (old red sandstone) and Milton hill, north of Wells; and Masberry castle and Beacon hill (both old red sandstone), north of Shepton Mallet.

The long low ridge of Pawlet or Polden hill and the connected hills is an offset from the eastern hills between Castle Cary and Ilchester. It extends about 20 miles in a direction parallel to the Mendips, from which it is separated by a wide intervening fenny flat, drained by the Brue, and comprehending East Sedgemoor and the adjacent moors. Among the higher points of this range, which consists of lias resting on the new red marl or red sandstone, are Kingweston down, Butleigh hill, Dundon beacon (360 feet), Moorlynch (330 feet), Cook hill, and Ball hill. Some detached knolls of lias, and a tract of new red marl crowned with some lias, or oolitic eminences, rise out of the fens between the Polden and the Mendip hills; such as Brent knoll, near the sea, and Glastonbury Tor, or Chalice hill, near Glastonbury. Gypsum occurs abundantly in the red marl on the south side of Polden hill near Somerton.

In the western part of the county, running north-west from the neighbourhood of Taunton to Bridgewater bay in the Bristol Channel, bounding the valley of the Parret after the junction of the Tone, are the Quantock or Quantox hills. They consist of an elevated mass of a coarse gritstone (with some portions of killas), and belong to the slate formation which overspreads the north of Devonshire, separated however from the principal slate district by an intervening tract of new red sandstone, which formation nearly surrounds the foot of the range. At the northern foot of the hills lias occurs, covering both the red sandstone and the slates. The principal summits of the Quantock range are—Thorncombe barrow, Hurley beacon, Doucebury or Danesborough (1092 feet), Fire beacon, Bagborough station of Will's-neck (1270 feet), Cothelston lodge (1660 feet), and Buncombe hill. The length of the Quantock hills is about 14 miles. Their greatest breadth is about 5 or 6 miles, or, including the hills which are thrown off from the principal range toward the bank of the Parret, about 9 or 10 miles. Limestone is procured in the hills, and gypsum in the new red marl formation of the adjacent coast, near Watchet. Some veins of copper have been found and worked, but with little advantage.

The greater part of the county west from the narrow tract of new red sandstone which separates the Quantock hills from the principal district of the slate rocks, is occupied by an irregular hilly district, forming part of the wild moorlands of Exmoor forest, extending into the two counties of Devon and Somerset. This hilly district is bounded on the south by the valley of the Tone, and on the north by the Bristol Channel. It is occupied by the slate rocks of the Devonian range; but in some of the valleys near the coast these are covered by the rocks of the new red sandstone group. The principal eminences are—Oare hill, Porlock hill, North hill (824 feet), Grabbist hill (906 feet), Croydon hill, and Old Cleeve hill, near the coast; and Ox-Head hill, Dure down, Ashcombe hill, Span head, Shear down, Black Barrow down, Lucott hill, Dunkerry beacon (1668 feet), Winsford hill, Exton hill, Lype hill, and Brendon hill (1210 feet) more inland. Slate is quarried in these hills near Wiveliscombe.

The measurements of heights given above are from the Ordnance Survey, except Doucebury, North hill, and Grabbist hill, which are given by Mr. Leonard Horner, and Brendon hill, which is given by Mr. S. Woods. The latter gentleman has estimated North Hill at 1000 feet, and Dunkerry Beacon at 1784 feet.

There are mineral springs at Bath, Glastonbury, Alford, near Castle Cary, and Queen Camel, near Ilchester. Most, if not all of these, are found in a stratum of marl between the lower oolite and the lias formations. Others are enumerated by Collinson, in his *History of Somersetshire*.

The coast from the mouth of the Avon (which separates Gloucestershire from Somersetshire) runs about 15 or 16 miles south-west to Sand Point. For about 2 miles from the mouth of the Avon, it is low and marshy, but at Portishead point, near the village of Portishead, the coast rises, and low cliffs skirt the shore, with one or two slight intervals, for 7 miles to the quiet watering-place of Clevedon. Between Portishead and Clevedon is a continuous range of hills, formed by an outlying mass of mountain limestone and old red-sandstone, separated from Leigh down by a low marshy valley; the cliffs are formed on the side of these hills. For nearly 5 miles beyond Clevedon the shore is lined with the marshes through which the Yow or Yeo and some other small streams flow into the sea; but between St. Thomas's head and Sand point is a range of cliffs of about a mile in length, worn in the face of a mountain-limestone hill. From Sand point the coast runs southward to Brean down, a hill of mountain limestone, precipitous on every side, and surrounded by the sea except just at its eastern end, where a marshy flat connects it with the mainland. Between Sand point and Brean down, which are distant nearly 5 miles in a straight line, the coast forms two bays, Sand bay and Uphill bay, separated by the intervening cliffs of Anchor head. This headland is the extremity of Worle hill, one of the Mendips, composed of mountain-limestone, on the sides of which the magnesian or conglomerate limestone rests, and upon this the lias. The two bays are filled with sand, dry at low-water; on Uphill bay, just at the foot of Anchor head, is the little watering-place of Weston-super-Mare.

Between Brean down and Little Stoke point, which is distant from Brean down 10 miles in a direct line south-west, is the bay usually called Bridgewater bay, although the town of Bridgewater lies some miles up the Parret inland. The coast from Brean down runs about 7 miles almost in a direct line due south to the æstuary of the Parret, forming one side of the bay, and then gradually turning westward runs about 7 or 8 miles in an irregular line to Little Stoke point. The greater part of the shore of the bay is formed by sand hills, bounding the marshes which extend between the Mendip hills and the lower offsets of the Quantock range. Polden hills and the detached knolls which rise out of this flat do not, any of them, reach the shore. This flat district appears to have been once covered by the sea, but not within the period of authentic history. Toward the western extremity of the bay, between Catsford and Little Stoke point, the coast is higher, and is lined for the last 3 miles of its extent by lias cliffs; where the lower Quantock hills abut on the sea, at Little Stoke point, the cliffs are interrupted by a very narrow interval of marsh land, through which a small stream flows into the sea.

From the extremity of Bridgewater bay the coast runs westward 25 miles to the boundary of the county. For the first 9 miles, to the little watering-place of Blue Anchor, it continues to be lined by the lias cliffs of the Quantock range, with one or two trifling interruptions. These cliffs sometimes rise to the height of 100 feet (Conybeare and Phillips) or even 200 feet. (Collinson, *Hist. of Somerset.*) From Blue Anchor to Minehead, about 4 miles, the coast, which forms a shallow bay, is lined with marshes; at the back of which, about a mile inland, Grabbist hill rises. From Minehead to Bossington point, 5 miles, are lofty cliffs, formed in the face of the slate rocks of North hill. At Bossington point the cliffs cease, and the eastern side of the shallow bay of Porlock, which is 5 miles between its extremities, is formed by a low shore: but the cliffs reappear on the western side of the bay, and continue nearly to the boundary of the county: these last cliffs are formed in the slate-rocks of Oare and Porlock hills. The coast is lined, with very little interruption, by sands, but, excepting in Sand bay, Uphill bay, and Bridgewater bay, they have little breadth. These three bays are filled up with sand, dry at low-water, except in the channel of the Parret: the sands in Bridgewater Bay have in one part a breadth of three miles. The only islands are Stert island and Fenning's island, in the marshes at the mouth of the Parret; and Flat Holm (magnesian or conglomerate limestone) and Steep Holm (mountain limestone) in the midst of the Bristol Channel. These two islands are both girt with cliffs: there is a lighthouse on Flat Holm opposite Brean down. The only harbours of any importance are formed by the rivers Avon and Parret. The roadstead of King's Road is at the mouth of the Avon. Some shipping trade is carried on from the towns of Porlock, Minehead, and Watchet.

*Hydrography, Communications, &c.*—The general direction of the rivers is to the north-west: the only material exception is in the case of the Tone and the upper part of the Bristol Avon. The larger rivers (except the Tone) rise in the adjacent counties, and pass through the depressions which break the continuity of the border hills.

The Avon, distinguished from the Warwickshire river so called, by the title of the Lower Avon, rises in Gloucestershire, on the eastern slope of the Cotswold hills, and flows through Wiltshire by Malmesbury, Chippenham, Melksham, and Bradford; below which it reaches Somersetshire, and has a farther course, on or within the border of the county, of 31 miles into the Bristol Channel or æstuary of the Severn at King's Road. Its course to the border of the county is for the most part southward; but after that it flows northwest by Bath, having a winding course between the oolite and mountain limestone hills of the north-eastern border. It is navigable up to Bath (where the Kennet and Avon canal locks into it) for barges, and to Bristol for sea-borne vessels, the largest class of which, owing to the great rise of the tide, reach the quays of the town without any difficulty, though it is 8 miles, following the winding of the channel, above its mouth. At the mouth of the Avon the spring tides usually rise 40 feet, and have been known to rise 50 feet.

The Avon receives the Frome, the Midford brook, above Bath, and the Chew at Keynsham. The Frome rises not far from Bruton, flows northward past the town of Frome, and joins the Avon between Bradford and Bath: its course (of about 20 miles) is within or upon the border of Somersetshire.

The Avon is connected with the Thames by the Kennet and Avon canal, of which a portion is in this county; it enters by the Dundas aqueduct over the Avon, and then follows the valley of that river to Bath. The Somersetshire coal canal is cut from the coal-works near Paulton into the Kennet and Avon canal on the border of the county: it is 9¼ miles long. Connected with this canal is a railway from the adjacent coal-works at Radstock. Acts were obtained some years since for a canal to connect the Dorsetshire Stour at Blandford Forum with the Avon: it was to follow the valley of the Frome, but was never executed.

The Yow or Yeo rises at Compton Martin on the northern slope of the Mendip Hills, and flows north-west 13 miles between them and Broadfield Down into the Bristol Channel. The Axe rises in Wookey Hole or Cavern, on the southern side of the same hills, near Wells, and flows north-west 21 miles through the flats at their foot; it is navigable to the village of Lower Weare, near Axbridge, about 11 miles above its mouth, following the natural channel of the river; but this distance has been shortened to 9 miles by one or two cuts.

The Brue rises on the slope of the chalk marl and green-sand hills, on the border of Somerset and Dorsetshire, and flows westward by Bruton and Glastonbury, 36 miles through the marshy flat between the Mendip and the Polden Hills into the æstuary of the Parret. It is not navigable; but the lower part of its course is included in the Glastonbury navigation, for which an act was obtained A.D. 1827. The navigation from Glastonbury to the Brue is by a canal running nearly parallel to the river.

The Parret, antiently the Pedred, the principal river in the county, rises in the chalk downs at South Perrot, near Beaminster in Dorsetshire. It reaches the border of Somersetshire about a mile from its source, and flowing northward for 15 miles, traverses the oolitic border hills by a depression near Crewkerne and passes by South Petherton to Langport, receiving the Isle or Ile on its left bank, and the Yeo or Ivel on the right. From Langport the Parret flows north-west 12 miles, through a marshy flat to Bridgewater, receiving midway between that town and Langport the Tone on the left bank. Below Bridgewater the Parret has a winding course of 16 miles into Bridgewater Bay, in the British Channel, receiving the Cary on its right bank, and uniting just at its outfal with the Brue. The whole course of the river is thus about 43 miles; but the computation would be considerably higher were the Tone or the Yeo regarded as the principal stream.

The Isle or Ile rises in the slope of an outlying chalk hill between Chard and Crewkerne, and flows north and north-east 15 or 16 miles into the Parret, through marshes which cover the lias formation. It passes near Ilminster, but not through it. The Yeo or Ivel rises amid the oolite border hills near Milborne Port; and flows south and south-west, and then north-west 11 miles, through a valley amid the oolite hills, past Sherborne in Dorsetshire to Yeovil, receiving several streams from the Dorsetshire chalk downs on the left bank. From Yeovil it flows 8 miles in a circuitous course north-north-west to Ivelchester or Ilchester, and from thence 7 miles west-north-west, making 26 miles in all, into the Parret at Langport. All this part of its course is through marshes, which cover the lias and new red-sandstone formations. The Tone rises in the southern slope of Brendon hill, and flows 10 miles south to the border of Devonshire; its course thus far is through the hills of the slate formation in which it rises. It then turns eastward and flows 23 miles through the new red-sandstone formations of the vale of Taunton, past the town of Taunton into the Parret. The Cary rises in the oolite border hills near Castle Cary, and flows westward through the lias and new red-sandstone, and through the marshes which cover them, into the Parret; its whole course is about 30 miles.

The navigation of this system of rivers commences at Ilchester on the Yeo, which is navigable for 7 miles into the Parret at Langport; this is sometimes called the Ivelchester and Langport Canal. A little above Langport the navigation of the Parret commences, and continues to the mouth of that river. Ships of 200 tons can get up to Bridgewater. The Tone is navigable from Taunton to its junction with the Parret ten or eleven miles. The Carey is not navigable.

It was intended to make a canal from Morgan's Pill in the Avon six miles below Bristol, to the neighbourhood of Taunton, where it was to unite with the intended 'Grand Western Canal' from Exeter. There were to be two branches, one to the coal-works at Nailsea, and one to Axbridge and Cheddar. The act was obtained, A.D. 1811, and the project taken up with apparent spirit; but thirteen years afterwards (A.D. 1824) another act was obtained, abandoning the greater part of the line, retaining only the portion between Bridgewater and Taunton, which has been made. A branch to Chard is in progress if not finished. The Grand Western Canal was designed to follow the valley of the Tone from the border of the county to Taunton. Acts were obtained A.D. 1796, 1811, and 1812, but the canal has never been executed. The English and Bristol Channels ship canal was to cross the county by Chard and Bridgewater, but this undertaking, for which an act was obtained A.D. 1825, has been given up.

The river Exe has its source and the upper part of its course in the western extremity of Somersetshire, to which some of its first affluents belong, but this river belongs chiefly to Devonshire.

The two principal coach roads from London to Bristol (one by Calne and Chippenham, the other by Devizes and Melksham) enter the county near Bath, before reaching which city they unite; the road from Bath to Bristol through Keynsham is wholly in this county. The mail-road from London to Exeter through Salisbury crosses a corner of the county between Shaftesbury and Sherborne, and re-entering it beyond Sherborne, passes through Yeovil, Crewkerne, and Chard. The Falmouth mail-road by Amesbury enters the county between Mere (Wilts) and Wincanton, and runs through Ilchester and Ilminster. A road from Bristol runs by Axbridge to Bridgewater, from whence one road leads near the coast by Watchet, Dunster, and Minehead to Porlock, and from thence to Ilfracombe in Devonshire; a second by Milverton and Wiveliscombe to Barnstable, Devon; and a third to Taunton, and from thence either by Wellington and Collumpton (Devon) or by Honiton (Devon) to Exeter. A road from Bath leads by Wells and Glastonbury to Taunton; and roads from Bristol and Bath unite at Shepton Mallet, and proceed by Castle Cary and Yeovil to Dorchester. The road from London by Devizes and Trowbridge to Frome enters the county a little beyond Trowbridge. From Frome a road leads on one hand to Shepton Mallet, Glastonbury, and Taunton; and on the other to Bruton, Castle Cary, and Ilchester.

The Great Western railway, now open throughout the whole line, enters the county near Bath, and runs by Bath to Bristol, where it is connected with the Bristol and Exeter railway. The Box tunnel, near Bath, is close on the border of this county. The Bristol and Exeter railway commences at Bristol, and runs south-west between Leigh down and Broadfield down through the Nailsea coal-field, where there is a short branch, to Weston-super-Mare; its course is then south by Bridgewater to Taunton, where it inclines to the south-west, and passes by Wellington into Devonshire. There is one tunnel just on the border of the county, under White Ball hill, between Wellington and Collumpton. This railway is open from Bristol to Bridgewater.

*Agriculture.*—The county of Somerset possesses a soil and climate well suited to the growth of wheat and all the agricultural produce usually raised in any part of England. The hills do not rise to any great height, and are mostly cultivated or in profitable pasture. There is a fair proportion of woodland without any extensive forests. In some of the vales, such as the extensive vale of Taunton, the soil is of a rich nature, and the wheat which is produced there is of superior quality, so as to be much sought after for sowing in other parts of the country. Excellent butter and cheese are made where the land is better adapted to pasture. The Cheddar cheese, which, from its superior quality, gives its name to a great portion of the cheese made in the county, is reckoned by many to be the best cheese made in England, from pure milk without any addition of cream: the real Cheddar cheese is consequently scarce, and bought up as soon as it is made.

The cows are mostly of the Devon breed; but many short-horns are also to be found in the dairies. The oxen fatted are either Devons or Herefords and short-horns. Many of the landed proprietors have farms in their own hands, and show their tenants an excellent example in the choice of their cattle and sheep, and in introducing improvements in the cultivation of the soil, so that the state of agriculture has greatly improved within a few years: better implements are used, and more profitable rotations of crops are introduced than in the old triennial system.

The sheep on the best lands are of the Leicester or South Down breeds, with crosses between these and the Cotswold sheep, which increases their size. Some Dorset ewes are kept for early lambs, which are fatted for the Bath and Bristol markets. The railway which now traverses the county will probably increase this species of industry.

There are a few hops grown in the county, but no very extensive hop-gardens; nor is there much cider made, although there are some good orchards.

Many hogs are fatted, and very good bacon is cured; the breed of pigs is like the Hampshire and Berkshire, which have of late years been improved by crosses with the Essex and Neapolitan breeds. Greater attention is paid to the breed of pigs than formerly.

The farm horses are generally strong and active; and although some heavy waggons and old-fashioned ploughs are still met with, light carts and ploughs begin to be appreciated and gradually supersede the old implements. Somerset is decidedly improving in its agriculture, and keeps pace with the progress which is visible throughout the whole kingdom. There are many important fairs in the county. The principal are:—

Ashbrittle, Feb. 25, Oct. 16; Ashcott, Jan. 9; Ashill, Easter Wed., Sept. 12; Axbridge, Feb. 5, Mar. 25, June 11, Oct. 28; Backwell, Sept. 21; Bagber-West, May 12; Banwell, Jan. 18, July 18; Bath, Feb. 14, July 10; Binegar, Whit-Wed. and Th.; Bishop Lydeard, April 5, Sept. 9; Blagdon, last Fri. in Aug.; Bridgewater, 2nd Th. in Lent, June 24, Oct. 2, 3, Dec. 28; Bristol, Mar. 1, Sept. 1; Broadway, Sept. 14; Broomfield, Nov. 13; Bruton, April 23, Sept. 17; Buckland, Oct. 10; Buckland St. Mary, Sept. 21, 22; Burnham, Trinity-Mon.; Castle Cary, Tu. after Palm-Sun., May 1, Whit-Tu.; Chard, 1st Wed. in May, Aug., and Nov.; Cheddar, May 4, Oct. 29; Chesilborough, last Th. in Oct.; Cockhill, Jan. 8; Coombe St. Nicholas, June 19, 1st Wed. after Dec. 10; Congresbury, Sept. 14; Crewkerne, Sept. 4; Crowcombe, 1st Fri. in May, Mon. after Aug. 1, Oct. 31; Curryrivel, last Wed. in Feb., first Mon. after Lammas-day; Decuman's, St., Aug. 24, Sept. 17; Dulverton, July 10, Nov. 8; Dundry, Sept. 12; Dunster, Mon. in Whitsun-week; Draycot, Sept. 10; East Brent, Aug. 28; Freshford, Sept. 6; Frome, Feb. 24, July 22, Sept. 14, Nov. 25; Glastonbury, Wed. in Easter week, Sept. 19, Oct. 11; Hinton St. George, April 23; Holloway, May 14; Huntsfield, June 29; Ilchester, Mon. before Palm-Sun., July 2, Aug. 2; Ilminster, last Wed. in August; Ivelchester, Mon.-fortnight before Easter, July 2, Aug. 2; Keynsham, Mar. 24, Aug. 15; Kilmington, Aug. 29; Kingsbrompton, Wed. before Holy Th., Th. se'nnight after Oct. 10; Langport, Mon. before Lent, 2nd Wed. in Aug., 2nd Mon. in Sept., last Mon. in Nov.; Langridge, Aug. 2; Lansdown, Aug. 10; Lifford Green, Holy Th., Aug. 12; Limpsham, April 25; Lyng, last Mon. in Aug.; Martok, Tu. before Whit-Sun., Aug. 10, Sept. 15; Martock, 2nd Th. in Oct.; Milborne Port, June 5, Oct. 28; Mells, Mon. after Trinity, Sept. 29; Midsummer Norton, April 25; Milverton, Easter-Tu., July 25, Oct. 10; Minehead, Wed. in Whitsun-week; Moorlinch, Aug. 20; Montacute, May 9, Sept. 27; North Curry, 1st Tu. in Sept.; North Petherton, May 1, Nov. 7; Nunny, Nov. 11; Otterford, Nov. 28; Pensford, May 6, Nov. 8; Petherton, July 6; Phillips Norton, Mar. 21, 27, May 1, Aug. 29; Pilton (near Shepton Mallet), 1st Mon. after Sept. 10; Portlock, Th. before May 12, October 9, Nov. 12; Portbury, Whit-Mon.; Preddy, Aug. 21, 22; Queen Camel, Trinity Th., Oct. 25; Redlyach, June 29; Road, Mon. after Aug. 29; Ruishton, Whit-Mon.; Samford Arundel, Wed. before Easter, 3rd Tu. in Sept.; Shepton Mallet, Fr. after Whit-Mon., Aug. 8; Snowdon, Whit-Th.; Somerton, Tu. in Passion-week, 3rd, 6th, 9th, and 12th Tu. after, Sept. 30, Nov. 8; South Brent, Oct. 10; South Petherton, July 6; Stavordale, Aug. 5; Stoford, June 11, Sept. 28; Stogursey, May 2, Sept. 12; Stogumber, May 6, Aug. 1; Stoke-under-Hamden, April 25; Stowey, Sept. 18; Stucklebridge, Fr. before Holy Th., Wed. after Oct. 17; Taunton, June 17, July 7, 8, 9; Ubley, Oct. 4; Watchet, Nov. 17, Aug. 23; Wedmore, Aug. 2; Wellington, Th. se'nnight before Easter, Holy Th.; Wellow, May 20, Oct. 17; Wells, Jan. 3, May 14, July 6, Oct. 25, Nov. 30; West Pennard, 1st Mon. in Aug.; Weston Zoyland, Sept. 10; White Down, Whit-Mon. and Tu.; Williton, Trinity-Mon.; Wincanton, Easter-Tu. and Michaelmas-day; Winsham, Whit-Wed.; Wiveliscombe, last Tu. in Feb., May 12, Sept. 25, last Sat. in April; Woolavington, Oct. 18; Wootton Courtney, Sept. 19; Yarlington, Aug. 26; Yeovil, June 28, Nov. 17.

*Divisions, Towns, &c.*—The county of Somerset is divided, according to Collinsen (*Hist. of Somersetshire*), into forty hundreds and seven liberties; but in the Population Returns (1831) two of the hundreds are united with others, and two of the 'liberties' are given as hundreds; thus keeping the number of hundreds forty. The remaining liberties are not noticed. The towns of Bath, Taunton, and Bridgewater, which are given separately in the Population Returns, we have included in the hundreds in which they are respectively situated.

| Name of Hundred. | Situation. | Area in Acres. | Pop. in 1831. |
|---|---|---|---|
| Abdick and Bulstone | Central | 38,070 | 11,231 |
| Andersfield | Central | 10,950 | 2,764 |
| Bath-Forum (including the City of Bath) | N.E. | 16,530 | 59,172 |
| Bempstone | N.W. | 24,530 | 7,328 |
| Brent with Wrington | N.W.& Central | 18,210 | 4,828 |
| Bruton | E. | 14,250 | 4,490 |
| Cannington | N.W. | 25,480 | 5,695 |
| Carhampton | W. | 60,350 | 8,102 |
| Catsash | Central | 25,340 | 7,516 |
| Chew and Chewton | Central | 46,700 | 17,832 |
| Crewkerne | S. | 13,260 | 6,847 |
| Curry (North) | Central | 12,940 | 4,211 |
| Frome | E. | 32,900 | 19,884 |
| Glaston-twelve-hides | Central | 24,610 | 6,366 |
| Hampton and Claverton (liberty or hundred) | N.E. | 2,610 | 687 |
| Hartcliffe with Bedminster | N. | 19,440 | 17,047 |
| Horethorne | S.E. | 26,370 | 7,663 |
| Houndsborough, Berwick, and Coker | S. | 18,890 | 8,163 |
| Huntspill and Puriton | N.W. | 6,800 | 2,012 |
| Keynsham | N. | 24,520 | 9,029 |
| Kilmersdon | Central | 15,400 | 6,629 |
| Kingsbury (East and West) | S.W.& S. | 36,690 | 19,062 |
| Martock | Central | 6,930 | 2,841 |
| Mells and Leigh (liberty or hundred) | Central | 4,720 | 1,899 |
| Milverton | S.W. | 15,250 | 4,634 |
| Norton Ferris | E. | 18,730 | 5,099 |
| Petherton (North), including Bridgewater | Central | 26,730 | 13,697 |
| Petherton (South) | S. | 14,680 | 6,267 |
| Pitney | Central | 3,690 | 1,923 |
| Portbury | N. | 23,980 | 9,333 |
| Somerton | Central | 25,450 | 5,452 |
| Stone | S.E. | 10,720 | 7,433 |
| Taunton and Taunton Dean, including the borough of Taunton | Central | 43,240 | 22,427 |
| Tintinhull | Central | 7,450 | 4,493 |
| Wellow | N.E. | 21,900 | 8,974 |
| Wells-Forum | Central | 30,090 | 11,420 |
| Whitestone, or Whitstone | Central | 33,150 | 12,412 |
| Whitley | Central | 49,640 | 12,794 |
| Williton and Freemanners | W. | 114,870 | 14,717 |
| Winterstoke | N.W.& Central | 62,030 | 19,511 |
| | | 1,028,090 | 402,776 |
| Militia under training | | | 1,424 |
| | | | 404,200 |

*Liberties, enumerated by Collinson.*

Hampton and Claverton,

Mells and Leigh.—These are enumerated above as hundreds.

Easton and Amrill, included in Bath-Forum hundred.

Hinton and Norton, included in Wellow hundred.

East Cranmore, included in Frome and Wells Forum hundreds.

Hill-House, included in Frome hundred.

Witham Friary, included in Frome hundred.

Somersetshire contains the cities of Bath and Wells, and a part of the city of Bristol; the parliamentary boroughs of Taunton, Bridgewater, and Frome; the municipal (but not parliamentary) boroughs of Axbridge, Chard, Glastonbury, Ilchester, Langport, Milborne Port, and Yeovil; and the market-towns of Bruton, Castle Cary, Crewkerne, Dulverton, Dunster, Ilminster, Milverton, Minehead, South Petherton, Shepton Mallet, Somerton, Watchet, Wellington, Wincanton, and Wiveliscombe. To these may be added, as places of some consequence, Bedminster, Backwell, Brislington, Long Ashton, Nailsea, Clevedon, Pill, and Keynsham, all near Bristol; Bathwick, Lyncomb and Widcomb, Bath-Easton, Weston, and Twiverton, all near Bath; Beckington and the other villages supported by the woollen manufacture near Frome, and the villages in the Mendip coal-field north-west of that town; North Petherton and Huntspill, near Bridgewater; Cheddar, Banwell, Burnham, Wedmore, Wrington, and Congresbury, near Axbridge; Merriot, near Crewkerne; East Coker, Montacute, Stoke-under-Hamden, and Martock, near Yeovil; Curry Revel, near Langport; Porlock and Old Cleeve, near the Bristol Channel; Stogumber, between Watchet and Taunton; and Weston-super-Mare on the sea, between Bristol and Bridgewater. Several of these are given in their respective articles [AXBRIDGE; BATH; BRIDGEWATER; BRISTOL; CHEDDAR; FROME; TAUNTON; and WELLS], the others we notice here, giving first the towns in alphabetical order, and the other places according to their locality. All distances from London are computed from the General Post-office.

Bruton is in Bruton hundred, on the river Brue, from which it gets its name, 112 miles west by south from London, by Andover and Amesbury, and 32 miles east by north from Taunton. The manor of Bruton (or, as it is written in Domesday, Brumetone) was held by the kings Edward the Confessor and William the Conqueror; and was granted by the latter to Sir William de Mohun, whose descendants founded here a priory for black canons, on the ruins of a more antient Benedictine monastery. This priory, at the suppression, just before which it was made an abbey, had a yearly revenue of 480*l.* 17*s.* 2*d.* gross, or 439*l.* 6*s.* 8*d.* clear.

The town stands on the right bank of the Brue, which is here a small stream crossed by a stone bridge, and comprehends one main street, clean and well paved, with neatly built houses, and several smaller streets. The church, which is on the left bank of the river, is large; it comprehends a nave, chancel, side aisles, vestry, and two porches, partly of decorated English, partly of perpendicular architecture, with a pinnacled tower at the west end. Dr. Maton (*Observations on the Western Counties*) and Collinson (*Hist. of Somersetshire*) notice a second and more antient tower on one side of the north aisle. There are no remains of the priory, which was near the church: some parts of it were incorporated in a mansion occupied by the Berkeley family, now pulled down. The town-hall contains a court-room, used for petty sessions; the lower part is used as a market-house. There are an Independent meeting-house, and a well endowed and commodious hospital or almshouse, founded by Hugh Saxey, or Sexey, auditor to Queen Elizabeth; the buildings of this hospital form a spacious quadrangle decorated with a statue of the founder in a niche on the south side.

The area of the parish is 3520 acres; the population, in 1831, was 2223, of which 2031 belonged to the town. The principal manufactures are of stockings and silk: in Leland's time the townsmen were 'much occupied with making of clothe.' The market is on Saturday, and there are two yearly fairs.

The living is a perpetual curacy, of the clear yearly value of 138*l.*, with a glebe-house: it is in the archdeaconry of Wells, in the diocese of Bath and Wells.

There were, in 1833, an endowed free grammar-school, founded by Edward VI., with 11 boys on the foundation and 30 others; Sexey's hospital-school, with 15 boys; and eight other day-schools, with 97 boys and 108 girls; and two Sunday-schools, with 99 boys and 110 girls.

Castle Cary is in the hundred of Catsash, 116 miles west by south from London, by Bruton, and 28 miles east by north from Taunton, by Langport and Somerton. It is called Cari in Domesday. The castle was built or strengthened by William Gouel de Percheval, lord of the place in the reign of Stephen; it was twice besieged in the civil wars of that reign, William de Percheval having taken arms against the king. The earthworks alone remain. Charles II. was in this town in disguise after the battle of Worcester.

The town is irregularly built; the principal street, which is partially paved, but not lighted, extends near a mile on the road to Ilchester; the houses are straggling, but neatly built. The small village of Almsford is so near as almost to form part of the town. Castle Cary church is handsome, and on an elevated site; it comprehends nave, chancel, side aisles, and an embattled western tower. Almsford church is small, but neat. There are Independent and Methodist meeting-houses.

The area of Castle Cary parish is 3640 acres; the population, in 1831, was 1794; Almsford has an area of 920 acres; the population was 304; together 4560 acres and 2098 inhabitants. The market, which is very small, is on Tuesday. There are three fairs and seven great cattle markets in the year.

The living of Castle Cary is a vicarage, of the clear yearly value of 312*l.*; that of Almsford is a rectory, of the clear yearly value of 297*l.*, with a glebe-house: both are in the archdeaconry of Wells, in the diocese of Bath and Wells.

There were in the two parishes, in 1833, seventeen day or boarding schools, with 128 boys and 121 girls; and five Sunday-schools, with 86 boys and 94 girls.

Chard is in the hundred of East Kingsbury, 143 miles west-south-west of London, by Salisbury and Shaftesbury, and 13 miles south-east of Taunton. It is written Cerdre in Domesday, at the compilation of which the manor was held by the bishop of Wells. It is asserted to have been a borough by prescription; it sent members to parliament in the reigns of Edward II. and III., but not since.

The town stands on the high ground on the south border of the county, and consists of several streets irregularly laid out, and lighted with gas: the houses are generally well built. The church, which is on the south side of the town, is a large and handsome cross-church; it comprehends a nave, chancel, side aisles, north and south transepts, and a low tower at the west end. The market-house, formerly used as the borough court-house, is an antient building; as is the present town-hall, formerly a chapel. There are meeting-houses for Baptists and Independents.

The area of the parish is 5140 acres; the population, in 1831, was 5141. The manufactures are chiefly of lace and woollen cloth, in which nearly 500 men are employed; to the introduction of these manufactures the increasing importance of the town may be ascribed. The market is on Monday, it is noted for the sale of potatoes; there are three yearly fairs.

The corporation of Chard, under the Municipal Reform Act, consists of four aldermen and twelve councillors. The borough is not to have a commission of the peace, except on petition and grant. The corporation never possessed any jurisdiction. The limits of the borough comprehend nearly the whole town; and it is proposed to enlarge them so as to comprehend the whole; the borough is distinct from the rest of the parish, as respects the maintenance of the poor.

The living is a vicarage, of the clear yearly value of 436*l.*, with a glebe house; it is in the archdeaconry of Taunton, in the diocese of Bath and Wells.

There were in the parish, in 1833, eight day-schools, one endowed with 15 boys, and seven others, with 110 boys and 105 girls; and three Sunday-schools, with 745 children of both sexes.

Crewkerne is in the hundred of Crewkerne, 135 miles from London, by Salisbury and Shaftesbury, and 19 south-east of Taunton. Crewkerne is written Cruche in Domesday, at the compilation of which it belonged to the king. The town consists of several streets meeting in the market-place, in the centre of which is a commodious market-house; the houses are generally well built. The church is a large cross church, with an embattled tower with pinnacles at the corners, rising from the intersection of the nave and transepts. It is lighted with large windows of perpendicular character, and is remarkable for a small room behind the altar, once used as a confessional. There are meeting-houses for Methodists, Baptists, and Unitarians.

The area of the parish is 5810 acres; the population, in 1831, was 3789. The principal manufacture is of sail-cloth and sacking, which employs a numbers of hands; some dowlas and stockings are also made. There are a well attended corn-market on Saturday and one yearly fair.

The living is a perpetual curacy, of the clear yearly value of 158*l.*, in the archdeaconry of Taunton, in the diocese of Bath and Wells.

There were in the parish, in 1833, seven infant or dame schools, with 121 children of both sexes; a well endowed free grammar-school, with 14 boys; and six other day-schools (two of them with small endowments), with 80 boys and 70 girls; and four Sunday-schools, with 304 boys and 270 girls.

Dulverton is in the hundred of Welliton and Freemanners, 167 miles west by south from London by Andover, Frome, and Bridgewater, and 24 miles west of Taunton. It was a royal manor at the compilation of 'Domesday,' in which it is called Dolvertune. The town stands in a deep valley, watered by the Barle (a feeder of the Ex), over which there is a stone bridge of five arches. The hills round are richly wooded. The town consists of two well-paved streets, with channels of water running through them: the houses are mostly well built. The church is an antient building, comprising nave, chancel, and two side aisles, with an embattled tower, 60 feet high, at the west end. There is an Independent meeting-house.

The parish has an area of 7760 acres, and had, in 1831, a population of 1285. The silk manufacture is carried on on a small scale. The market is on Friday, and there are two yearly fairs.

The living is a vicarage, in the archdeaconry of Taunton, in the diocese of Bath and Wells, of the clear yearly value of 322*l.*, with a glebe-house.

There were in the parish, in 1833, five infant or dame schools, with 37 boys and 49 girls; two day-schools (one endowed) and one boarding-school, with 59 boys and about 30 girls; and two Sunday-schools, with about 124 children.

Dunster is in the hundred of Carhampton, 165 miles west by south from London through Frome and Bridgewater, and 21 miles west-north-west of Taunton. The West Saxon kings had a fortress here during the period of the Heptarchy. It was called Torre (tower), by which name it appears in 'Domesday,' where the manor is said to belong to William de Moion (or Mohun), who had his castle here. This castle afterwards obtained the name of Dunes-torre (tower on the downs), now Dunster. The De Mohuns supported the empress Maud against Stephen. In the reign of Edward III. the castle passed by sale, on the failure of the male line of the De Mohuns, to the Luttrell family, by which it is still held. It was a military post of the Royalists in the civil war of Charles I., and was afterwards the place of confinement of Prynne. Dunster sent members to parliament as early as the time of Edward III., and was in later times united in the exercise of the franchise with the adjacent borough of Minehead, until its disfranchisement by the Reform Act. There was a Benedictine priory here, founded by the De Mohuns, a cell of the abbey of St. Peter at Bath: its yearly revenue at the suppression was 37*l.* 4*s.* 8*d.*

The town stands at the eastern foot of Grabbist Hill, at the end of a narrow valley which here opens upon the Bristol Channel, the shore of which is a mile north-east of the town. A small stream which drains the valley runs near the town, and is crossed by a stone bridge of three arches. There are two principal streets, at the southern end of one of which is the castle, a building of the Elizabethan period and style, having behind it a richly wooded park, commanding a beautiful and extensive prospect. The church is a fine spacious building of perpendicular architecture, built in the reign of Henry VII. It consists of a nave, chancel, and aisles, west of the central tower, and a disused portion east of it. Before the suppression of the priory (which was adjacent to the church, and of which some remains still exist), in consequence of a dispute between the parishioners and the monks, the eastern part of the church was separated for the use of the monks, since whose time it has been neglected: it contains several monuments of the De Mohuns and Luttrells. There is an old market house in the town.

The parish of Dunster contains 2500 acres: the population, in 1831, was 983. The market is on Friday, and there is one yearly fair.

The living is a perpetual curacy, in the archdeaconry of Taunton, in the diocese of Bath and Wells, of the clear yearly value of 130*l.*

There were in the parish, in 1833, an endowed day-school, with 30 children of both sexes; another day-school with 21 boys and 17 girls; and one day and Sunday school, supported by contributions, for 30 girls.

Glastonbury is in the hundred of Glaston-twelve-hides, 127 miles west by south from London by Amesbury, Frome, and Shepton Mallet, and 22 miles east-north-east from Taunton. The eminence on which the town stands is nearly insulated by the surrounding marshy flats, and was called by the Britons 'Ynswytryn,' or 'Ynys-wytryn, the glassy island,' afterwards 'Avalon;' the meaning of the latter name is disputed, as well as the reason for which the former was given. Monkish legends ascribed the foundation of a Christian church on this spot, said to be the first in England, to Joseph of Arimathea, the supposed apostle of the British Islands; and a species of thorn, still existing in the neighbourhood, which blossoms in the winter, was long believed to have sprung from his walking-staff which he stuck in the earth. A monastery or abbey was certainly established here at an early period, in the precincts of which the semi-fabulous British chieftain Arthur was said to be buried. A leaden cross, bearing the following Latin inscription, 'Hic jacet sepultus inclitus rex Arthurus in insula Avallonia,' was found under a stone seven feet beneath the surface; and nine feet below this an oaken coffin, inclosing dust and bones, was discovered. Of this discovery, which took place in the time of Henry II., and is recorded by Giraldus Cambrensis, who was an eye-witness, there can be no doubt, though the genuineness of the remains has been questioned. Upon the establishment of the Saxons, the spot obtained a new designation, Glaestingbyrig, the first part of which appears to be the Saxon equivalent for its British name 'Wytryn.' The monastery, which had fallen into decay, was rebuilt with great splendour by Ina, king of Wessex (about A.D. 708), and the establishment, enriched by the liberality of successive princes, flourished till the period of the Danish incursions, under Ethelred I. and Alfred the Great, the West Saxon princes. Under the abbacy of the famous Dunstan [DUNSTAN, SAINT], and by the munificence of the Anglo-Saxon kings Edmund I. and Edgar, it regained its former prosperity, and was conformed to the rule of the Benedictines. At the Conquest, the abbot of Glastonbury was a personage of importance in the Anglo-Saxon state; but the jealousy of William, who deposed the abbot and substituted a Norman in his room, and stripped the abbey of many of its lands, depressed the establishment for awhile; but it was restored by the carefulness and influence of subsequent abbots. The buildings were in great part rebuilt in the reigns of Stephen and Henry II., and were subsequently repaired or enlarged. It became soon after this time a mitred abbey, and was for a short period annexed to the bishopric of Wells, which was during this interval called the bishopric of Glastonbury. At the time of the suppression, Richard Whiting, the abbot, who resisted the measures of Henry VIII., was, upon a charge of embezzling the conventual plate, tried, and hanged on the adjacent eminence of the Tor Hill, A.D. 1539. The yearly revenue at the dissolution was 3508*l.* 13*s.* 4¾*d.* gross, or 3311*l.* 7*s.* 4¼*d.* clear. Some idea of the extent and magnificence of the abbey may be formed from the statements given in Dugdale's 'Monasticon' (last edition) of the abbot's munificence, and from an enumeration, at the time of the suppression, of nearly eighty apartments, offices, &c. contained in the precincts, which included a space of 60 acres. The reputation of Glastonbury for sanctity did not cease at the Reformation. As late as A.D. 1750 and 1751, a number of invalids, to the number in one month (May, 1751) of ten thousand, flocked to Glastonbury in consequence of the account of a wonderful, not to say miraculous, cure wrought by drinking the water of a spring near the town. We are not told how long the delusion lasted.

The town consists of several streets; four of these inclose a quadrangular space, in which the ruins of the abbey are comprehended; and from the corners of this quadrangle other streets extend. The houses are generally low, and many of them have been built with the stones taken from the ruins of the abbey. The remains of this splendid structure consist of some fragments of the church, the chapel of St. Joseph of Arimathea, and what is called the abbot's kitchen. The ruins of the church, which was cruciform, comprehend two of the pillars which supported the central tower, some portions of the walls of the choir, and a fragment of the wall of the nave. The architecture belongs to the period of transition from the Norman to Early English, with some portions of later date. The whole length of the church was 380 feet, the breadth of the choir and its aisles 70. St. Joseph's chapel is in better preservation than the church, at the west end of which it is placed, and with which it communicates by an ante-chapel, of somewhat later date; both however belong to the same transition period as the church, but are of a more enriched character: the length of the chapel and ante-chapel together is 110 feet, the breadth 25 feet. The abbot's kitchen is a small building, square externally, but octagonal within: it is in a very perfect state, and belongs to the late perpendicular period. The roof is surmounted by a double lantern. Glastonbury has two parish churches, St. John and St. Benedict, both elegant structures in the perpendicular style, with graceful towers; and in the town are several buildings which were formerly dependencies of the abbey: the George Inn, one of these, offers a good specimen of late perpendicular. On a hill near the town is what is called 'the Tor,' a tower, which is the only remain of a chapel dedicated to St. Benedict. It is of the decorated English character, of beautiful though simple composition, and very perfect in its details. There are places of worship for Independents, Baptists, Wesleyans, and Quakers.

The area of the parishes, and their population, in 1831, were as follows:—

| | Area. | Pop. in 1831. |
|---|---|---|
| St. John . . . | 6107½ acres. | 2501 |
| St. Benedict . . | 1109 | 483 |
| | 7216 | 2984 |

Some hosiery and coarse gloves are manufactured. The market is on Saturday, and there are four yearly fairs.

The municipal borough comprehends nearly the whole of the two parishes; but it is proposed to contract the limits. The town was incorporated in the reign of Anne, from whom it received its only charter. The Municipal Reform Act assigns to it 4 aldermen and 12 councillors; it is not to have a commission of the peace, except on petition and grant. Glastonbury is not a parliamentary borough.

The living of St. John is a perpetual curacy, to which the chapelry of St. Benedict is united: their joint yearly value is 195*l.*, with a glebe-house: they are in the diocese of Bath and Wells, and, with several adjacent parishes, constitute the peculiar jurisdiction of Glaston.

There were in the two parishes, in 1833, one infant school, with 39 boys and 31 girls; nine boarding or day schools (three of them partially supported by endowment or subscription), with 89 boys, 51 girls, and 85 children of sex not stated; and three Sunday-schools, with 148 boys and 150 girls.

Ilchester or Ivelchester (from the river Ivel or Yeo, on which it stands) is in the hundred of Tintinhull, 124 miles west by south of London by Andover and Amesbury, and 22 miles east of Taunton by Langport. This town is of great antiquity: the British name is given by Nennius as Caer Pensavelcoit, which is said to signify 'the city at the head of the river's mouth in the wood:' it was the Ischalis of the Romans, mentioned by Ptolemy, who writes it Ἴσχαλις, as one of the chief towns of the Belgæ. The Roman town was defended by a wall and deep ditch, comprehending an oblong quadrangle, through which the Foss-way [Foss] passed from north to south. The ditch and the foundations of the wall may be traced in many places, the latter consisting of brick and stone work regularly mingled. Roman hypocausts and baths, tessellated pavements, urns, lacrymatories, pateræ, fibulæ, bracelets, and other relics of antiquity have been repeatedly discovered, and medals, especially of Vespasian, Trajan, and Antoninus Pius. 'Vast arches and immense foundations of antient buildings,' says Collinson, 'lie beneath the surface of the ground, and the entire site of the old city is filled with subterraneous ruins.' Some traces of the paved ford by which the Foss was carried across the river are still visible near the bridge. Under the Saxons, who called the place Givel-cestre, it was a place of note, and at the time of the Domesday Survey contained 107 burgesses, who had a market. It was besieged without success, A.D. 1088, by the forces of the lords, who had espoused the claim of Robert of Normandie to the crown against William Rufus. It sent members to parliament in the reigns of Edward I. and Edward II., and in the reign of Edward III. the county courts and assizes were ordered to be held here, but the elective franchise was suspended till the reign of Edward IV., and then again suspended after a short interval till the reign of James I.: it was disfranchised by the Reform Act. There were three religious establishments in the town; an hospital called White Hall, subsequently converted into a nunnery, and then into a free chapel; a house for lepers, with a chapel annexed; and a house of Dominican or Black friars.

The town is in a rich valley, and may be considered as consisting of two parts, Ilchester proper and the village of Northover; these are separated by the river Yeo or Ivel, which is crossed by a stone bridge of two large arches. Ilchester proper consists of four streets of indifferently built houses; and there are some large piles of building, formerly inhabited in separate apartments by burgage tenants, for whom these dwellings were erected by the patrons of the borough. The church is an antient building, consisting of a nave, chancel, and north aisle or chapel, with a low octagonal tower, 'constructed,' says Collinson, 'of Roman stone.' The county gaol, which is still at Ilchester, though the assizes are no longer held here, is a spacious building of freestone from Hamden hill. The town-hall is a neat modern building at one end of the market-place, at the other end of which is a sun-dial with four faces, supported by a Doric pillar. There are some remains of the Dominican friary, used some years since as a silk-factory: those of White Hall were removed some time since.

The parish comprehends an area of 690 acres; the population in 1831 was 975, without reckoning the inmates of the county gaol; to this statement we may add 220 acres and 138 inhabitants for Northover: total 910 acres, 1113 inhabitants. The trade of the place is trifling; some women are engaged in the glove manufacture, of which Yeovil is the centre. The market has been discontinued, and two of the three yearly fairs are falling into neglect. The corporation still exists, but it exercises no jurisdiction, and is of little importance; it was not included in the Municipal Reform Act.

The living of Ilchester is a rectory, in the archdeaconry of Wells, in the diocese of Bath and Wells, of the clear yearly value of 282*l.*; that of Northover is a vicarage, of the clear yearly value of 106*l.*

There were in the parish, in 1833, two day-schools, with 62 children (31 boys and 31 girls), and two Sunday-schools, with 73 children (42 boys and 31 girls).

Ilminster is in the hundred of Abdick and Bulstone, 136 miles west by south of London by Ilchester, and 12 miles south-east of Taunton. It was a market-town at the time of the Domesday Survey, when it belonged to the Benedictine abbey of Micelenie, now Muchelney, near Langport, and was called Ileminstre. The town is in a low but pleasant situation, about a mile distant from the river Isle or Ile, from which it derives its name: it consists principally of two streets forming a cross; the longer of these extends nearly a mile from east to west: the houses are neat and well built. The church is a large cross church, in the centre of the town, and consists of nave, chancel, transept, north and south aisles, and porch; at the east end is a small vestry, formerly a chantry chapel. There is a handsome tower, at the intersection of the cross, of light and uncommon construction, crowned with twelve pinnacles. The general character of the architecture is perpendicular. There are meeting-houses for Wesleyans, Independents, and Unitarians; and a neat market-house.

The area of the parish is 4390 acres; the population in 1831 was 2957. The woollen-cloth and silk and lace manufactures are carried on in a small way, and there are some tan-yards and a considerable malt-trade. The market is on Wednesday, and there is one yearly fair.

The living is a vicarage, in the archdeaconry of Taunton, in the diocese of Bath and Wells, of the clear yearly value of 200*l.*, with a glebe-house.

There were in the parish, in 1833, one dame-school; a well endowed grammar-school, with 20 boys on the foundation and about 100 others; another school of 50 boys and 40 girls, supported from the same property as the grammar-school; a third endowed school, with 27 children of both sexes; and thirteen other day-schools, with 237 children of both sexes; and four Sunday-schools, with 340 children.

Langport is in the hundred of Pitney, 131 miles west by south from London, and 13½ miles east of Taunton. It was a borough at the time of the Domesday Survey, and was held of the king; it had 34 burgesses, and was called Lanporth. A severe encounter took place here in the civil war of Charles I. (A.D. 1645), between a Royalist detachment of Lord Goring's army and a Parliamentarian force: the Royalists were beaten with considerable loss.

The town is at the junction of the Ivel and Parret, and is on the slope and at the foot of the hills which overlook the marshy flats adjacent to those rivers: the lower part of the town near the river is liable to be flooded. The principal street leads down the hill to the Parret, over which was a bridge of ten arches: this bridge is now pulled down, and a handsome bridge of three arches is erected on the site (1840-1). There are several other bridges or arches, either over arms of the river, or designed to allow a passage to the waters in the time of floods. The town is well lighted with gas, and paved throughout. A small part of the town lies west of the Parret, and is distinguished as Langport Westover, from the principal part, which is 'Langport Eastover.' The village of Huish Episcopi, or Bishop's Huish, in the hundred of Kingsbury East, is so near to Langport on the east side of the town as to form part of it. Langport church consists of nave, chancel, north and south aisles, two chapels, and a vestry-room, with a good western tower. There is an antient building with an arched gateway under which the road to Yeovil passes: it is popularly called Hanging Chapel, a name which it perhaps owes to its having been a place of execution after Monmouth's rebellion: it is now used as a museum. There are an Independent meeting-house and a neat guild-hall. On a bridge of one arch, near the middle of the town, the Register-office, an elegant little building, has lately been erected. There is also a public reading-room. The church of Bishop's Huish has a fine tower with eight pinnacles.

The parish of Langport has an area of 660 acres; the population in 1831 was 1245; to this may be added 1780 acres, and 574 inhabitants, for Bishop's Huish: together 2440 acres and 1819 inhabitants. The chief business of the place is the import of coal, iron, timber, and other articles from London, Bristol, and Wales, by means of the navigation of the Parret, which is now made navigable for several miles above Langport bridge by means of locks. The market is on Saturday, and there are four yearly fairs.

Langport is a borough; the corporate body consists of a portreeve and two bailiffs chosen yearly, and nine other capital burgesses: the portreeve and recorder are magistrates, and petty sessions are held occasionally, but the borough court of record is disused. The corporation keep the bridges in repair. Langport sent members to parliament in the reign of Edward I.

The living of Langport is a chapelry, annexed to the vicarage of Huish Episcopi; their joint clear yearly value is 210*l.*, with a glebe-house: they constitute a peculiar of the archdeacon of Wells.

There were in the two parishes, in 1833, one infant-school with 70 children; an endowed grammar-school with 30 boys; a national day and Sunday school with 80 children; eight other day or boarding schools, with 102 children; and one Sunday-school with 50 boys and 40 girls.

Milborne Port is in the hundred of Horethorne, 117 or 118 miles west-south-west of London by Salisbury and Shaftesbury, and 34 miles east by south of Taunton by Ilminster and Yeovil. It was a borough and market-town at the time of the compilation of Domesday, in which it is called Mileburne and Meleburne, and is recorded to contain 56 burgesses. It sent members to parliament in the time of Edward I., after which it ceased to send them till the reign of Charles I., when it regained the franchise, which it finally lost by the Reform Act.

The town is pleasantly situated in a valley near the sources of the Yeo: it consists chiefly of detached houses, and is irregularly built; it is small and of mean appearance. The church is a large cross church, with a square tower: there is an antient town-hall with a curious Norman doorway, and there are an Independent and a Wesleyan meeting-house.

The parish comprehends an area of 3150 acres, with a population, in 1831, of 2072. Leather-dressing and glove-making are carried on, having replaced the manufacture of woollen-cloth, linen, and hosiery, which formerly existed. The market is discontinued, but there are two yearly fairs. The corporation still exists, and consists of nine proprietors of certain pieces of land or burgage tenements; two of whom are annually appointed 'reigning bailiffs.' The borough is not noticed either in the Reports of the Commissioners of Municipal Corporations or in the Municipal Reform Act.

The living is a vicarage, in the archdeaconry of Wells, in the diocese of Bath and Wells, of the clear yearly value of 233*l.*, with a glebe-house.

There were, in 1833, five dame-schools, with 91 children of both sexes; five other day-schools, with 156 children; and three Sunday-schools, with 315 children.

Milverton is in the hundred of Milverton, 152 or 153 miles west by south of London, and 8 miles west of Taunton. It was a market-town at the time of the compilation of Domesday, and belonged then to the king, but had previously belonged to the bishop of Wells. The town is pleasantly situated in a valley drained by a feeder of the Tone, and surrounded by wooded hills. It consists principally of three streets, irregularly laid out, and neither paved nor lighted. The church is a spacious building of perpendicular character; there are meeting-houses for Quakers and Independents.

The area of the parish is 6400 acres; the population in 1831 was 2233. The only manufacture is of woollen-cloth; formerly druggets and serges were made to considerable amount: stone is quarried in the parish. The market is on Friday, and there is one yearly fair.

The living is a vicarage, united with the chapelry of Langford Budville, both in the peculiar jurisdiction of the archdeacon of Taunton, of the clear yearly value of 449*l.*, with a glebe-house.

There were in the parish, in 1833, a day-school with 90 boys and 59 girls, partly supported by endowment; and eight other day-schools or boarding-schools, with 104 boys and 79 girls; and one Sunday-school with 187 boys and 148 girls.

Minehead is in the hundred of Carhampton, 167 miles west by south of London, and 23 miles west-north-west of Taunton. It is written in Domesday Manheve, and was held by Willelmus de Moion. The town was incorporated by Queen Elizabeth, and returned two members to parliament, until disfranchised by the Reform Act. The corporation has fallen into disuse.

The town consists of three parts: the upper town, comprehending the church and some streets of mean houses, irregularly laid out, on the eastern slope of Greenaley Hill, which rises to the height of 600 feet, and is cultivated on the land side to the very top; the lower town, which is the principal part, and has some respectable streets; and the Quay-town along the shore. The church is large and handsome, with an embattled tower, 90 feet high, at the west end: it contains a monument with an effigy, but with the inscription obliterated, supposed to be that of the antient law-writer Henry de Bracton; there is also an alabaster statue of Queen Anne. There are a Baptist meeting-house and an alms-house. At Quay-town is a quay, faced with masonry and with a parapet towards the sea: also a custom-house.

The area of the parish is 3780 acres; the population in 1831 was 1481. The trade of the port a century ago consisted in the import of woollen-yarn, raw-wool, linens, and hides, chiefly from Ireland; and in the export of coals and oak-bark to Ireland, and of herrings to the Mediterranean. At present only a few vessels belong to the port, which export grain, malt, flour, and hides to Bristol and to Wales; and import groceries and iron from the former, and coal and culm from the latter. The herring fishery is carried on along the coast. The market is on Wednesday, and there is one yearly fair. Minehead is sometimes resorted to by invalids on account of the mildness of the climate.

The living is a vicarage, in the archdeaconry of Taunton, in the diocese of Bath and Wells, of the clear yearly value of 200*l.*, with a glebe-house.

There were in the parish, in 1833, six day or boarding-schools, with 75 boys and 92 girls; and two Sunday-schools, with 83 boys and 79 girls.

South Petherton is in the hundred of South Petherton, 131 miles west by south of London through Andover, Amesbury, and Ilchester, and 17 miles south-east of Taunton through Ilminster. Considerable Roman remains have been found at Wigborough in this parish, which is supposed to have been the site of a Roman town. The Anglo-Saxon kings had a palace at South Petherton. The town is called in Domesday Sudperet. It is about a mile west from Petherton bridge (a stone bridge of three arches, adorned with the figures, in stone, of two children who were drowned in the river, and by whose parents the bridge was built) over the Parret: and consists of several streets or lanes irregularly laid out. The church is cruciform, and consists of nave and chancel, with side aisles and transept; and a plain octangular tower at the intersection. There are meeting-houses for Independents and Wesleyan Methodists.

The area of the parish is 3410 acres; the population in 1831 was 2294; some stone is quarried in the parish; there are two small weekly markets and one yearly fair.

The living is a vicarage, of the clear yearly value of 475*l.*, with a glebe-house; in the archdeaconry of Taunton, in the diocese of Bath and Wells.

There were, in 1833, one endowed day-school with 20 boys; four other day-schools, with 42 boys and 49 girls; and four Sunday-schools, with 150 boys and 174 girls.

Shepton Mallet is in the hundred of Whitestone, 118 miles west by south of London through Andover, Amesbury, and Frome, and 32 miles east-north-east of Taunton. It is called Sepeton in Domesday; but, becoming afterwards part of the territory of the Malet family, took the additional designation of Mallet. The town is situated in a valley watered by a small feeder of the Brue, and consists of several streets, irregularly laid out; the principal street, which runs north and south, is broad and well built, and is paved and lighted. The church is a large and handsome cross church, on the east side of the market-place: it comprehends a nave, chancel, side aisles, transept, two chapels, and a chantry, now used as a vestry-room. There is a tower at the west end crowned with a spire. There are Unitarian, Independent, and Methodist meeting-houses, a Catholic convent, and a nunnery. The county bridewell is at Shepton Mallet. In the market-place is an antient market-cross.

The area of the parish is 3770 acres; the population in 1831 was 5330. The principal manufactures are of woollen-cloth, serge, sail-cloth, and silks, which employed, in 1831, 109 men, besides women and children. The markets are on Tuesday and Friday; the latter is a considerable corn market: there are three yearly fairs.

The living is a rectory, of the clear yearly value of 553*l*., with a glebe-house, in the archdeaconry of Wells, in the diocese of Bath and Wells.

There were in the parish in 1833 twenty-seven day-schools of all kinds (including four boarding-schools, a national school, and another school supported by subscription), with 236 boys, 216 girls, and 60 children of sex not stated; one evening (national) school with 20 children; and four Sunday-schools, with 627 children. There is a foundation for a grammar-school, but the school was, in 1833, in abeyance.

Somerton is in the hundred of Somerton, 127 miles west by south of London, and 17½ miles east by north of Taunton. It was a fortified town in the time of the Heptarchy, and the West Saxon kings had a palace here. It was plundered by the Danes about A.D. 877, but recovered its importance, which is attested by its having given name to the county. It is called Summertone in 'Domesday.' The town has a neat and respectable appearance: it stands on a hill on the left bank of the Carey, over which is a stone bridge, and consists of about five narrow streets, the houses of which are built of blue lias from quarries in the neighbourhood. The church is antient, and consists of nave, chancel, side aisles, porch, and vestry, with an octangular embattled tower on the south side. There are an Independent meeting-house and a range of almshouses.

The parish comprehends an area of 6030 acres, with a population, in 1831, of 1786. The market is on Tuesday, and there are seven fairs in the year. Alabaster and lias are quarried near the town.

The living is a vicarage, in the archdeaconry of Wells, in the diocese of Bath and Wells, of the clear yearly value of 259*l*.

There were in the parish in 1833 an infant-school, partly supported by contribution, with 40 boys and 30 girls; an endowed day-school, with 12 boys; three other day-schools, with 21 boys, 40 girls, and 60 children of sex not stated; and two Sunday-schools, with 93 boys and 90 girls.

Watchet is in the parish of St. Decuman, in the hundred of Williton and Freemanners, 159 or 160 miles west by south of London by Shepton Mallet and Bridgewater, and 19 miles north-west of Taunton. It was attacked, but in vain, by the Danes in their war with Edward the Elder, but was twice taken, and the last time entirely ruined, by them in their war with Ethelred II.

The town stands on the coast of the Bristol Channel, and is at the mouth of a small rivulet: cliffs extend along the coast on both sides of the town, which consists of four streets, mostly paved. The parish church of St. Decuman's is in the village of that name, about a mile south of the town, and is a large handsome church, consisting of a nave, two side aisles, and a chancel, with an embattled western tower 80 feet high. There is a chapel at the village of Williton in the parish, and four antient stone crosses in the same village. There are in the town of Watchet meeting-houses for Baptists and Wesleyans.

The area of the parish is 3250 acres; the population in 1831 was 2120. There is a small harbour, formed by a pier, and some coasting trade is carried on; coals are imported from Wales, and lime and alabaster are (at least were) exported. There is a market on Saturday, and one yearly fair.

The living of St. Decuman's is a vicarage, of the clear yearly value of 134*l*., in the archdeaconry of Taunton, in the diocese of Bath and Wells.

There were in the parish in 1833 eight day-schools, with 103 boys and 97 girls; and four Sunday-schools, with 175 boys and 160 girls.

Wellington is in the hundred of West Kingsbury, 151 miles west by south of London by Andover, Amesbury, Somerton, and Taunton, and 7 miles south-west of Taunton. The manor of Wellington was bestowed by Alfred the Great on his friend and biographer Asser, bishop of Sherborne, and on his death was transferred to the bishop of the newly-erected diocese of Wells, by whose successor it was held at the time of the Domesday Survey, in which it is written Walintone.

The town is situated on high ground about a mile and a half south of the Tone, and consists chiefly of two streets intersecting in the middle of the town; one of them is along the road from Taunton to Exeter. Considerable improvements have been made of late years by paving the streets and removing old houses. The church is at the north-east end of the town, and is a fine Gothic building, consisting of nave, chancel, side aisles, two small chapels, vestry-room, and porch, with a handsome embattled western tower, crowned with twelve pinnacles: it contains a fine monument of Chief Justice Sir John Popham. There is an Episcopal chapel at the west end of the town: and there are meeting-houses for Baptists, Independents, Methodists, and Quakers.

The area of the parish is 4830 acres; the population in 1831 was 4762. The woollen manufacture is carried on to some extent: it gave employment in 1831 to 258 men. The market, which has declined of late years, is on Thursday; and there are two yearly fairs.

The living is a vicarage, united with the chapelry of West Buckland, in the peculiar jurisdiction of the bishop of Bath and Wells: their joint clear yearly value is 894*l*., with a glebe-house.

There were in the parish of Wellington in 1833, two infant schools, with 82 boys and 90 girls; and three dame-schools, with 24 boys and 28 girls; nine other day-schools, with 124 boys and 90 girls; and five Sunday-schools, with 262 boys and 335 girls.

The Duke of Wellington derives his title from this town, and he is lord of the manor of Wellington. A pillar in commemoration of the Battle of Waterloo has been erected by subscription in the neighbourhood of the town.

Wincanton or Wincaunton is in the hundred of Norton Ferris, 111 miles west by south of London by Andover and Amesbury, and 35 miles east of Taunton by Langport and Ilchester. Some Roman antiquities have been found in and near the town. It is called Wincaleton in 'Domesday,' a name embodying that of the river Cale, an affluent of the Dorsetshire Stour, on which it stands. The town consists of four principal streets, through one of which the road from London to Exeter by Ilchester and Honiton runs: the houses are commonly well built and regular, which is partly owing to their having been rebuilt after an extensive conflagration in 1747. The church is a tolerably large and plain building, consisting of nave, chancel, side aisles, and western tower. There are meeting-houses for Independents and Baptists.

The area of the parish is 3860 acres; the population in 1831 was 2123. Dowlas and bed-ticking are made, but not to the same extent as formerly. The market is on Wednesday, and there are two yearly fairs. The living is a perpetual curacy, in the archdeaconry of Wells, in the diocese of Bath and Wells, of the clear yearly value of 123*l*. There were in the parish, in 1833, eleven day or boarding schools, with 100 boys and 94 girls; and three Sunday-schools, with 150 boys and 155 girls.

Wiveliscombe is in the hundred of West Kingsbury, 156 or 157 miles west by south of London through Taunton, and 12 miles west of Taunton. On a hill a mile eastward of the town is a camp, described by Collinson as Roman, and within which Roman coins have been found. During the inroads of the Danes this camp was occupied by them, but when peace was restored the Saxons built the town of Wiveliscombe in the subjacent valley. The town is in a valley or 'combe,' enclosed by hills on all sides except the south-east: it is irregularly laid out, but consists for the most part of neat and well-built houses. The church consists of a nave and side aisles, with a western tower and spire. There are Independent and Wesleyan meeting-houses, an infirmary, and the ruins of an old residence of the bishops of Wells.

The area of the parish is 5310 acres; the population in 1831 was 3047. The woollen manufacture is carried on, but not to any great extent. The markets are on Tuesday and Saturday; the former is a considerable corn-market, and the market on the first Tuesday in February is also a great cattle-market. There are two yearly fairs. The town is governed by a bailiff and portreeve, who, with other officers, are chosen annually at the court leet.

The living is a vicarage, in the peculiar jurisdiction of the bishop of Bath and Wells, of the clear yearly value of 300*l*., with a glebe-house. There were in the parish, in 1833, fifteen day or boarding schools, with 135 boys and 156 girls; and three Sunday-schools, with 140 boys and 130 girls

Yeovil is in the hundred of Stone, or, as it is sometimes called, Stone and Yeovil, 125 miles west-south-west of London through Salisbury and Shaftesbury, and 26 miles east by south of Taunton. Roman coins and tessellated pavements have been found here: the town was called Gevele by the Saxons, and Ivle and Givele in 'Domesday,' which names may be identified with that of the river Ivel or Yeo, near which it stands. The town consists of a number of streets and lanes irregularly laid out, paved and lighted: some of the streets are spacious, and are lined with good houses of brick or stone. The church is a handsome cross church of perpendicular character: it comprehends a nave, a large chancel, side aisles, and transept, with a large plain western tower 90 feet high. It stands in a large churchyard surrounded with lime-trees. An antient building, probably a chapel, adjacent to the church, is now used as a school. There are meeting-houses for Independents, Baptists, Methodists, and Unitarians; and a range of almshouses well endowed.

The area of the parish is 3890 acres; the population in 1831 was 5921. The town is the centre of a considerable glove-manufacture, which in 1831 employed 300 men, beside women and children. The market is on Friday, and is an important market for the sale of corn, cattle, butter, cheese, hemp, and flax. There are many dairy-farms in the surrounding district, from which a good deal of butter is sent to London. There are two yearly fairs. Yeovil is incorporated, but the borough does not include more than one-third of the town: it is not noticed in the Municipal Reform Act. A court for the recovery of small debts is held every three weeks.

The living is a vicarage, united with the chapelry of Preston, in the archdeaconry of Wells, diocese of Bath and Wells, of the clear yearly value of 391*l*., with a glebe-house. There were in the parish, in 1833, twelve day or boarding schools, with 239 boys and 132 girls; and five Sunday-schools, with 307 boys and 323 girls.

Of the places near Bristol, Bedminster (population in 1831, 13,130) is a suburb of Bristol, and the parish is now almost entirely included in the municipal and parliamentary boundaries of that city. There is a church, which has various antient portions, amid additions and alterations of a later date; there are also a district church or chapel (St. Paul's) and several dissenting meeting-houses. There are rope-walks and tan-yards, and the place shares in the commerce of Bristol. In the outparts of the parish are numerous coal-works and market-gardens for the supply of Bristol. Bristol gaol is in Bedminster. The living is a vicarage, of the clear yearly value of 362*l*., with a glebe-house, and the vicar presents to the chapel of St. Paul's, the benefice of which is of the clear yearly value of 180*l*., with a glebe-house. Both are in the archdeaconry of Bath, and diocese of Bath and Wells. Long Ashton (population in 1831, 1423) and Brislington (population 1294) are distant about three miles, one south-west, the other south-east of Bristol. Long Ashton has iron-works and collieries. There are in the parish two remarkable camps, on the hills overlooking the Avon, opposite Clifton, and a neat and elegant church of perpendicular character. Brislington has a very extensive and complete private lunatic asylum. Backwell, just under Broadfield Down (population in 1831, 1038), has collieries. Nailsea, eight miles west by south of Bristol (population in 1831, 2114), gives name to the adjacent coal-field, the pits of which employ a considerable number of men; there are also stone-quarries and important crown-glass works. Clevedon (population in 1831, 1147) and Portished (population 800), on the Bristol Channel, one 12 or 14 miles west by south from Bristol, the other nearer, are resorted to as bathing-places. Pill, or Crockern Pill, in the parish of Easton-in-Gordano (population in 1831, 2255), is a pilot-station on the Avon below Bristol. Several Roman antiquities have been found here: there are an episcopal chapel and several dissenting meeting-houses. Keynsham (population in 1831, 2142), nearly midway between Bath and Bristol, was formerly a market-town. It has a spacious church of perpendicular character, which exhibits some good portions. There are flax-manufactories, which in 1831 employed 79 men, and some copper-mills near the town. It has an almshouse and an endowed school.

Bathwick (population in 1831, 4033) and Lyncombe, and Widcomb (population 8704), are suburbs of Bath, and by late acts are included both in the parliamentary and municipal boundaries. Bathwick is separated from Bath proper by the Avon, which is here crossed by Pulteney Bridge. By the extension of the buildings in later years, some of the finest parts of Bath (Pulteney Street, Laura Place, and Sydney Gardens) are in Bathwick. The Kennet and Avon Canal and the Great Western Railway run through the parish. Many Roman antiquities have been found at Bathwick. Lyncombe and Widcomb parish is separated from Bath by the Avon: it contains a number of streets, which may be considered as forming the manufacturing part of Bath; and a number of detached villas or rows of good private houses, rather more distant from the town. The valley of Lyncombe is very beautiful, and, considering its proximity to so large a city, remarkably secluded. The woollen-manufacture in 1831 employed 565 men. Bath-Easton (population 1783) is about two miles north-east of Bath, on the London road. The church has a beautiful embattled tower, 100 feet in height. Weston (population 2560) is about the same distance west-north-west of Bath. Twiverton (population 2478), about the same distance west of Bath, on the south bank of the Avon, and on the road to Bristol, is the seat of a considerable cloth manufacture, which in 1831 employed 284 men.

Beckington (population in 1831, 1340), three miles north-north-east of Frome, Road (population 954), five miles distant in the same direction, and Berkeley (population 531), two miles east of Frome, are all engaged in the woollen manufacture, of which Frome is the centre. Mells (population 1259), three miles north-west of Frome; Kilmersdon (population 2129), Radstock or Radstoke (population 1165), Midsummer Norton (population 2942), Gamerton (population 1326), Timsbury (population 1367), High Littleton (population 911), Paulton (population 1784), Clutton (population 1287), Chew Magna (population 2048), are all more or less inhabited by the colliers of the Mendip coal-field, which in 1831 gave employment in these and the adjacent places to nearly 1800 men, beside boys, of whom several were employed.

North Petherton (population in 1831, 3566), about three miles south of Bridgewater, is one of the largest villages in the county: it was formerly a market-town, and though the market is disused, it retains two important cattle-fairs. Huntspill (population 1503), near the right bank of the Parret, seven miles north of Bridgewater, was formerly a market-town: it has three fairs.

Banwell (population 1623), three or four miles north-west of Axbridge, is pleasantly situated under the northern slope of the Mendip Hills. Two remarkable caverns have been discovered, one filled with diluvium, in which were embedded various fossil bones, the other covered with beautiful stalactites. There was an abbey at Banwell during the existence of the West Saxon kingdom. Alfred gave the abbacy to his friend Asser: it was destroyed in the Danish wars. There are considerable remains of an episcopal palace of the bishops of Bath and Wells, now converted into a private residence; and a modern cottage belonging to the same prelates. Burnham (population 1113), on the Bristol Channel, near the mouth of the Parret, has a church whose lofty tower is used as a sea-mark, and a lighthouse. The altar-piece of the church, sculptured in white marble, was designed by Inigo Jones. Wedmore (population 3557) is on a gentle elevation, rising out of the flats between the Mendip and the Polden hills; it was the occasional residence at one time of the West Saxon kings, and retains, in the power of choosing, at the manorial court, a portreeve and water-bailiffs, traces of former municipal organization. Wrington (population 1540), on the bank of the river (Yeo) which drains the valley between Broadfield down and the Mendips, was formerly a market-town, and had one yearly fair, but both market and fair have fallen into disuse within the last fifty years. Barley Wood, the residence of the late Hannah More, is in the parish. Congresbury (population 1327), two miles west of Wrington, had antiently a market, now disused.

At Merriot (population in 1831, 1405), two miles north of Crewkerne; East Coker (population 1330), three miles south of Yeovil; Montacute (population 1028), three miles, Stoke-under-Hamden (population 1365), five miles, and Martock (population 2841), seven miles west of Yeovil,—about 200 men are employed in glove-making or in weaving sail-cloth, sacking, and girth-web. East Coker has a fine cross church and a row of almshouses. The remains of a Roman villa were found here in the middle of the last century in a field; but the site has been ploughed up, and the fragments dispersed. Montacute has extensive quarries. Martock was formerly a market-town, but the market has fallen into disuse within the last fifty years. In the market-place are the former market-house with an assembly-room over it, and a fluted column supporting a dial. Martock church has a tower 90 feet high, and a handsome altar-piece, but of a character not in harmony with the Gothic architecture of the church. Curry Revel (population in 1831, 1378) has quarries of lias, and two cattle and sheep fairs. In this parish, on a commanding eminence, is Burton Pynsent, the seat of the great earl of Chatham, to whom a monument was erected in the park by his widow.

Porlock (population in 1831, 830) is in the hilly district which occupies the western extremity of the county, six miles west of Minehead. The Saxons gave to this place the name of 'Port-locan,' the locked or enlocked harbour; but as this title would by no means apply to the shallow bay near which Porlock stands, it is probable that the line of coast has undergone considerable change by the retreat of the sea. The principal part of the village, consisting of two streets of mean straggling houses near the church, is now above a mile from the sea. The Danes were repulsed in an attack on this place, A.D. 918; but it was burnt, and the neighbourhood plundered by Harold, in the revolt of his family against Edward the Confessor, A.D. 1052. There is an old but unfinished camp not far from the town, supposed to have been formed about this time. Porlock Quay is two miles north-west of the village, on the shore: a small harbour is here formed by means of a pier. A very few small sloops which import coal and lime from Wales, and some fishing-boats, belong to the place. The market formerly held has been discontinued. There are three yearly fairs for cattle and sheep. The antient market-cross is still standing. Old Cleeve (population in 1831, 1347) is about two miles west of Watchet: the parish extends northward to the cliffs which here line the Bristol Channel. There are the ruins of an antient Cistercian monastery; the remains, which are extensive, have been converted into a private house; the architecture is, to a considerable extent, of perpendicular character. The revenue of the monastery at the dissolution was 155*l.* 9*s.* 5*d.* An old cross with four steps, the pedestal and pillar almost entire, stands in the churchyard of the parish church. The hamlet of Blue Anchor in this parish is a little resorted to as a bathing-place. Stogumber (population in 1831, 1294), between Watchet and Taunton, was formerly a market-town: it has still two yearly fairs.

Weston-super-Mare (population in 1831, 1310) is a watering-place much frequented, especially from Bristol: it has commodious inns, lodging-houses, and baths. The Bristol and Exeter railway passes near it. It has a neat church, and some dissenting meeting-houses.

*Divisions for Ecclesiastical, Legal, and Parliamentary Purposes.*—The county constitutes the diocese of Bath and Wells; and is divided into three archdeaconries, and again into thirteen rural deaneries as follow:—

| | Parishes according to Collinson in 1791. | Benefices according to Cox's *Clergy List*, 1841. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Single Benefices. | | | United Benefices. | | | Proprietary and other Chapels. | Total. |
| | | Rectories. | Vicarages. | Perp. Curacies, &c. | Rectories. | Vicarages. | Perp. Curacies, &c. | | |
| I. Archdeaconry of Bath: | | | | | | | | | |
| 1. Deanery of Bath | 24 | 10 | 4 | 5 | 2 | 3 | 4 | 8 | 36 |
| 2. Deanery of Redcliffe and Bedminster | 53 | 24 | 12 | 6 | 2 | 6 | 6 | .. | 56 |
| II. Archdeaconry of Wells: | | | | | | | | | |
| 3. Deanery of Axbridge | 36 | 14 | 14 | 5 | .. | 2 | 2 | .. | 37 |
| 4. Deanery of Cary | 55 | 30 | 4 | 14 | 3 | 4 | 7 | 1 | 63 |
| 5. Deanery of Frome | 47 | 25 | 8 | 8 | 3 | 1 | 5 | 2 | 52 |
| 6. Jurisdiction of Glaston | 20 | .. | 4 | 3 | 1 | 3 | 7 | .. | 18 |
| 7. Deanery of Ilchester | 36 | 20 | 8 | 3 | 1 | 3 | 2 | 1 | 38 |
| 8. Deanery of Marston | 28 | 17 | 6 | .. | .. | 1 | 1 | .. | 25 |
| 9. Deanery of Pawlet | 7 | 4 | 1 | .. | .. | 2 | .. | .. | 7 |
| III. Archdeaconry of Taunton: | | | | | | | | | |
| 10. Deanery of Bridgewater | 31 | 13 | 8 | 6 | 2 | 3 | 1 | .. | 33 |
| 11. Deanery of Crewkerne | 55 | 17 | 12 | 12 | 4 | 3 | 3 | 1 | 52 |
| 12. Deanery of Dunster | 44 | 24 | 10 | 5 | 1 | 2 | 3 | .. | 45 |
| 13. Deanery of Taunton | 46 | 19 | 9 | 16 | .. | 3 | 4 | .. | 51 |
| | 482 | 217 | 100 | 83 | 19 | 36 | 45 | 13 | 513 |
| | | Making a total of 400 single benefices. | | | These are combined in 46 united benefices. | | | | |

The number of benefices, as returned to the church commissioners, was 430, besides two not returned, and exclusive of those which are annexed to other preferments. Two of the benefices were sinecure rectories, the clear yearly revenue of which, taken together, amounted to 386*l.* The remaining 428 benefices are classified by their clear yearly revenue as follows:—under 50*l.*, 12; 100*l.*, 47; 150*l.*, 57; 200*l.*, 81; 300*l.*, 101; 400*l.*, 57; 500*l.*, 37; 600*l.*, 14; 700*l.*, 11; 800*l.*, 7; 900*l.*, 3; 1000*l.*, 1: total, 428.

It will be seen that there is a slight difference in the number of benefices as given in the report of the church commissioners and in the 'Clergy List.'

The county is in the Western Circuit. The spring assizes are held at Taunton; the summer assizes at Bridgewater and Wells alternately. The quarter-sessions are held, the Epiphany and Easter at Wells, the Midsummer at Bridgewater, and the Michaelmas at Taunton. There are a county gaol at Ilchester; a county gaol and house of correction at Wilton near Taunton; and a county house of correction at Shepton Mallet. There are a city gaol at Bath, a borough gaol at Bridgewater, and a city and county lock-up house at Wells. The city gaol and house of correction of Bristol are at Bedminster in this county. The prison at Ilchester is not large; it is not in a dry situation, nor is it well ventilated; it is used for untried and convicted prisoners and debtors. It has been proposed, but not decided, to abolish this gaol. The Wilton and Shepton Mallet prisons are too small for the number of prisoners; and the Bath and Wells prisons are altogether insufficient. The erection of a new gaol at Bath has been determined on, and is probably by this time completed. Bridgewater gaol is used as a lock-up house, and for the temporary confinement of prisoners at the assizes or quarter-sessions.

Before the Reform Act Somersetshire sent altogether sixteen members to the House of Commons; viz. two for the county, two each for the cities of Bath and Wells, and two each for the boroughs of Taunton, Bridgewater, Minehead, Ilchester, and Milborne Port. The county members were elected at Ilchester.

By the Reform and Boundary Acts the county has been divided into two parts, each returning two members. The eastern division comprehends the hundreds or liberties of Bath Forum, Bempstone, Brent with Wrington, Bruton, Catsash, Chew and Chewton, Frome, Glaston-twelve-hides, Hampton and Claverton, Horethorne, Keynsham, Kilmersdon, Mells and Leigh, Norton Ferris, Portbury, Wellow, Wells Forum, Whitstone, Winterstoke, and Witham Friary (this is included in Frome hundred), and such parts of the hundred of Hartcliffe with Bedminster as are not included in the parliamentary limits of Bristol. The court of election is held at Wells; and the polling-stations are Wells, Bath, Shepton Mallet, Bedminster, Axbridge, and Wincanton.

The western division comprehends the hundreds or liberties of Abdick and Bulstone, Andersfield, Cannington, Carhampton, Crewkerne, North Curry, Houndsborough Berwick and Coker, Huntspill and Puriton, East Kingsbury, West Kingsbury, Martock, Milverton, North Petherton, South Petherton, Pitney, Somerton, Stone, Taunton and Taunton Dean, Tintinhull Whitley, and Williton and Freemanners. The court of election is held at Taunton; and the polling-stations are Taunton, Bridgewater, Ilchester, and Williton.

Three of the boroughs, Ilchester, Milborne Port, and Minehead, were disfranchised by the Reform Act; but Frome was made a parliamentary borough, to return one member. The number of city or borough members is now nine, making, with the four county members, a total of thirteen.

The number of registered electors in the years 1835-6 and 1839-40 was as follows:—

| | 1835-6. | 1839-40. |
|---|---|---|
| County, Eastern Division | 8504 | 9759 |
| " West do. | 8854 | 9024 |
| City of Bath | 2892 | 3119 |
| " Wells | 388 | 414 |
| Borough of Bridgewater | 497 | 573 |
| " Frome | 307 | 339 |
| " Taunton | 1165 | 1010 |

*History and Antiquities.*—In the earliest historical period this county is thought to have been inhabited by the Belgae (Βέλγαι of Ptolemy), by which generic name alone it is designated. This nation appears to have possessed the greater part of the counties of Hants and Wilts, and was subdued by Vespasian during the command of Aulus Plautius, in the reign of Claudius. Of the incidents of this warfare scarcely any are recorded, none at least that can be connected with this county. According to Richard of Cirencester, the Belgae could have possessed little of this county, for the Hedui, a nation whose name links them with the Celtic stock, are placed by him in the eastern part, and the Cimbri of the same writer appear to have occupied the western.

In the Roman division of the Island, Somersetshire was included in the province of Britannia Prima. The Antonine station Aquae Solis (called also Ὕδατα Θερμά by Ptolemy, and Thermae by Richard) was Bath; the river on which it stands is called by Richard Abona, a name evidently identical with Avon. It appears from inscriptions dug up, that Sulis was the tutelary goddess of Bath, which makes it probable that the Antonine name Aquae Solis is a blunder for Aquae Sulis. The town Abone (ad Abonam, as Richard calls it), 18 Roman miles from Bath, according to Antoninus, and which is fixed by Reynolds (*Iter Britanniarum*) near the Gloucestershire end of the New Passage, is by Richard placed 6 miles from Bath, and 6 from Ad Sabrinam, at the passage over the Severn. As the distance thus measured from Bath to the Severn is insufficient, it is probable that in one the above distances, perhaps the second, VI. is a transcriber's error for XI. We are of opinion that Richard is correct in placing Ad Abonam between Aquae Solis and Trajectus or Trajectum (the name of which indicates its position at the passage of the Severn, and which Richard distinctly states to be on the Monmouthshire side), and that the present copies of Antoninus are wrong in reversing this arrangement. We agree with Mr. Hatchard (in his translation of Richard) and with the Useful Knowledge Society's map, in fixing Ad Abonam at Britton in Gloucestershire, nearly opposite Keynsham; and we are inclined to fix Ad Sabrinam at Portishead, or Portbury, west of Bristol. The Avalonia of Richard was in all probability Glastonbury; and the Ischalis (Ἴσχαλις, Ptol.), Uxella (Οὔξελλα of Ptolemy, who describes it as belonging to the Δουμνόνιοι or Dumnonii), and Ad Aquas, are placed by Hatchard, and in the Society's map, at Ilchester, Bridgewater, and Wells respectively. Ischalis, Avalonia, and apparently Aquae Solis, Ad Aquas, and Ad Abonam, were in the territory of the Hedui. The river Uxella of the same writer (the Οὐέξαλλα of Ptolemy) is supposed to be the Parrot; it separated the territories of the Hedui from those of the Cimbri. The antient road the Fosse, Foss, or Foss-way [Foss] enters the county on the north-east side near Bath, and runs south-west by Radstoke, Stratton-on-the-Fosse, Shepton-Mallet, Street-on-the-Fosse near Shepton-Mallet, East and West Lydford, Ilchester, and Petherton Bridge near South Petherton; and appears to have quitted the county not far from Chard. A Roman road from the coast runs along the crest of the Mendip Hills in the direction of Sorbiodunum (Old Sarum), crossing the Foss-way at right angles. The Foss may be traced near Bath, where it united with another road coming from Londinium (London), Calleva (Silchester), and Spinae (Speen, near Newbury); it may be seen also on the hill near Combe Hay, south of Bath, and near Camerton and Midsummer-Norton. In many parts of its course it coincides with and is obliterated by modern roads.

Richard of Cirencester describes a chain of mountains, called Ocrinum, as extending from the Uxella (or Parret) to the promontory Ocrinum (the Lizard).

Roman antiquities have been found in considerable abundance. Those near Bath are mentioned elsewhere [Bath], and those at Ilchester have been mentioned in a former part of this article. At Farleigh, or Farley, near the border of Wilts; at Dishcove, near Bruton; at East Coker, near Yeovil; and at Yeovil itself, tessellated pavements have been dug up; and a piece or pig of lead, 50 lbs. weight, with a Roman inscription, was found near Bruton, and another piece at Wookey, near Wells. At South Cadbury, between Wincanton and Ilchester, is a remarkable camp (called by some old topographies Camalet castle, but more commonly Cadbury castle) of irregular form, according to the shape of the hill on which it stands, with an inner and higher fort or prætorium. It is partly hewn in the solid rock, partly formed with a rampart of loose stones, and is defended by never less than four ditches, and in one part by six or seven. Various Roman antiquities, especially coins, and pavements, and other remains of buildings, have been dug up in the enclosure, which is about 30 acres in area. Another camp, three miles in circuit, of irregular form, on Hamden Hill, is supposed to have been Roman. The vallum is almost entire; the north-western part, the most difficult of access, is separated from the rest by an intrenchment. Various antiquities have been found at and near South Petherton, indicative of a Roman settlement in that neighbourhood. Neroche castle, west of Ilminster, is supposed to have been a Roman post, and there are other reputed Roman camps, one popularly called 'the Castle,' near Wiveliscombe, near which coins have been dug up; a second at Badialton, near Milverton; and a third at Brompton Regis, near Dulverton. There is a Roman camp at Stringston, between Bridgewater and Watchet. At Cadbury, between Bristol and Clevedon, is a camp supposed to be Roman, but of less importance and extent than the camp at South Cadbury already noticed. There is a third hill called Cadbury, near Congresbury (between Bristol and Weston-super-Mare), on which also are vestiges of antient fortifications. There is a remarkable camp on the summit of Brent Knoll, a lofty eminence rising out of the flats between the Mendip and Polden hills, in which Roman coins and other antiquities have been found. The name of an adjacent hamlet, Battleborough, is the record of some now-forgotten encounter. There are two other camps, supposed to be Roman, at Long Ashton near Bristol, opposite Clifton. The name of one, Burwalls, and the nature of its construction (of limestone rubbish cemented with an almost impenetrable cement), indicate it to have been a permanent military post. The foundations of buildings, supposed to be Roman, have been discovered in the same neighbourhood. It is not unlikely that Masbury camp, or, as it is sometimes called, Masbury Castle, near Shepton Mallet, and the 'bulwarks' or other military works at Blacker's Hill, not far from Masbury, both on the Mendips, are Roman works. And from the massive remains of antient buildings at Portbury, near the south bank of the Avon, not far from its mouth, we think it not an implausible conjecture that the Ad Sabrinam of Richard should be placed here, or in the neighbouring parish of Portishead. A Roman road from Axbridge, in many parts (says Collinson) still plain and visible, leads towards Portbury and Portishead. Coins in great abundance have been found in various places, especially at Elm, near Frome; at Corton-Dinham, near South Cadbury camp; at Street, in Winsham parish, near Chard; at Bishops Lydeard, and Lydeard St. Lawrence, near Taunton; and at Stogumber, Bicknoller, Putsham, in Kilve parish, and Kilton, near the northern end of the Quantock Hills. Other antiquities, as well as coins, have been found at Wincanton; at Street, on the Fosse, near Shepton-Mallet; at Edington and at Chedzoy, near Bridgewater; aud at Hinton Charterhouse, between Bath and Frome.

Beside the Roman camps above mentioned, there are several other antient forts or camps scattered throughout the county. Doleberry castle, on Mendip, is one of the most remarkable. Several are on Leigh down near Bristol, and on Lansdown, and the other hills round Bath; others are in the grounds and woods of Longleat and Stourhead, on the eastern border of the county. To what period or nation these are to be attributed is uncertain. Burrows are numerous, especially on the Mendip Hills, on the Quantock Hills, and the hilly districts west of these.

The remarkable entrenchment called 'Wansdike' is partly in this county. Commencing near Andover in Hampshire, it crossed the Wiltshire Downs, and entered Somersetshire near Bath-Hampton; and turning westward and then north-westward, so as to make a circuit round Bath, it ran along the hills by South Stoke, English Combe, Stanton Prior, Compton Dando, Norton Malreward, and Long Ashton, to the Bristol Channel at Portishead. It is still existing in many places, as on Claverton down and Odd down; and may be traced, with ocasional breaks, for five or six miles between English Combe and Norton Malreward. The antient camps on Bath-Hampton down, Stantonbury hill near Stanton Prior, and Mays knoll near Norton Malreward, are just on the line of Wansdyke. This entrenchment consists of a ditch, with the vallum or embankment on the south side, the top of which is, in some places, twelve feet high from the bottom of the ditch; the breadth of the ditch is from eight to ten feet. The date and origin of this singular work are unknown: it has been supposed to have been a barrier between the Anglo-Saxon kingdoms of Mercia and Wessex, with which its position would agree; but the manner in which it is intersected by a Roman road on Marlborough Downs shows it to be of earlier date than the road, and consequently earlier than the Roman conquest and settlement. This has led Collinson to regard it as a barrier made by the Belgic Britons to repress the incursions of the Celts; but the position of it does not suit this hypothesis, as the Hedui, a people whose name clearly connects them with the Celtic stock (for the Gallic Hedui, or Ædui, were undoubtedly Celts), were on the southern or supposed Belgic side of the barrier. Possibly it may have been erected by the South-Western Britons as a defence against the first Roman attack, which was probably made from the side of the Dobuni, who occupied Gloucestershire and Oxfordshire. [BRITANNIA.]

Of what are usually regarded as Druidical antiquities Somersetshire possesses but few. The principal is at Stanton Drew, east of the road between Bristol and Wells: it consists of four groups of stones, forming (or rather having formed, when complete) two circles; and two other figures, one an ellipse, the other vaguely described by Collinson as an 'oblong.' Some of the stones are 9 feet high, 22 feet in girth, and 15 tons weight.

In the Saxon invasion, this county was the scene of conflict: the battle of Mount Badon, in which the Britons under Arthur repulsed the Saxons under Cerdic, founder of the West Saxon kingdom, is commonly fixed at or near Bath: its date is uncertain; perhaps it was fought A.D. 520. In the reign of Cealwin, or Ceaulin, of Wessex (A.D. 577), after the defeat of the Britons at Deorham in Gloucestershire, Bath was taken by the Saxons, from whom it received the characteristic names of Acemannes-ceastre, or 'the town of aching men or invalids;' or Bathan-ceaster, or 'the town of the baths.' Cenwalch, king of Wessex, defeated the Britons or Welsh, Wealas, as the Saxon chronicle terms them, at Peonnum, or Pen (Pen-Selwood, or Penzlewood), near Wincanton (A.D. 658), and drove them to Pedridan (Petherton), on the Parret, and the county was permanently incorporated in the West Saxon kingdom. Offa of Mercia appears to have possessed Bath: he founded or restored the abbey there (A.D. 775). In the early Danish invasions, in the reign of Ethelwulf (A.D. 845), a body of those marauders was repulsed with great slaughter at Pedridan-muth, or the mouth of the Parret; and in the reign of Alfred, Somersetshire was again attacked by them. Alfred, when driven from his throne, found security in the marshes of the isle of Athelney [ATHELNEY, ISLE OF], at the junction of the Tone and Parret. When he emerged from this retreat, he assembled his army at Egbyrtes-stane, perhaps Brixton in Wiltshire, in Seal-wuda or Selwood Forest, which occupied the border of Somersetshire and Wiltshire. After the battle of Edington, Godrum or Guthrum the Dane was baptized at Alre, now Aller, near Langport; and Alfred and Guthrum spent twelve days at Wedmore, between Glastonbury and Axbridge, on occasion of the Danish chieftain's 'crisom-leasing,' or baptismal anointing. In the subsequent struggle of Alfred with Hastings the Dane, the men of East Somerset, 'from every town east of Pedridan (the Parret), as well as west of Sealwuda' (Selwood), formed part of the force which besieged Hastings (A.D. 894) at Buttington, on the Severn. In the reign of Edward the Elder (A.D. 918), a band of marauders, probably Danes, from Bretagne landed twice, first near Watchet, and then at Porlock; but they were repulsed both times, and were afterwards blockaded in the island of Flatholm, in the Bristol Channel, until they were nearly starved, when they managed to escape to Ireland. Edred, king of England, died in this county, at Frome (A.D. 955); and Edgar, in the latter part of his reign, was 'hallowed,' or consecrated, king at Acemannesceastre, or Bathan, now Bath (A.D. 973). On his death (A.D. 975) he was buried at Glastonbury. In the reign of Ethelred II., Watchet was plundered, apparently by the Danes (A.D. 987); and ten years after (A.D. 997) it was a second time plundered by the same enemy. Sweyn, king of the Danes, was at Bath with his army (A.D. 1013); and all the west country submitted, and gave hostages to him there. In the short reign of Edmund II. (Ironside), a severe battle took place between him and Canute at Pen-selwood; and on the death of Edmund, the same year, he was buried at Glastonbury, near his grandfather Edgar. In the troubles raised by the contests between the faction of Godwin and the Norman faction in the time of Edward the Confessor, Porlock and the neighbourhood were plundered (A.D. 1052) by Harold, the son of Godwin. In A.D. 1067, the year after the battle of Hastings, a son of Harold came with an army and fleet to the mouth of the Avon, and plundered part of the county. During the West Saxon, Anglo-Saxon, and Anglo-Danish dynasties, Somerset existed, for at least a great part of the time, as a county. A 'dux provinciæ Sumersetton' was at the battle of Ellandun (A.D. 823), in which Egbert of Wessex broke the power of Mercia. It was included in the earldom of Wessex held by Godwin and his son Harold. (Ingram's *Saxon Chronicle*; Palgrave's *Rise, &c. of the English Commonwealth.*)

In the rising of Odo and other supporters of Robert of Normandie against William Rufus (A.D. 1088), Bath and the neighbourhood were plundered by the insurgents. Some military operations were carried on in the reign of Stephen, who took Castle Cary and Richmont castles.

Of the middle ages there are several memorials, some of which are noticed elsewhere [BATH; WELLS]: the ruins at Glastonbury, Ilchester, Banwell, and Old Cleeve have been described above. Other monastic ruins, those of Stavordale priory, for canons of St. Augustin, near Wincanton, and of Woodspring priory, near Weston-super-Mare, for regular canons of St. Augustin, are tolerably entire, and are now converted each into a farm-house and offices: the latter are of more elegant architecture than the former. The remains of Montacute Cluniac priory, near Yeovil, and of Muchelney Benedictine abbey, founded by King Athelstan, near Langport, are of considerable interest. Of the Carthusian priory of Hinton Charterhouse, near Bath, there are several remains: the present manor-house was built out of the ruins. Cannington church and Stogursey church, north-west of Bridgewater, and Witham Friary church, between Frome and Bruton, were all conventual churches: the first is a very fine building. The only important castellated remains are Farleigh or Farley Castle, between Bath and Trowbridge in Wiltshire; Nunney, near Frome; and Walton Castle, near Clevedon. The ruins of Farleigh are very picturesque. There are some remains of Bridgewater and Taunton castles. The antient mansions of Montacute, near Yeovil; Shapwick, between Glastonbury and Bridgewater; Fairfield, near Stogursey, north-west of Bridgewater; Sutton Court, near Chew Magna, between Keynsham and Axbridge; Hinton St. George, near Crewkerne; and Barrow Court, near Bristol, all belong to the middle ages, or at least to the period which preceded the general revival of classical architecture.

In the civil war of Charles I. several memorable events are connected with this county. A severe battle was fought 5th July, 1643, on Lansdown Hill near Bath. The Parliamentarians occupied the top of the hill, under Sir William Waller; and the Royalists, under Prince Maurice and the earl of Caernarvon, advanced to storm the works which Waller had thrown up: the victory was not decisive, but on the whole rested with the Royalists. They however lost many of their chiefs, especially Sir Bevil Grenville, to whose memory a monument was erected on the hill, which still remains. The Royalists had previously, in their advance from Devonshire, occupied Dunster castle, Bridgewater, and Taunton, and obliged the train-bands of the county, which were raised by the Parliamentarian 'Committee,' to retire from Wells. The capture of Bristol soon after seemed to confirm the superiority of the Royalists. In 1644 Taunton was taken by the Parliamentarians under the earl of Essex, in his march into the West; and the king marched through Bath, Frome, Bruton, and Chard in pursuit of him. After Essex's infantry had capitulated in Cornwall, the king ordered Taunton to be blockaded; and next year (A.D. 1645) the blockade was converted into a siege, and the town reduced to extremity, when it was relieved by Col. Weldon. The relieving party were however beaten on their return, and obliged to retreat to Taunton, which was again besieged by the Royalists under Lord Goring, but relieved by Fairfax, who advanced for the purpose after the battle of Naseby. The garrison of Taunton was commanded by Blake, afterwards the famous admiral. Goring drew off from Taunton and advanced to Langport, where he was beaten by Fairfax, who also took by assault the strong post which the Royalists had garrisoned at Bridgewater, while a detachment of his army surprised and took Bath. Some other actions of less consequence were fought.

Somersetshire was the principal scene of Monmouth's rebellion (A.D. 1685) against James II. After landing at Lyme, in Dorsetshire (11th June), and carrying Bridport by assault (14th June), he marched (15th June) by Axminster, in Devonshire (from whence the Devonshire militia retreated) to Chard; and thence to Taunton, where he was received with great enthusiasm, and declared himself king. After a delay of some days at Taunton, he proceeded (21st June) to Bridgewater, where also he was cordially received, and next day to Glastonbury; the militia of the county, which had been assembled to oppose him, having retreated to Bath and Bristol. The duke now resolved to attack Bristol, and advanced by Shepton Mallet to Pensford; from whence he sent a detachment which secured the bridge at Keynsham, where he passed the Avon. From Keynsham he advanced on the Gloucestershire side of the river toward Bristol, which he prepared to assault; but bad weather having compelled him to return to Keynsham, he was attacked there, but without success, by two parties of the king's horse. Here he learned the approach of the king's army, 4000 strong, which induced him to march towards Wiltshire, from which he expected to be joined by a strong body of horse; but a number of his supporters, who had assembled from Warminster, Westbury, and Frome, were routed at Frome by a party of the royal forces; and Monmouth's own army was weakened by desertion and discouragement from his Wiltshire supporters not having joined him. At Norton St. Philip's, between Bath and Frome, he was attacked (27th June) by the Royalists, whose advanced guard had marched from Bath under the duke of Grafton, Monmouth's half-brother. Monmouth repelled this attack; but retreated slowly to Frome, Shepton Mallet, Wells, and Bridgewater. From thence he marched with about 5000 horse and foot on the night of the 5th July, to surprise the king's army, which, under the orders of the Earl of Feversham and Lord Churchill (afterwards the celebrated duke of Marlborough), was encamped on Sedgmoor to the number of about 3000, or, as some say, 5000. The attempt at surprise failed, but a fierce engagement ensued (6th July), in which, though Monmouth's army behaved with great spirit, they were defeated with great loss; 300 being killed on the field, and 1500 or more in the pursuit on that and the following day. Monmouth quitted the field early, but was taken before the night of the 7th, and subsequently condemned and executed in London. The most fearful severities followed the suppression of this revolt. The Earl of Feversham hanged twenty-two men at Bridgewater on the evening of the battle, without any form of trial: and on his leaving the command to Colonel Kirke, the severity and violence of the soldiery were increased, so that Kirke's name was long the object of popular execration in the West of England. But this was not all: a special commission, with Lord Chief Justice Jeffreys at its head, was sent into the West; and a great number of persons were condemned and executed at Dorchester, Exeter, and especially Taunton and Wells. The prisoners for trial in this county alone were above 1000, and of these at least 239 were executed, and probably more. The sentences were carried into effect in thirty-six different towns and villages, among which they were distributed.

(Collinson's *History of Somersetshire;* Maton's *Observations on the Western Counties;* Conybeare and Phillips's *Geology of England and Wales;* Priestley's *History of Navigable Rivers and Canals;* Rickman's *Gothic Architecture;* Turner's *Anglo-Saxons;* Ingram's *Saxon Chronicle;* Carte, Kennett, Eachard, and Vaughan's *Hist. of England;* Fox's *James II.; Parliamentary Papers.*)

### Statistics.

*Popul n and Occupations.*—Above one-third of the population is employed in agriculture, in which occupation there were, in 1831, 6032 occupiers of land employing labourers; 3731 smaller occupiers not employing hired labour; and 28,107 labourers subsisting on wages. The remainder of the male population aged 20 and upwards, were as follows:—4350 engaged in manufactures or in making manufacturing machinery; 26,762 in retail trades and handicrafts; 4676 belonging to the professions, and bankers and capitalists; 12,183 non-agricultural labourers; 3801 domestic servants; and 7074 other males of this age whose occupations are not distinguished: the number of female servants was 18,333. The manufacture of fine woollen cloth is extensive in the county of Somerset, principally at Frome, where 730 men are so employed; Road contains 59 such manufacturers; Beckington 32; Charter House Hinton 24; at Twerton, near Bath, are 284; at Lyncombe and Widcombe 565; at Freshford 32; at Wellington 258; at Milverton and elsewhere, in small numbers, to the amount of 200; sheep-skins are tanned or dyed at Street, for hearth-rugs and gig-rugs. About 300 men are employed in sail-cloth, sacking, or girt-wed, at Crewkerne (and its vicinity), at East Coker, Merriot, West Hatch, and North Perrot; at Ilminster 21 men are variously employed in silk or lace machinery; at Chard 478; several at Bruton; at Taunton 109 men; and at Shepton Mallet as many are variously employed in making woollen cloth, serge, sail-cloth, and silk goods: at Corbon Denham, Wincanton, and Stoke-Trister, dowlas is made, and ticking; and at Keynsham are flax manufactories, employing 79 men; about 600 men are employed in the glove trade, of whom 300 men are at Yeovil, 150 at Milborne Port, 45 at Stoke-under Hamdon, Montacute, and Martock. Edge-tools are made at Mells by 56 men, and by several at Whatley, Emborrow, and other places; at Nailsea 94 men are employed in the manufacture of glass; paper-making and tanning employ 59 men at Cheddar; and at various places in the county are mentioned a few manufactures in iron, calamine, copper, brass, paper, and snuff; and a variety of small articles are made at Bath. (*Census of* 1831.)

The population of Somersetshire at each of the five following periods was as under:—

| | Males. | Females. | Total | Increase per cent. |
|---|---|---|---|---|
| 1801 | 126,297 | 146,823 | 273,570 | .. |
| 1811 | 141,449 | 161,731 | 303,180 | 10·7 |
| 1821 | 170,199 | 185,115 | 355,314 | 18·1 |
| 1831 | 194,316 | 209,884 | 404,200 | 13·6 |
| 1841 | 209,421 | 226,581 | 436,002 | 7·8 |

Being an increase of 162,252, or 58½ per cent., in forty years, the increase for the whole of England during the same period being 79·9 per cent.

The only details published up to the present time (December) of the census in June, 1841, are the number of houses and the gross totals of the population, distinguishing the sex. At this period there were in the county 81,632 inhabited houses, 4702 uninhabited, and 893 were building.

The following table exhibits a summary of the population of every hundred, &c. as taken in 1831:—

| HUNDREDS, BOROUGHS, &c. | HOUSES. Inhabited | Families. | Building. | Uninhabited. | OCCUPATIONS. Families chiefly employed in agriculture. | Families chiefly employed in trade, manufactures, and handicraft. | All other Families not comprised in the two preceding classes. | PERSONS. Males. | Females. | Total of persons. | Males twenty years of age. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Abdick and Balstone . | 1,977 | 2,234 | 10 | 48 | 1,161 | 686 | 387 | 5,694 | 5,537 | 11,231 | 2,794 |
| Andersfield . . . | 501 | 525 | 9 | 16 | 300 | 147 | 78 | 1,403 | 1,361 | 2,764 | 716 |
| Bath Forum . . . | 3,683 | 4,643 | 85 | 316 | 1,084 | 1,752 | 1,807 | 9,392 | 11,717 | 21,109 | 4,696 |
| Bempstone . . . . | 1,299 | 1,457 | 12 | 62 | 926 | 293 | 238 | 3,595 | 3,733 | 7,328 | 1,894 |
| Brent with Wrington . | 769 | 928 | 4 | 38 | 555 | 221 | 152 | 2,350 | 2,478 | 4,828 | 1,126 |
| Bruton . . . . . | 890 | 944 | 6 | 48 | 458 | 281 | 205 | 2,081 | 2,409 | 4,490 | 1,006 |
| Cannington . . . | 1,001 | 1,161 | 12 | 28 | 668 | 330 | 163 | 2,801 | 2,894 | 5,695 | 1,396 |
| Carhampton . . . | 1,487 | 1,628 | 11 | 42 | 879 | 450 | 299 | 4,032 | 4,070 | 8,102 | 1,984 |
| Catsash . . . . . | 1,343 | 1,536 | 16 | 53 | 816 | 387 | 333 | 3,727 | 3,789 | 7,516 | 1,847 |
| Chew and Chewton . | 3,285 | 3,589 | 29 | 100 | 1,184 | 660 | 1,745 | 9,027 | 8,905 | 17,932 | 4,240 |
| Crewkerne . . . . | 1,286 | 1,359 | 16 | 60 | 619 | 485 | 255 | 3,264 | 3,583 | 6,847 | 1,579 |
| Curry, North . . . | 815 | 871 | 11 | 38 | 540 | 177 | 154 | 2,088 | 2,123 | 4,211 | 987 |
| Frome . . . . . . | 3,842 | 4,189 | 12 | 423 | 949 | 2,126 | 1,114 | 9,438 | 10,446 | 19,884 | 4,363 |
| Glaston Twelve Hides | 1,149 | 1,318 | 7 | 38 | 787 | 276 | 255 | 3,208 | 3,158 | 6,366 | 1,557 |
| Hampton and Claverton . . . . . | 100 | 113 | 2 | 16 | 77 | 16 | 20 | 281 | 306 | 587 | 145 |
| Hartcliffe with Bedminster . . . . | 3,010 | 3,937 | 158 | 177 | 404 | 1,405 | 2,128 | 8,179 | 8,868 | 17,047 | 4,094 |
| Horethorn . . . . | 1,439 | 1,660 | 4 | 44 | 815 | 553 | 292 | 3,690 | 3,973 | 7,663 | 1,859 |
| Houndsborough . . | 1,447 | 1,683 | 16 | 45 | 780 | 693 | 210 | 3,973 | 4,190 | 8,163 | 1,867 |
| Huntspill and Puriton. | 371 | 387 | — | 3 | 263 | 84 | 40 | 1,030 | 982 | 2,012 | 454 |
| Keynsham . . . . | 1,558 | 1,889 | 21 | 56 | 734 | 598 | 557 | 4,469 | 4,560 | 9,029 | 2,217 |
| Kilmersdon . . . | 1,272 | 1,401 | 14 | 41 | 337 | 238 | 826 | 3,310 | 3,319 | 6,629 | 1,572 |
| Kingsbury, East and West . . . . . | 3,803 | 4,338 | 59 | 202 | 1,616 | 2,050 | 672 | 9,666 | 10,296 | 19,962 | 4,579 |
| Martock . . . . | 364 | 557 | — | 16 | 255 | 164 | 138 | 1,341 | 1,500 | 2,841 | 638 |
| Mells and Leigh . . | 389 | 439 | 5 | 7 | 146 | 145 | 148 | 933 | 966 | 1,899 | 465 |
| Milverton . . . . | 849 | 978 | 7 | 51 | 479 | 284 | 215 | 2,257 | 2,377 | 4,634 | 1,140 |
| Norton Ferris . . . | 937 | 1,137 | 2 | 35 | 510 | 333 | 294 | 2,473 | 2,619 | 5,092 | 1,255 |
| Petherton, North . . | 1,047 | 1,199 | 14 | 27 | 803 | 240 | 156 | 2,969 | 2,921 | 5,890 | 1,402 |
| Petherton, South . . | 1,221 | 1,359 | 9 | 39 | 851 | 283 | 225 | 3,090 | 3,177 | 6,267 | 1,483 |
| Pitney . . . . . | 321 | 359 | 3 | 15 | 114 | 115 | 130 | 980 | 943 | 1,923 | 425 |
| Portbury . . . . | 1,665 | 1,895 | 18 | 46 | 635 | 444 | 816 | 4,605 | 4,728 | 9,333 | 2,264 |
| Somerton . . . . | 1,017 | 1,185 | 18 | 33 | 632 | 273 | 280 | 2,681 | 2,771 | 5,452 | 1,340 |
| Stone . . . . . . | 1,297 | 1,442 | 15 | 79 | 341 | 747 | 354 | 3,564 | 3,869 | 7,433 | 1,690 |
| Taunton and Taunton Dean . . . . . | 1,935 | 2,260 | 26 | 92 | 1,276 | 580 | 404 | 5,546 | 5,742 | 11,288 | 2,886 |
| Tintinhall . . . . | 795 | 954 | 14 | 40 | 354 | 332 | 268 | 2,189 | 2,303 | 4,492 | 1,074 |
| Wellow . . . . . | 1,510 | 1,694 | 58 | 43 | 525 | 662 | 507 | 4,445 | 4,529 | 8,974 | 2,142 |
| Wells Forum . . . | 2,041 | 2,234 | 9 | 91 | 891 | 779 | 564 | 5,421 | 5,999 | 11,420 | 2,709 |
| Whitestone . . . | 2,582 | 2,776 | 29 | 168 | 902 | 879 | 995 | 5,914 | 6,498 | 12,412 | 3,147 |
| Whitley . . . . | 2,340 | 2,585 | 35 | 61 | 1,496 | 597 | 492 | 6,388 | 6,406 | 12,794 | 3,221 |
| Williton and Freemanners . . . . | 2,678 | 2,969 | 23 | 104 | 1,746 | 792 | 431 | 7,410 | 7,307 | 14,717 | 3,801 |
| Winterstoke . . . | 3,523 | 3,947 | 51 | 216 | 2,082 | 944 | 921 | 9,765 | 9,746 | 19,511 | 4,639 |
| Bath (City) . . . | 5,063 | 9,044 | 40 | 382 | 221 | 3,907 | 4,916 | 15,587 | 22,476 | 38,063 | 8,556 |
| Bridgewater (Borough) | 1,400 | 1,507 | 20 | 85 | 82 | 629 | 796 | 3,683 | 4,124 | 7,807 | 1,797 |
| Taunton (Borough) . | 2,024 | 2,261 | 29 | 108 | 159 | 1,193 | 909 | 4,953 | 6,186 | 11,139 | 2,510 |
| Militia under training . | — | — | — | — | — | — | — | 1,424 | — | 1,424 | — |
| Total . . . | 71,935 | 84,571 | 939 | 3,632 | 30,452 | 28,230 | 25,889 | 194,316 | 209,884 | 404,200 | 95,556 |

*County Expenses, Crime, &c.*—Sums expended for the relief of the poor:—1748-49-50 (annual average), 25,596*l.*; 1776, 50,491*l.*; 1783 84-85 (average), 66,267*l.* The sums expended at the four dates of

| | £. | | s. | d. | |
|---|---|---|---|---|---|
| 1801 were | 121,790, | being | 8 | 10 | for each inhabitant. |
| 1811 . . | 185,407 | „ | 12 | 2 | „ |
| 1821 . . | 153,906 | „ | 8 | 7 | „ |
| 1831 . . | 178,047 | „ | 8 | 9 | „ |

And in each of the following years ending 25th March, the expenditure was as under:—

| 1835. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|
| £154,443 | £140,442 | £124,699 | £130,077 | £155,632 | £156,059 |

The expenditure in the last of the above years would average about 7*s.* 2¼*d.* for each inhabitant, which is 1*s.* 4*d.* per head higher than for the whole of England. The expenditure for the year ending 25th March, 1834, was 176,286*l.* The saving effected between that year and 1840 amounted to 41,680*l.*, or 20 per cent.; namely, under the head of relief and maintenance, 20,227*l.*, or 11 per cent.; in suits of law, &c., 5093*l.*, or 76 per cent.; and in miscellaneous expenses, 16,360*l.*, or 78 per cent. The number of poor-law unions is 17, comprising every parish in the county. The number of paupers relieved during the quarter ending Lady-day, 1840, was 43,462 (4001 in-door, and 39,461 out-door), being 10 per cent. of the population, the proportion for England being 8·6 per cent. The social condition of the county may be further illustrated by the following facts:—Illegitimate births in 1830, 503, or 1 in 23;—in England 1 in 20. Bastard children chargeable on the poors'-rate in 1835 6, 2260, or 1 in 179;—in England 1 to 215. Lunatics and idiots chargeable on the same fund in 1836, 484, or 1 in 835;—in England 1 in 1033. Proportion per cent. of persons married under 21 years of age in 1840, 8·4;—in England and Wales, 9·6 for the two sexes.

The annual value of real property in the county assessed to the property-tax in 1815, was 1,900,651*l.* The sum raised for poor-rate, county-rate, and other local purposes, for the year ending 25th March, 1833, was 223,492*l.*, levied upon the under-mentioned descriptions of property:—

| | |
|---|---|
| On land . . . | £169,354 |
| Dwelling-houses . . | 44,936 |
| Mills, factories, &c. . . | 2,868 |
| Manorial profits, navigation, &c. . | 6,333 |
| Total | £223,492 |

The amount expended was—

| | |
|---|---|
| For the relief of the poor . . . | £184,595 |
| In suits of law, removal of paupers, &c. . | 6,474 |
| For other purposes . . . . . . | 31,794 |
| Total money expended | £222,864 |

The county expenditure in 1834, exclusive of that for the relief of the poor, was 19,129*l.* 19*s.* 7½*d.*, disbursed as follows:—

| | |
|---|---|
| Bridges, building, repairs, &c. . | £1,495 |
| Gaols, houses of correction, and maintaining prisoners . . . | 7,413 |
| Shire-hall and courts of justice, building, repairs, &c. . . . | 33 |
| Prosecutions . . . . | 5,364 |
| Clerk of the peace . . . | 726 |
| Conveyance of prisoners before trial | 1,351 |
| Conveyance of transports . . | 404 |
| Vagrants, apprehending and conveying | 60 |
| Constables, high and special . . | 77 |
| Coroner . . . . . . | 585 |
| Miscellaneous . . . . | 1,681 |
| Total | £19,129 |

The county-rate levied at different periods during the last half-century, and the principal disbursements, so far as they can be made out, are shown in the following table:—

| | 1801. £ | 1811. £ | 1821. £ | 1831. £ | 1838. £ |
|---|---|---|---|---|---|
| Income . | 6,036 | 10,563 | 20,006 | 17,837 | 20,606 |
| Expenditure:— | | | | | |
| Bridges . | 406 | 738 | 1,181 | 1,287 | 827 |
| Gaols . | 148 | 795 | 287 | 1,895 | 1,087 |
| Prisoners' maintenance | 3,941 | 3,446 | 8,813 | 10,410 | 7,532 |
| Prosecutions | 876 | 614 | 3,994 | 4,705 | 4.489 |
| Constables and vagrants . | 298 | 214 | 1,133 | 477 | ... |

In 1839 the length of streets and highways in the county, and the expenditure thereon, were as under:—

| | | Miles. |
|---|---|---|
| Streets and roads repaired under local acts | | 89 |
| Turnpike roads . . . . . | | 876 |
| All other highways . . . . . | | 3,346 |
| | | 4,311 |
| Amount of rates levied . . . | | £39,165 |
| Expended in repairs of highways | £37,060 | |
| Law and other expenses . | 403 | |
| Total expenditure | | 37,463 |

The number of turnpike trusts in the county in 1839 was 23, and the income arising from tolls amounted to 61,040*l.*; from parish compositions, in lieu of statute-duty, 595*l.*; and the total income (including 2700*l.* borrowed) was 65,230*l.*; the total expenditure for the same year being 64,652*l.* The assets, including arrears of income, amounted to 10,482*l.*; the debts to 318,583*l.* In 1836 the debt was equal to 5·17 years of the annual income;—the proportion for England being 4·56 years; the proportion of unpaid interest to the total debt was 6 per cent., the average for England being 12 per cent.

In 1839 the church-rates amounted to 14,743*l.*; and with 2904*l.* derived from other sources, were applied to defray expenses connected with the established church: in 1832 the sum derived from other sources included 684*l.* from estates and rent charges. The sum expended for the purposes of the establishment amounted to 16,780*l.* in 1839, and 8674*l.* were expended in repairs of churches.

*Crime.*—Number of persons charged with criminal offences in the four septennial periods ending 1819, 1826, 1833, and 1840:—

| | 1813-19. | 1820-26. | 1827-33. | 1834-40. |
|---|---|---|---|---|
| Total of each septennial period . | 2,053 | 3,156 | 4,267 | 6,014 |
| Annual average . | 293 | 450 | 623 | 859 |

The numbers committed, convicted, and acquitted in each year from 1834 to 1839 were as under:—

| | 1834. | 1835. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|---|---|
| Committed | 677 | 684 | 796 | 1028 | 858 | 843 | 1128 |
| Convicted | 448 | 484 | 543 | 722 | 636 | 589 | 756 |
| Acquitted | 229 | 200 | 253 | 306 | 222 | 254 | 372 |

In 1834 the proportion of persons committed, to the total population of the county, was 1 in 597; and in 1840, allowing for the increase of population, 1 in about 380.

Of 1128 criminal offenders tried at the assizes and sessions in Somersetshire in 1840, there were 51 charged with offences against the person; 131 with offences against property committed with violence; 836 (including 612 cases of simple larceny) with offences against property committed without violence; 3 with malicious offences against property; 10 for forgery and uttering base coin; and 97 for various misdemeanors, including 64 for riot and breach of the peace. Above two-thirds of the offences were those against property committed without violence; and above one-half were cases of simple larceny. Sentence of death was recorded in 5 cases, which was commuted for various periods of transportation. Of 756 offenders convicted, including the 5 above-mentioned cases, 13 were transported for life; 33 for periods varying from 10 to 15 years; 74 from 7 to 10 years; 47 for 7 years, making in all 172 offenders transported; 1 was imprisoned for above two years; 22 for a term exceeding twelve months; 62 for above six months; and 479 for six months and under; and 20 were whipped, fined, or discharged on sureties. The acquittals were 379 in number: in 18 cases there was no prosecution; in 128 no bill was found; and 226 persons were found not guilty on trial. Of the total number committed 915 were males and 213 females; and of those transported 151 were males and 16 were females; and of the total number 340 males and 70 females could neither read nor write; 423 males and 127 females could read, or read and write imperfectly; 81 males and 7 females could read and write well; 6 males had received superior instruction; and the state of instruction of 65 males and 9 females was not ascertained. On an average of several years the proportion of uninstructed criminals in this county was 86·3 per cent.; of those instructed, 13·7 per cent;—the average of the former for England and Wales being 89·3 per cent.

*Savings' Banks.*—There are 9 of these useful institutions in the county; and the number of depositors and amount of deposits on the 20th of November in each of the following years, were as under:—

| | 1833. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|---|
| No. of depositors | 11,904 | 14,402 | 15,233 | 16,527 | 17,281 | 19,542 |
| Am. of deposits | £460,426 | £519,962 | £538,206 | £565,043 | £577,786 | £601,374 |

The various sums placed in the savings' banks in 1830, 1834, and 1839, were distributed as follows:—

| | 1830. | | 1834. | | 1839. | |
|---|---|---|---|---|---|---|
| | Depositors. | Deposits. | Depositors. | Deposits. | Depositors. | Deposits. |
| Not exceeding £20 | 5,300 | £41,069 | 5,843 | £45,256 | 8,904 | £63,042 |
| ,, 50 | 3,410 | 105,354 | 3,699 | 112,821 | 4,670 | 143,394 |
| ,, 100 | 2,006 | 137,616 | 186 | 126,599 | 2,207 | 154,194 |
| ,, 150 | 749 | 88,705 | 661 | 79,462 | 901 | 108,353 |
| ,, 200 | 424 | 72,416 | 435 | 72,771 | 468 | 78,785 |
| Above . . 200 | 252 | 63,401 | 171 | 40,194 | 131 | 30,108 |
| | 12,141 | 508,784 | 12,625 | 477,103 | 17,281 | 577,786 |

The deposits of 144 friendly societies, not reckoned above, amounted in 1840 to 25,482*l.*; and 30,654*l.* were invested by 375 charitable institutions.

From 1835 to 1839-40, the number of county electors in the eastern division increased 1255; and in the western division 170. The number in each division at the latter period was as under:—

| | E. div. | W. div. | Total. |
|---|---|---|---|
| Freeholders of every class . . | 6,505 | 5,489 | 11,994 |
| Copyholders and customary tenants | 165 | 416 | 581 |
| Leaseholders for life or for a term . . . . . . | 633 | 849 | 1,482 |
| 50*l.* tenants at will . . . | 2,286 | 2,093 | 4,379 |
| Trustees and mortgagees . | 10 | 18 | 28 |
| Qualified by offices . . . | 61 | 5 | 66 |
| Joint and duplicate qualifications | 51 | 143 | 194 |
| Defective specification . . | 47 | 11 | 58 |
| | 9,758 | 9,024 | 18,782 |

*Education.*—Summary of the Returns made to Parliament in 1833:—

| | Schools. | Scholars. | Total. |
|---|---|---|---|
| Infant schools . . . . | 121 | | |
| Number of children at such schools; ages from 2 to 7 years — | | | |
| Males . . | | 917 | |
| Females . . | | 1,001 | |
| Sex not specified . | | 1,268 | |
| | | | 3,186 |
| Daily schools . . . | 1,303 | | |
| Number of children at such schools; ages from 4 to 14 years:— | | | |
| Males . . | | 14,748 | |
| Females . . | | 12,744 | |
| Sex not specified . | | 5,213 | |
| | | | 32,705 |
| Schools . . . | 1,424 | | |
| Total of children under daily instruction . . . . | | | 35,891 |
| Sunday schools . . . . | 593 | | |
| Number of children at such schools; ages from 4 to 15 years:— | | | |
| Males . . | | 16,923 | |
| Females . . | | 17,904 | |
| Sex not specified . | | 7,947 | |
| | | | 42,774 |

The number of children in Somersetshire in 1833, between the ages of 2 and 15, may be taken at about 14,000. Thirty-eight Sunday-schools, attended by 1392 children, are returned from places where there are no other schools; but in every other case the children have the opportunity of attending daily schools as well, but to what extent they do so cannot be ascertained. Seventy schools, attended by 4267 children, are both daily and Sunday schools, and duplicate returns are known to be thus far created. The children between the ages of 2 and 15 who were under instruction in this county in 1833 probab'y did not exceed one-half of the total number. One hundred and thirty-four boarding-schools are included in the number of daily schools given above.

The proportion of persons who attested their marriages by marks instead of writing their names, was, in 1839-40, 37 per cent. for men and 49 per cent. for women, which is a little under the average for England and Wales.

*Maintenance of Schools.*

| Description of Schools. | By endowment. | | By subscription. | | By payments from scholars | | Subscrip and payment from scholars. | |
|---|---|---|---|---|---|---|---|---|
| | Schls. | Scholars. | Schls. | Scholars. | Schls. | Scholars. | Schls. | Scholars. |
| Infant Schools | .. | .. | 3 | 248 | 97 | 1533 | 21 | 1405 |
| Daily Schools | 105 | 2544 | 76 | 3,079 | 1021 | 20,952 | 101 | 6130 |
| Sunday Schools | 15 | 1005 | 528 | 37,937 | 3 | 122 | 47 | 3710 |
| Total... | 120 | 3549 | 607 | 41,264 | 1121 | 22,607 | 169 | 11,247 |

The schools established by Dissenters, included in the above statement, are—

| | | Scholars. |
|---|---|---|
| Infant-schools . . . | 2, containing | 190 |
| Daily-schools . . . | 30, . | 1,070 |
| Sunday-schools . . . | 163, . | 15,665 |

The schools established since 1818 are—

| | | |
|---|---|---|
| Infant and other daily schools . | 828, containing | 21,282 |
| Sunday-schools . . | 340 . | 26,512 |

Lending libraries are attached to 83 schools.

SOMERTON. [SOMERSETSHIRE.]

SOMERVILLE, WILLIAM, was born in 1692, at Edstone, in Warwickshire, which had been the residence of his ancestors from the time of Edward I. He studied at Winchester School, and at New College, Oxford. Having completed his education, he resided during the rest of his life in the family mansion, partly occupied with the duties of a justice of peace, partly with the active pleasures of the sportsman, and partly with the cultivation of his poetical talents. His income, derived from the estate which he inherited from his father, was 1500*l.* a year, out of which his mother had a jointure of 600*l.* a year. Hospitable, convivial, and careless of economy, he became involved in debt, and in the latter part of his life, according to the account of his friend Shenstone the poet, 'drank himself into pains of the body, in order to get rid of the pains of the mind.' He died, July 19, 1742, and was buried at Wotton, near Henley-in-Arden, Warwickshire.

Somerville's 'Chase' is still a favourite with those who combine a taste for poetry with an attachment to the sports of the field, and has been frequently reprinted. It is written in tolerably harmonious blank verse; and as the poet was practically master of his subject, his descriptions are always accurate and frequently vivid, and he has given variety to them by comparing the rural sports of other countries with those of his own. Somerville has written another rural poem, called 'Field Sports,' which describes the amusement of hawking; and 'Hobbinol, or Rural Games,' a mock heroic. He has also written some Fables, which are mostly dull and uninteresting; some rather coarse Tales; and a few lyrical pieces, which display no great poetical power, but contain many beautiful lines. Johnson (*Lives of the Poets*) has justly praised the happy delicacy with which, in his verses to Addison, Somerville mentions the name Clio, the letters of which are used by Addison to distinguish his own papers in 'The Spectator:'—

> 'When panting Virtue her last efforts made,
> You brought your Clio to the virgin's aid.'

SOMME, River. [FRANCE; SOMME, Department.]

SOMME, one of the departments of France, bounded on the north by that of Pas de Calais, on the north-east by that of Nord, on the east by that of Aisne, on the south by that of Oise, and on the south-west by that of Seine Inférieure; it is washed on the west by La Manche, or the English Channel. The form of the department is compact: the greatest length is from east-south-east to west-north-west, from the neighbourhood of Ham to the mouth of the river Somme, 80 miles; the greatest breadth is from the bank of the river Bresle near Aumale (in the department of Seine Inférieure) to the neighbourhood of Lucheux, 47 miles. The area is estimated at 2378 square miles: the population in 1831 was 543,704; in 1836 it was 552,706; showing an increase in five years of 9002, or 1·7 per cent., and giving 232 inhabitants to a square mile. In area it is just about the average of the French departments, and about midway between the English counties of Devon and Norfolk. In population, absolute and relative, it exceeds the average of the departments in the proportion of rather more than four to three; and is in both respects considerably above either of the two English counties with which we have compared it. Amiens, the capital, is on the Somme, 70 miles in a direct line north of Paris, or 75 miles by the road through Chantilly and Clermont; in 49° 54′ N. lat. and 2° 17′ E. long.

The surface of the department is generally level, and the scenery monotonous. The coast, which has a tolerably straight outline, extending from south by west to north by east, is divided into two nearly equal parts by the mouth of the Somme; to the north of that river the shore is lined by sand-hills or downs, which protect the low grounds from the incursions of the sea; to the south of the Somme commence the cliffs which extend westward to the neighbourhood of Hâvre. The coast-line has undergone a considerable change even in comparatively recent times. In the ninth century the waves covered the low ground between the Somme and the Authie, several miles inland from the present shore. When the sea retired, there remained for some time a large lake or pool, long since dried up, and the site of which is now among the most fertile land in the department. The whole of the department is occupied by the formations of the cretaceous group. The extensive chalk-plains are intersected at intervals by valleys, watered by streams, and presenting green meadows and trees, which contrast favourably with the general nakedness of the country. Some sandstone for paving is quarried, and peat is dug in great abundance in the valleys.

The department is watered by the Somme, with its tributaries, and by the Bresle and the Authie. The Somme rises in the adjacent department of Aisne, not far from St. Quentin: it has a south-western course, past that town, of about 18 or 20 miles, and enters this department just above the town of Ham, below which it flows about 20 miles to the north-north-west to Cléry below Peronne, and from thence westward 30 miles to Amiens: below Amiens its course is north-west in a tolerably direct line, 45 miles to the sea: its whole course may thus be estimated at 115 miles, 95 of which are in this department. The navigation of the river commences at the port of Grand Sailly, between Corbie and Bray, and about midway between Peronne and Amiens: its length may be estimated at 60 miles; but it is so impeded by difficulties, that a canal, partly coinciding with the river, partly parallel to it, has been formed to improve the navigation. By means of this canal, which is carried far above Grand Sailly, a communication has been opened with the canal of St. Quentin; and by means of the two, water-carriage is provided along the valley of the river, and adjacent to it, almost up to its source, and a communication is formed with the Escaut or Schelde and the Oise. The principal feeders of the Somme are the Miraumont, the Nieve, and the Maie, on the right bank; and the Avre, which receives the Dam or Don and the Noye, and the Celle, on the left bank. These are all small; but the Avre has been made navigable for about 11 miles. The Authie rises not far from Doullens, and flows past that town in a north-west direction into the sea. Its whole course is about 50 miles, nearly the whole on the border of the department, which it separates from that of Pas de Calais. The Bresle rises in the department of Oise, near Formerie, and flows north-west into the sea; about 25 miles of its course are on the border of this department, which it separates from that of Seine Inférieure. Neither the Authie nor the Besle is navigable; but the mouth of the latter forms the harbour of La Tréport. [SEINE INFERIEURE.]

The official return of the inland navigation of the department is as follows:—

| | | |
|---|---|---|
| Avre . . . . . . | | 11 miles. |
| Luce . . . . . . | | 1 |
| | Rivers | —12 |
| Canal of the Somme, and navigation of the river . . . | | 97 |
| | Total | 109 miles. |

The department is traversed by ten government roads (Routes Royales), which had, in January, 1837, an aggregate length of 362 miles; viz. 304 in good repair, 8 miles out of repair, and 50 miles unfinished. The chief roads are that from Paris to Calais, which enters the department near Poix, and runs by Ayraines and Abbeville into the department of Pas de Calais; that from Paris to Dunkerque, which enters the department beyond Breteuil (department of Oise), and runs by Amiens and Doullens; and that from Paris to Cambray and Lille, which enters the department near Roye, and passes by Peronne. Roads run from Amiens to Abbeville; to Rouen (department of Seine Inférieure), by Poix; to Cambray (department of Nord), by Albert and Bapaume; and to Compiègne (department of Oise), by Montdidier; and from Abbeville to Eu and Dieppe (department of Seine Inférieure); to Neufchâtel and Rouen; to Arras (department of Pas de Calais), by Doullens; and to St. Omer (department of Pas de Calais), by Hesdin: there are some other roads of less amount. The departmental roads had, in January, 1837, an aggregate length of 109 miles; viz. 96 in good repair, and 13 unfinished. The bye-roads amounted in round numbers to 5000 miles.

The department is by no means naturally fertile: the chalky plains by which a large part is occupied have been rendered tolerably productive by the care bestowed on them. Of the whole area, which may be estimated at above 1,500,000 acres in round numbers, nearly 1,200,000 acres, or four-fifths, are under the plough. The principal crops are of wheat, rye, and maslin. The produce in wheat is about half as much again as the average produce of the French departments; and of rye and maslin the produce is nearly double that of wheat. Barley and buckwheat are grown, the former in tolerable quantity; but oats and potatoes are comparatively little cultivated. A great quantity of corn is exported into the neighbouring department of Seine Inférieure, and to those of Seine and Nord; but in oats a considerable importation is requisite to make good the shortness of the supply. The meadows do not exceed 40,000 acres, nor do the open pasture-grounds much exceed 20,000; yet horses are very numerous, because they are chiefly employed in the labours of agriculture. Cows are also numerous, nearly half as many again as in the average of the departments; and in sheep the preponderance is yet greater; but there are very few oxen. The long-woolled English sheep have been bred with great success. The wool not required for the consumption of the department is exported to the departments of Seine, Seine Inférieure, and Nord. Pulse, seeds for oil, hops, hemp, and flax are grown. There are no vineyards, but the orchards and gardens are numerous and extensive. The apple is the fruit chiefly cultivated, and a considerable quantity of cider is made: it forms, with beer, the ordinary drink of the inhabitants. Game abounds, and sea-fish and fresh-water fish are plentiful. The woodlands amount to nearly 130,000 acres. The only extensive forest is that of Crécy, on the north-western part of the department. The supply of fuel is insufficient, and would be more so but for the quantity of peat dug.

The department is divided into five arrondissements, as follows:—

| Chief towns. | Situation. | Area in square miles. | Population in 1831. | Population in 1836. | Communes. |
|---|---|---|---|---|---|
| Amiens | Central & S.W. | 712 | 178,206 | 181,989 | 250 |
| Abbeville | W. | 604 | 132,717 | 133,300 | 172 |
| Doullens, or Doulens . . | N. | 255 | 58,425 | 59,023 | 88 |
| Montdidier | S. | 354 | 67,881 | 69,271 | 144 |
| Peronne | E. | 453 | 106,475 | 109,123 | 181 |
| | | 2378 | 543,704 | 553,706 | 835 |

The number of cantons or districts, each under a justice of the peace, is 41.

In the arrondissement of Amiens are—Amiens (population in 1831, 31,457 town, 45,001 whole commune; in 1836, 46,129 commune), Corbie, and Picquigny, on the Somme; Poix and Conty, on the Celle or its affluents; Senarpont, on the Bresle; and Airaines (population 1930). Oisemont and Hornoy, in the district between these three rivers. Amiens is described elsewhere. [AMIENS.] Corbie has some woollen manufactures and tan-mills; there are two yearly fairs. Picquigny has some historical note. Here Guillaume, Longue Epée (Long Sword), duke of Normandie, was assassinated, A.D. 942 [NORMANDIE]; and here Louis XI. had an interview with Edward IV. of England, A.D. 1475. [EDWARD IV., vol. ix., p. 296.] The town, which is on the left bank of the river, is ill built. The townsmen carry on some trade in linen. Peat is dug in the neighbourhood of both Corbie and Picquigny. Poix is a well built town: it has a large tile-yard and two yearly fairs. Conty, or Conti, was formerly the capital of a principality which gave title to one of the branches of the house of Bourbon: it has a manufactory of hosiery and a paper-mill, and the townsmen carry on trade in corn. Oisemont has lime-works and brick-yards; and the townsmen trade in grain, wool, and horses. Near Picquigny is a Roman camp in tolerably good preservation: it is ascribed to Cæsar.

In the arrondissement of Abbeville are—Abbeville (population in 1831, 19,162; in 1836, 18,247), La Ferté, St. Valery (population 3265), and Le Crotoy, on the Somme; Rue and Crécy, on the Maie; St. Riquier, between the Authie and the Somme; Cayeux (population 2549), on the coast between Somme and the Bresle; and Gamaches, on the Bresle. Abbeville and Crécy, the latter the scene of a memorable battle between the English and French, under their respective kings (A.D. 1346), are noticed elsewhere. [ABBEVILLE; CRECY.] St. Valery is at the mouth of the Somme, on the south bank of the river which forms the harbour. The town is on the side of a hill; it has large warehouses, ropewalks, and ship-building yards. The harbour is capable of receiving ships of 300 tons, but the shifting sandbanks render the entrance difficult. The tide rises about 12 feet. Considerable trade is carried on; sail and packing cloth, cordage, and glass are exported; and an important commission-trade is carried on in the wines, brandies, and other productions of the south of France. Vessels are fitted out for the fisheries, the colonies, and the coasting-trade: the imports are conveyed by the Somme navigation up to Abbeville and Amiens in lighters of 35 to 40 tons. Communication by steam has been established between St. Valery and London. There is one yearly fair. St. Valery has a theatre, an hospital, and a free navigation-school. The remains of a Roman post or camp and several antiquities have been discovered on the slope on which the town stands. Some writers have represented this as the port from which Guillaume or William the Conqueror sailed for the conquest of England. [NORMANDIE.] Le Crotoy is a small but busy fishing-town on the north bank of the Somme, opposite St. Valery. Rue has some trade in fish, cattle, horses, sheep, and wool: it was once a seaport, but by the recession of the sea is now three or four miles inland. St. Riquier was antiently called Centule, and took its present name from St. Riquier, native of the town, who founded here, in the seventh century, a Benedictine abbey: it is said to have contained, under Louis-le-Debonnaire, 2600 houses. The church of the abbey still remains, and is the finest ecclesiastical building in the department after the cathedral of Amiens; and there is an hospital. Some trade is carried on in corn and hemp. Cayeux is near the mouth of the Somme; it has a lighthouse to guide vessels amid the sands which line this part of the coast. Gamaches was, in the middle ages, a place of strength; and there are yet some remains of its ramparts and its castle; the town is tolerably well built; it has a linen manufactory, a pottery, and several oil-mills.

In the arrondissement of Doullens are—Doullens (population in 1831, 2511 town, 3703 whole commune; in 1836, 3912 commune) and Lucheux, on the Authie or its feeders, and Domart, on an affluent of the Nieve. Doullens or Doulens is defended by a double citadel, formed by two forts or citadels communicating with each other. It has several public offices, fiscal or judicial, a theatre, and two hospitals. There is a fine manufactory for cotton-yarn, and several oil-mills or presses for seed-oil. Trade is carried on in coarse linen for wrappers, and in corn, oil, hemp, flax, and cattle. There are two yearly fairs for horses, cattle, and hardwares. This town was taken by the Huguenots, A.D. 1567, and retaken by the Catholics next year. Domart, or Dommart, sometimes distinguished as Dommart-les-Ponthieu, has two yearly fairs for horses, cattle, drapery, and hardwares.

In the arrondissement of Montdidier are—Montdidier (population in 1831, 3769; in 1836, 3790), on the Dam or Don, a branch of the Avre; Roye (population 3636) and Moreuil (population 1930 town, 1941 whole commune), on the Avre; and Ailly, on the Noye, another affluent of the Avre. Montdidier is on a hill on the right bank of the river; it is an old ill-built town, with some remains of the fortifications which formerly defended it. It has several government offices, a high school, and an agricultural society. Cotton yarn, cotton hose, and leather are manufactured; and trade is carried on in grain, pulse, cattle, poultry, peat, and coals. Roye is built on the slope of a hill on the right bank of the Avre; it has narrow streets and ill-built houses. The town-hall, a Gothic building, is in the public square, which is large. There are manufactures of cotton yarn, cotton and woollen stuffs, stockings, &c.; and considerable trade is carried on in corn and flour for the supply of Paris. There is one yearly fair. Roye was a place of strength in former times, and has been repeatedly besieged. Moreuil has manufactures of hosiery and paper. Peat is dug in the neighbourhood. Ailly, distinguished as Ailly-sur-Noye, has a paper-mill.

In the arrondissement of Peronne are—Peronne (population in 1831, 3802; in 1836, 4119), Ham (population 1663), and Bray, on the Somme; Albert (population 2668), on the Miraumont; and Lihons and Nesle (population 1565 town, 1643 whole commune), between the Somme and the Avre. Peronne was a place of importance in the middle ages. Charles-le-Simple died here in captivity, A.D. 929. It was the scene of the well-known interview (A.D. 1468) between Louis XI. of France, and Charles, duke of Bourgogne [BOURGOGNE], described by Sir Walter Scott in his 'Quentin Durward.' In A.D. 1536, it was besieged by Henri of Nassau, one of the officers of the emperor Charles V., but without success. Though still fortified by a brick rampart and a ditch, it is no longer of any importance as a fortress, from its being commanded by the neighbouring heights. The town has two suburbs; the houses are tolerably well built, and there are two churches, a nunnery, a high school, an hospital, and a theatre. Calico, dimity, muslin, lawn, and other cottons and linens are manufactured; also leather, seed oil, and beet-root sugar. Peat is dug in the neighbourhood. There are thirteen yearly fairs, and considerable trade is carried on in woven goods and cattle. Ham is situated in a marshy plain, and was in the middle ages a place of strength. It is surrounded by the ruins of its antient fortifications, and has a castle, used as a state prison, and memorable as the place of confinement of the ministers of Charles X. There are three parish churches and an hospital. The townsmen manufacture blankets and cotton goods, beet-root sugar, and oil. There are two yearly fairs for cattle and general merchandise. General Foy was a native of Ham. Bray has a number of tan-yards. Albert has a manufactory of cotton-yarn, a bleach-ground, a paper-mill, a print-work for paper-hangings and calico, and, in the suburbs, a saltpetre manufactory. Trade is carried on in cattle. There is at Albert a subterraneous cavern, or quarry, vaulted with the most singular petrifactions. Nesle, or Nêle, has an hospital, and considerable works for making seed-oil, beet-root sugar, and mustard.

The population, when not otherwise described, is that of the commune, and from the census of 1831.

The department constitutes the diocese of Amiens, the bishop of which is a suffragan of the archbishop of Reims. It is in the jurisdiction of the Cour Royale of Amiens and of the Académie Universitaire of the same city. It returns seven members to the Chamber of Deputies. In respect of education it is rather above the average of France. Of the young men enrolled in the military census of 1828-29, 44 in every 100 could read and write; the average of France being between 39 and 40.

This part of France was in the earliest historical period included in the territories of the Ambiani (Ἀμϐιανοί), a Belgic nation of inferior importance. Their territories formed part of what Cæsar designates Belgium, a name far more limited, as applied to the country, than that of Belgae, given to the inhabitants. In the Roman division of Gaul, the Ambiani was included in the province of Belgica, and upon the subdivision of this, in Belgica Secunda. The river Somme was known to the Romans as the Samara. It is mentioned by Ptolemy by the name Φροῦδις (*Φρούδιος ποταμοῦ ἐκβολαί*). The Britanni, a people mentioned by Pliny, appear to have occupied the sea-coast near the mouth of the Somme. The Gallic or Roman towns included in the limits of the department were Samarobriva, Pontes, Teucera, Setuci, and Rodium. Samarobriva is mentioned by Cæsar, and appears to have been of some importance in his time; for he fixed upon it as the place for holding a general assembly of the Gauls (*De Bell. Gall.*, lib. v., c. 24). The name, which is Celtic, signifies 'the ford or passage of the Samara or Somme,' and indicates the situation of the place. Samarobriva obtained in the later period of the Roman domination the name of Ambiani, from the people to whom it belonged, and from this name is derived its modern name Amiens. Pontes, mentioned in the Antonine Itinerary, was probably at Ponches, a small place on the south bank of the Authie. Possibly this place may have given name to the district of Ponthieu, or Pontieu, of which Abbeville was the capital. Teucera (inserted in the *Peutinger Table*) was between Nemetacum (Arras) and Samarobriva (Amiens), perhaps at Tievre, near the Authie, which is just beyond the boundary of the department. Setuci (also inserted in the *Peutinger Table*), the name of which D'Anville conjectures to have been Catuci, was perhaps near Cayeux, between Amiens and Roye; and Rodium (*Peutinger Table*) may be fixed at Roiglise, or Roye-eglise, near Roye.

On the overthrow of the Roman empire, this district passed early into the hands of the Franks; and in the middle ages constituted part of the province of Picardie. It comprehends the greater part of the former districts of Amiénais, Santerre, and Ponthieu, in which last were Ponthieu, properly so called, Vimeux, and Marquenterre. Ham and its district were part of the province of Vermandois. It was the frequent scene of hostilities in the English wars of the fourteenth and fifteenth centuries, and in the Spanish wars of the sixteenth and seventeenth.

SOMNA'MBULISM, a word of modern origin, which means strictly and etymologically *sleep-walking;* and in this sense is synonymous with the various names, *noctivagatio, noctisurgium, noctambulatio, paroniria ambulans, hypnobasis, nyctobasis,* &c.; it is however generally used in a more extended signification to comprehend all the phenomena that take place when a person, apparently insensible to external objects, acts as if he were in a state of consciousness: and this is the sense which the word will bear in this article. M. Bertrand, in his 'Traité du Somnambulisme' (8vo., Paris, 1823), divides those phenomena into four classes: 1, essential (or *proper*) somnambulism, which arises from some particular disposition of the nervous system in persons who in other respects apparently enjoy perfect health; 2, symptomatic (or *morbid*) somnambulism, which occurs in the course of certain diseases; 3, artificial somnambulism, which is occasioned by the proceedings employed in animal magnetism or mesmerism; and, 4, ecstatic somnambulism, which is the result of a sort of religious enthusiasm. The same division of the subject will be here adopted.

I. *Essential* (or *Proper*) *Somnambulism* is intimately connected with the subject of sleep and dreaming; and in fact 'a somnambulator,' as Dr. Pritchard says, 'is nothing but a dreamer who is able to act his dreams.' As a minute inquiry into the physiology of these two phenomena would here be out of place, the reader must consult the articles already given on these subjects. This form of somnambulism was noticed by the antients. The author of the treatise 'De Morbo Sacro,' that commonly goes under the name of Hippocrates, says that 'he knew many persons who used to groan and cry out in their sleep, and others that seemed to pant for breath (πνιγομένους), and others that would get up and run out of the house and act like madmen till they were awakened, after which they were in good health and sound sense as before, only rather pale and weak.' (tom. i., p. 588, ed. Kühn.) Aristotle tells us that 'there are individuals who rise in their sleep and walk about, seeing as clearly as those that are awake.' Diogenes Laertius mentions (*De Vitis Philosophorum, Pyrrho*, lib. ix.) that a Stoic philosopher named Theon was a sleep-walker; and Galen says (*De Motu Musculorum*, lib. ii., cap. 4, tom. iv., p. 435, 436, ed. Kühn) that he would not believe that people ever fell asleep while walking, until one night when walking along the road he did so himself, and went on for about a furlong, sleeping and dreaming, till at last he was awakened by kicking against a stone. 'And this,' adds he, 'is the reason why people cannot go on walking for any distance in their sleep, because they cannot meet with a perfectly smooth road;' in which he is not quite correct, as we often find that both the bodily and intellectual powers of the individual are more active and developed in his sleep than when he is awake, and that he is then able to perform feats which at any other time he would shudder at. The instances on record of this species of somnambulism are so numerous, that it is difficult to select the most interesting; one or two examples however must be given, and for a more copious collection the reader must be referred to some of the works whose titles will be given in the following part of this article.

The following case is reported in the 38th volume of the French *Encyclopædia*, on the highly respectable authority of the archbishop of Bordeaux, and has been frequently copied into other subsequent publications. It is the case of a young ecclesiastic, who was in the habit of getting up during the night in a state of somnambulism, of going to his room, taking pen, ink, and paper, and composing and writing sermons. When he had finished one page of the paper on which he was writing, he would read over aloud what he had written, and correct it. Upon one occasion he had made use of the expression—'Ce divin enfant.' In reading over the passage, he changed the word 'divin' into 'adorable.' Observing however that the pronoun 'ce' could not stand before the word 'adorable,' he added to it the letter *t*. In order to ascertain whether the somnambulist made any use of his eyes, the archbishop held a piece of pasteboard under his chin, to prevent him from seeing the paper upon which he was writing; but he continued to write on, without being apparently incommoded in the slightest degree. The paper upon which he was writing was taken away, and other paper laid before him; but the young ecclesiastic immediately perceived the change. He wrote pieces of music while in this state, and in the same manner, with his eyes closed: the words he placed underneath the music. It happened upon one occasion that the words were written by him in too large a character, and did not stand exactly under the corresponding notes; he soon perceived the error, blotted out the part, and wrote it over again with great exactness.

Several interesting cases of somnambulism will be found in Muratori's work, *Della Forza della Fantasia Humana*; some of them given on the authority of Gassendi. One of Gassendi's somnambulists used to rise and dress himself in his sleep, go down to the cellar and draw wine from a cask. He appeared to see in the dark as well as in a clear day; but when he awoke, either in the street or cellar, he was obliged to grope and feel his way back to his bed. He always answered his wife as if awake, but in the morning recollected nothing of what had passed. Another sleep-walker, a countryman of Gassendi's, passed on stilts over a swollen torrent in the night, but on awaking was afraid to return before daylight, or until the water had subsided. This species of somnambulism has been known to be hereditary. Horstius, in his work 'De Natura, Differentiis, et Causis eorum qui Dormientes ambulant' (seu 'de Noctambulonibus'), Lips., 1595, 8vo., p. 172, mentions three brothers who were affected with it at the same time; and Willis knew a whole family that was subject to it. Perhaps however these may rather be considered as instances of the influence of example and of the power of unconscious imitation, which sometimes renders it in a manner contagious. Of this there is a curious example given by Dr. Pezzi, in a work entitled 'Scretti di Medico Argomento,' Venez., 1813. It appears that his nephew, after reading more than once the history of a somnambulist, was himself seized with this affection; and also that the servant who attended him soon began to exhibit in his own person similar phenomena.

Essential somnambulism occurs in many persons (says Dr. Good) without any manifest predisponent cause, though it is generally connected with a considerable irritability of habit. A morbid state of the stomach, where this habit exists, has very frequently proved an exciting cause; and where this is the case, the attention of the physician must of course be directed to that quarter. With respect to the mode of treatment during the fit, though it has sometimes been recommended to employ violent means, so as to awaken the somnambulist suddenly, and to repeat this as often as the attacks come on, until they have completely ceased; yet M. Bertrand warns us against such a proceeding. 'If, in the first place,' says he, 'sensibility is completely extinguished, all the means employed to awaken the somnambulist will be useless; secondly, even when it is possible to awaken him at once, the sudden shock produces serious consequences; thirdly, as somnambulism is often the result of a salutary crisis of nature, one is never sure of not hurting the patient by suppressing it; and, lastly, the sudden suspension of a habit of the animal economy that has been contracted for a long time, must in all cases be attended with danger.' He adds that the best plan is to try to put oneself in connection with the patient by entering into the course of ideas by which he is occupied during the attack, and so endeavour to direct him in a reasonable manner.

Further information respecting this species of somnambulism may be found in the following works, besides those already quoted and referred to:—Zacuti Lusitani *Medicor. Princip. Hist.*, lib. i., hist. 15; Jo. Langii *Epist. Miscell.*, lib. ii., ep. 44; Pet. Salii Diversi *Curat. Partic. Morb.*, cap. 18; Abercrombie *On the Intellectual Powers*; Macnish's *Anatomy of Sleep*; Colquhoun's *Animal Magnetism* (from which work and M. Bertrand's great part of this article is abridged); &c.

II. *Symptomatic* or *Morbid Somnambulism* generally presents itself as one of the phenomena attending catalepsy, for a general account of which singular affection the reader is referred to the article on that subject: as however this remarkable part of the disease is there only very slightly alluded to, it will not be out of place to enlarge upon it here. This form of somnambulism (as far as the writer is aware) does not appear to have been noticed by the antients; but there are many cases on record long before the time of Mesmer, as well as others described by persons unacquainted with and even opposed to the doctrines of animal magnetism. The following case is given by Colquhoun, on the authority of Sauvages, and may be found in greater detail in the 'Hist. de l'Académie des Sciences,' for the year 1742: A girl of twenty years of age was frequently attacked with cataleptic insensibility, during which she continued stiff and deprived of all sensation, whether standing, sitting, or lying, in the position she might happen to be in at the commencement of the attack, and she could be pushed forward, like a statue, when it was wished to remove her from one place to another. She was afterwards placed in a different state, which commenced with the same deprivation of sense and motion, but at intervals presented a wonderful kind of animation. She first became motionless, then, some minutes afterwards, she began to yawn, sat up on the bed, and enacted the following scene, which she repeated at least fifty times. She spoke with an unusual liveliness and cheerfulness, and what she said was a continuation of what she had spoken in her previous fit, or a repetition of some part of the catechism which she had heard read on the preceding evening. She frequently addressed her acquaintances in the house, and sometimes made ironical applications of moral apophthegms to them under feigned names with open eyes, and such gestures as she had made the previous evening. That during all this time she was not awake, is clear from various experiments. A hand was suddenly passed near her eyes, without producing any motion in the eye-lids or any attempt to evade it, or interrupting her speech in the slightest degree. The same thing happened when a finger was suddenly approached close to her eye, or a burning taper held so near to it that the hair of her eye-lids was actually burnt, and also when any one called loudly into her ear from behind, or threw a stone against the bedstead. Nay more, brandy and spirit of hartshorn were poured into her eyes and mouth; Spanish snuff was blown into her nostrils; she was pricked with needles; her fingers were wrenched; the ball of her eye was touched with a feather, and even with the finger: she manifested not the slightest sensation. During these trances she always began to speak with more than usual animation; soon afterwards, she sang and laughed aloud, attempted to get out of bed, and at length sprang out of it and uttered a cry of joy. She kept the middle way between the bedsteads as well as when awake, and never came against them—turned dexterously round between the bedsteads and a concealed closet, without ever groping her way or touching the objects; and after turning round, she returned to her bed, covered herself with the clothes, and again became stiff as at the commencement. She then awoke, as if from a profound sleep, and when she perceived, from the appearance of the bystanders, that she must have had her fits again, she wept the whole day for shame, and never knew what had happened to her during the paroxysm. The above is by no means one of the most wonderful cases of somnambulism occurring during a cataleptic seizure, but it has been chosen on account of the respectable authority on which it rests. Those recorded by M. Petetin (*Mémoire sur la Découverte des Phénomènes que présentent la Catalepsie et le Somnambulisme, &c.*, 1787; and *Electricité Animale prouvée par la Découverte des Phénomènes Physiques et Moraux de la Catalepsie Hystérique, et de ses Variétés*, Lyon, 1808), are not perhaps less authentic, but certainly carry less weight with them on account of their *number;* for no one can help being struck with the somewhat startling announcement, that of 'a disease so rare that its existence has been doubted by many writers' (Copland, *Dict. of Pract. Med.*), no less than *eight* cases should have been seen by a single practitioner in the course of his practice, all of which presented similar and most remarkable phenomena. Indeed one may suspect that he was himself doubtful whether his work would be believed, as he did not venture to publish it during his life; but it should at the same time be added that there is no other reason whatever to call in question the accuracy of his statements, as his own character both for talent and honesty was highly respectable, and his experiments were performed in the presence of satisfactory witnesses. Perhaps with some persons his observations will receive more credit from the fact that, when his experiments and discoveries were first made, he was not an advocate for the doctrines of animal magnetism, and that, even after he had found reason to change his opinion on the subject, he still continued to explain the phenomena which he had observed by quite a different hypothesis. An account of the contents of his works may be found in the *Histoire Critique du Magnétisme Animal*, by Deleuze (2 vols. 8vo., Paris, 1819); and in the *Rapports et Discussions, &c. sur le Magnétisme Animal*, by Foissac (8vo., Paris, 1833). One of the most extraordinary phenomena of this species of somnambulism is the transference of the faculties from their usual and appropriate organs to the epigastrium and other parts of the body, such as the extremities of the fingers and toes; another is the still more surprising faculty of prevision. By the *faculty of prevision* it is not meant that somnambulists enjoy an unlimited power of reading the pages of futurity, but merely that they predict with the greatest precision and accuracy the different symptoms and changes that are to take place in the course of their disease. This power is sometimes further extended. In both of these phenomena, as well as in several other respects, morbid or symptomatic somnambulism offers a striking similarity to the phenomena of the two following species; but as it is impossible here to go fully into the subject, it is perhaps better to leave it untouched, and to refer the reader for the details of the facts, and for the evidence on which they rest, to some of the above-mentioned works. (See also a posthumous essay by Deleuze, entitled *Mémoire sur la Faculté de Prévision*, 8vo., Paris, 1836.)

III. *Artificial Somnambulism*, or that which is occasioned by the proceedings employed in animal magnetism, is not expressly mentioned by any antient writer, but the following curious lines by Solon have been applied to this process by Colquhoun:—

*Πολλάκι δ' ἐξ ὀλίγης ὀδύνης μέγα γίγνεται ἄλγος,*
*Κοὐκ ἄν τις λύσαιτ' ἤπια φάρμακα δούς.*
*Τὸν δὲ κακαῖς νούσοισι κυκώμενον ἀργαλέαις τε*
*'Αψάμενος χειροῖν αἶψα τίθησ' ὑγιῆ.*

Thus translated by Grotius:

'Saepe dolor tenuis morbos produxit acerbos,
Tollere quos nullis sit medicaminibus;
Saepe diu saevo jactatum corporis æstu
Contactu sanum reddidit una manus.'
Stob., *Floril.*, tit. 9, § 25. v. 59.

The following verse in Plautus (*Amphitr.*, i., 1-157) has also been supposed by some persons to allude to the same manipulations: 'Quid si ego illum tractim tangam, ut dormiat?' where '*tractim* tangere' is explained to mean 'sensim et leniter tangere, manum trahendo, non infligendo; quod faciunt nutrices, blande et tracta manu palpantes infantulos, ut somnum capiant.' (Facciol., *Lex.*) As an account of the doctrines of Mesmer has been already given under the head of ANIMAL MAGNETISM, it will be sufficient here to add a few remarks upon Somnambulism as occasioned by it. There has been so much of 'knavery and credulity' (to use the words of that article) displayed in connection with the subject of animal magnetism, that it is of more than usual importance to select only those instances which rest on the most unexceptionable evidence; accordingly nothing will be noticed here except the 'Rapport sur les Expériences Magnétiques faites par la Commission de l'Académie Royale de Médecine [à Paris], lu dans les Séances des 21 et 28 Juin, 1831, par M. Husson, Rapporteur.' In this Report the experiments are distributed into four divisions: 1, Magnetism without effect; 2, Magnetism with slight effects; 3, Effects produced by *ennui*, monotony, and imagination; and 4, Effects probably depending only upon magnetism. The whole is well worth reading, but there is only room here for one extract from it, which relates to a case that was communicated to the surgical section of the French Academy on April 16, 1829, by Jules Cloquet, and which occupied two of its meetings in its investigation. It is that of a lady, aged sixty-four, who consulted M. Cloquet, April 8, 1829, on account of an ulcerated cancer on the right breast, of several years' standing, which was combined with a considerable swelling (*engorgement*) of the corresponding axillary glands. M. Chapelain, the physician attending this lady, who had magnetized her for some months, had obtained no other result than that of producing a most profound sleep, during which all sensibility appeared to be annihilated, while the ideas retained all their clearness. He proposed to M. Cloquet to operate upon her while she was plunged in this magnetic sleep. The latter, having deemed the operation indispensable, consented. The two previous evenings this lady was magnetized several times by M. Chapelain, who, in her somnambulism, disposed her to submit to the operation, although, when awake, she rejected the idea with horror. Upon the day appointed M. Cloquet found the patient dressed and seated in an elbow-chair, in the attitude of a person enjoying a quiet natural sleep. She had however been thrown into a state of somnambulism, and talked with great calmness of the operation. She undressed herself, and sat down upon a chair; M. Chapelain supported the right arm, the left was permitted to hang down at the side of the body. M. Cloquet deliberately performed the operation, which lasted from ten to twelve minutes, and the tumour was extirpated. During all this time the patient continued to converse quietly with the operator, and did not exhibit the slightest sign of sensibility. There was no motion of the limbs or of the features, no change in the respiration nor in the voice; no emotion even in the pulse. The patient continued in the same state of automatic indifference and impassibility in which she had been some minutes before the operation. There was no occasion to hold, but only to support her. A ligature was applied to one of the thoracic arteries, which had been opened during the extraction of the glands. The wound was united by means of adhesive plaster, and dressed. The patient was put to bed while still in a state of somnambulism, in which she was left for forty-eight hours. An hour after the operation there appeared a slight hemorrhage, which was attended with no consequence. The first dressing was taken off on the 14th, and the wound was cleaned and dressed anew; the patient exhibited no sensibility or pain, and the pulse preservits usual rate. After this dressing M. Chapelain awakened the patient, whose somnambulic sleep had continued from an hour previous to the operation, that is to say, for two days. She did not appear to have any idea of what had passed in the interval; but upon being informed of the operation, and seeing her children around her, she experienced a very lively emotion, which the magnetizer checked by immediately setting her asleep. The only doubt or objection that the writer has ever seen raised with respect to the above case, is that it does not appear certain that the patient was not in a state of anæsthesia *before* she was thrown into the magnetic trance; but this is so very far-fetched and improbable, that it is almost equivalent to confessing that the fact of an artificial state of anæsthesia having been produced is indisputable. With respect to the phenomenon of somnambulism as caused by mesmerism, or animal magnetism, the writer only wishes to add most distinctly and explicitly that so much credulity and deception have been brought to light in connection with it, that a person cannot be too cautious in sifting and weighing the evidence on which each of the alleged instances rests; but that, after all this mass of knavery and folly has been cleared away, there still remain a large number of instances which cannot be disbelieved without discarding all historical evidence whatever. For more information on the subject the reader may consult, besides the works already quoted, the Rev. Chauncey Townshend's work on Somnambulism, and 'Le Magnétisme Animal en France,' by M. Bertrand, Paris, 1826.

IV. *Ecstatic Somnambulism.*—M. Bertrand has given this name to that species which is produced by a high exaltation of the mind, and becomes in a manner infectious by sympathy in such persons as are predisposed and subjected to the same influences. Of this last species, the *devotional ecstasis* is perhaps the most frequent and the most remarkable; and this has been supposed to have had some connexion with the oracles and other miraculous stories of antiquity. M. Bertrand has however, for obvious reasons, selected his instances from four different periods in modern times, in each of which the devotional ecstasis appeared as a sort of epidemic, and presented symptoms very similar to those occurring in the three former species of somnambulism. The first series of phenomena are those which took place in connexion with the burning of the unhappy Grandier on the charge of sorcery at Loudun, in 1634, an account of which may be found in Bayle (*Dict. Hist.*, art. 'Grandier'); or in the 'Hist. des Diables de Loudun,' by a Protestant Refugee, Amst., 1693, 12mo. The next instances are extracted from a scarce work entitled 'Théâtre Sacré des Cévennes,' and relate to the French Protestants who, after the revocation of the Edict of Nantes, 1685, went by the name of the 'Trembleurs des Cévennes,' and were persecuted and massacred in those mountains. The third epidemic broke out at the tomb of the Abbé Pâris in the church of St. Médard, at Paris, about the year 1731. These are perhaps the most celebrated of all, as having been selected by Hume to oppose to the miracles of the New Testament. The original and authentic account of them was published by M. Carré de Montgeron, in a work entitled 'La Vérite des Miracles opérés á l'Intercession de M. De Pâris,' &c., 2 vols. 4to., 1737, 1741; and they are examined at some length and with great acuteness by Bishop Douglas, in his 'Criterion, or Miracles Examined,' &c. To these he has added, fourthly, some considerations on the state produced in the patients who, towards the end of the last century, were exorcised by a priest named Gassner, at Ratisbon. An account of these (supposed) miraculous cures is to be found in a work entitled 'L'Antimagnétisme; ou Origine, Progrès, Décadence, Renouvellement, et Réfutation du Magnétisme Animal,' 8vo., Londres, 1784 (pronounced by M. Deleuze to be the ablest publication that had appeared against the doctrines of Mesmer), which account is extracted from a work called 'Procès-verbal des Opérations Merveilleuses, &c., par le Ministère du Sieur Gassner,' &c., Schillingsfürst, 1775. As however neither these nor many other examples that might be brought forward can be fully noticed here, it has been thought sufficient to point out the places where further information may be procured.

SOMNER, WILLIAM, was born at Canterbury, according to the account given by his wife and son, March 30th, 1606; but according to the register of the parish of St. Margaret's, he was baptised there on November 5th, 1598. His father was registrar of the court of Canterbury under Sir Nathaniel Brent, who was then commissary. He was sent to the free-school of that city, where he acquired a competent knowledge of Latin. He was next placed as clerk to his father in the ecclesiastical courts of the diocese, and afterwards preferred to an office in the courts by archbishop Laud. His natural bent was to the study of antiquities, in which he was encouraged by Dr. Meric Casaubon, one of the prebendaries.

In 1640 he published 'The Antiquities of Canterbury,' 4to., a work which gained him considerable reputation, and which was afterwards reprinted and enlarged by Nicholas Batteley, fol., Lond., 1703. Somner's next production was an Appendix to the first part (all that was published) of Casaubon's Commentary 'De Quatuor Linguis,' 12mo., Lond., 1650, showing the relation of the German with the Saxon language. In 1652 he added a most valuable Glossary to Sir Roger Twysden's 'Decem Scriptores.' He was now urged by his friends to make a Saxon Dictionary, but as this was a work which required time and great labour, it was necessary that he should have sufficient means of support while engaged upon it. Sir Henry Spelman had founded at Cambridge a lecture for 'prómoting the Saxon tongue, either by reading it publicly or by the editing of Saxon Manuscripts;' and this lecture being vacant in 1657, archbishop Usher recommended Somner to the then patron Roger Spelman, grandson of the founder. Accordingly Somner had the salary, and went on with the work, which was published at Oxford, in folio, in 1659.

A short time before the Restoration, Somner was imprisoned in the castle of Deal for endeavouring to procure signatures to a petition for a free parliament.

In 1660 he was made master of St. John's Hospital, in the suburbs of Canterbury, and about the same time auditor of Christ Church. In this year he published in quarto his 'Treatise on Gavelkind,' his last publication. He died March 30th, 1669.

He left behind him various manuscript collections, and two or three treatises, one of which, 'Of the Roman Ports and Forts in Kent,' was published at Oxford, 8vo., 1693, by Brome. Another, 'De Portu Iccio,' translated into Latin by Mr. (afterwards bishop) Gibson, was published at Oxford, 8vo., 1694. To the former of these a Life of Somner is prefixed by White Kennet, afterwards bishop of Peterborough.

Somner was buried in the north aisle of St. Margaret's Church, Canterbury, where there is an inscription to his memory. His books and manuscripts were purchased by the dean and chapter of Canterbury, and they are still in the Cathedral library; a catalogue of them is appended to Kennet's Life of Somner. Somner gave great assistance to Dugdale and Dodsworth, in the first volume of the 'Monasticon Anglicanum.' Among his friends and correspondents were the archbishops Laud and Usher, Sir Robert Cotton, Sir Simonds D'Ewes, Sir William Dugdale, Burton the antiquary, Sir John Marsham, and Elias Ashmole.

(White Kennet's *Life;* Pref. to the *Roman Ports and Forts; Biographia Britannica;* and Gough's *British Topography*, vol. i., p. 443.)

SONCHUS (σόγχος), the name of a genus of plants belonging to the natural order Compositæ; suborder Cichoraceæ. It is characterised by a many-flowered head, involucre imbricated with scales, swelling at the base. Recepticle naked. Fruit transversely striated. Pappus simple, sessile. The species are inhabitants of Europe, Asia, Africa, and America. De Candolle enumerates forty-five species, of which four are natives of Great Britain. They are not used in medicine, but some of them are cultivated in gardens.

The most common species is the *Sonchus oleraceus*, the common sow-thistle. It has downy subumbellate flower-stalks; a glabrous involucre; lyrato-runcinate leaves, upper ones lanceolate sagittato-amplexicaul at the base, all dentato-ciliate. This plant is found commonly in waste places and cultivated ground all over the world. It has small yellow flowers and a conical involucre when in seed, and is greedily fed upon by many animals.

*S. arvensis* (corn sow-thistle): flower-stalks corymbose; involucre glandilose-hispid; leaves denticulate, cordate at the base, oblongo-lanceolate, lower ones sinuato-runcinate. It is frequent in corn-fields in this country and the southern parts of Europe, and in Pennsylvania. Dr. Sibthorp found it in Greece, and was of opinion that it was the same plant as the σόγχος ἕτερος of Dioscorides.

SO'NDRIO. [VALTELLINA.]

SONG, a term applied to either a short poetical or musical composition, but most frequently to the two inunion.

As a poetical composition it may, according to Dr. Aikin, 'be largely defined a short poem, divided into portions of returning measure, and turning upon some single thought or feeling.' As a union of the two arts, Rousseau describes Song (*chanson*) as a very brief lyrical poem, founded commonly on agreeable subjects, to which is added a melody for the purpose of singing it on familiar occasions, either at table among friends, or to a beloved object, and even when alone, to dissipate the *ennui* of the rich, or to lighten the care and labours of the poor.

As denoting a musical composition, *Song* is used, in this country, to signify a vocal melody of any length or character, and not confined to a single movement; and while the solemn, sublime air of the oratorio, and the *aria grande* of the Italian opera, are frequently, though erroneously, called by this name, the same is bestowed on the short, simple, unpretending ballad. But this is only one instance among many of the defective state of our musical nomenclature. Of the varieties of *Song*, see AIR, BALLAD, CANZONET. The term however is not absolutely unlimited in its meaning, for, as regards performance, it is confined to an air for a single voice; though formerly the word was considered as the past participle of the verb *to sing*, and signified anything sung. Thus our composers in the sixteenth and seventeenth centuries often entitled their productions for more than one voice, 'Part-Songs.'

Concerning tne *Songs*, or Σκόλια, of the Greeks, we refer to our article MUSIC, p. 24, col. 2, and SCOLIUM. Of the Roman Song, musically considered, we are without information. More of war than of taste in their nature, the Romans bestowed little thought on music, and coldly adopted what was transmitted by the elegant Greeks. But as we have before ventured to assert, and now repeat, music, as the term is at present understood, is an art exclusively modern, and cannot be said to have existed till the invention, or at least the use, of counterpoint.

Rousseau claims for the French pre-eminence in song-writing; if not for the melody of the music, at least for the spirit, wit, and grace of the words. In tenderness however and in priority as to the time at which we suppose it to have had its birth, the music of the Irish far excels that of the French; and for strength of feeling and energy of expression, the early lyric poetry of Scotland may challenge comparison with that of the most favoured nation. What is commonly supposed to be Scottish music—but much of which we believe to have originated in Ireland—yields to nothing of the kind in distinctness and force of character, in beauty and pathos. In Russian, Swiss, and Spanish melodies, great and agreeable nationality is undeniable; and not less is found in the rustic music of the Neapolitans and Venetians.

In England *Song* can hardly be said to have passed out of its infant state, whether considered in relation to music or poetry, till the middle of the sixteenth century; and though we have some lyric productions of merit before the time of Shakspere, yet they are so few in number, that with him and his contemporaries this species of verse may be said to have begun really to flourish. But of the music set to these songs scarcely any remains, and what is handed down, though generally equal to that produced during the same period in other parts of Europe, is, with an occasional exception, so nearly devoid of all those elements which constitute melody, as to be almost worthless. As the seventeenth century advanced, the number of our poets who succeeded in song-writing increased fast, and Henry Lawes was the composer who at the same time wrought that change—or, rather, set that example—which his friend Milton ascribes to him. (*Sonnet to Lawes.*) The civil wars checked the progress of song, so far certainly as it is connected with music: but at the Restoration lyric poetry recovered its gaiety, and song-composers began to appear; though till Purcell rose up no one seems to have possessed much talent, if Matthew Lock's single air in *Macbeth* does not entitle him to be named as an exception.

The poetry of modern Songs has, in too many instances, degenerated, while the music of them has gradually improved. England, from about the middle of the last century till a recent period, furnished its full share of beautiful songs (this term excluding all airs of greater pretensions) to the general stock. France rather later began to contribute its fair quota; and however opinions may differ respecting the merit of earlier French melodies, it seems to be agreed that they may now compete with those of most other nations. But it must be admitted that Germany is at present, and has been for many years, taking the lead in this, as in higher departments of music. German composers most commonly think much, and hence that truth of expression and depth of feeling which are so apparent in their vocal compositions, qualities which are introducing their productions into every circle where the beauties of the art are clearly perceived and justly valued.

SONG OF BIRDS. The Hon. Daines Barrington defines a bird's *song* as 'a succession of three or more different notes, which are continued without interruption during the same interval with a musical bar of four crotchets in an adagio movement, or while a pendulum swings four seconds.' But in this definition he excludes the call of a cuckoo and the *clucking* of a hen, these consisting of only two notes; 'while,' he says, 'the short bursts of singing-birds contending with each other, are equally distinguished from what I call *song* by their not continuing for four seconds.' 'Notes,' the same author adds, 'are no more innate in birds than language is in man, and depend entirely upon the master under whom they are bred, as far as their organs enable them to imitate the sounds which they have frequent opportunities of hearing.' By such *notes* however we presume the writer means those of imitation, and in the term 'master' includes the parent of the young bird. For though birds are often taught to sing musical tunes, strictly so termed, by human masters, yet many learn what may be called appreciable melodies, from the male parent, or from others of its own species. Mr. Barrington further says that 'Birds in a wild state do not commonly sing above ten weeks in a year; while the bird in a cage sings, perhaps, nine or ten months.' He denies that the singing of the male bird in the spring is only to please its mate during incubation, for that the greater number of birds do not sing at all. The caged bird which sings during the far greater part of the year cannot do so from the alleged inducement; but, on the contrary, he is only contending with some other bird; or, indeed, against any sort of continued noise. The song of birds, he observes, is rarely reduceable to musical notation; 1st, because its rapidity is often so great, and it is so uncertain when it will stop, that the notes cannot be reduced to a musical bar, in any time whatsoever; and, 2ndly, because the pitch of most birds is higher than that of any instrument. Dr. Wollaston tells us, in vol. 110, p. 306, of the 'Philosophical Transactions,' that the pitch of the chirp of the sparrow 'seems to be about four octaves above E in the middle of the piano-forte.'

Mr. Barrington thinks that all birds of the same species sing in the same key; and from 'an experienced harpsichord-tuner,' who had paid great attention to the subject, he learnt that woodlarks sing in the key of F; common cocks in A: Bantam cocks in C; cuckoos in C, falling to A; and thrushes in A. We give these as the conjectures of the learned writer; but to his opinion, which is decidedly expressed, that for the musical scale man is indebted to the singing of birds, we cannot assent, believing that a much more satisfactory source is to be found in the harmonics of all sonorous bodies, and in the simple arithmetical divisions of a vibrating string. He agrees with most others in assigning precedence in vocal rank to the nightingale, not only on account of its 'tone and variety,' but also because it 'sings with superior judgment and taste.' He places the skylark next; and with a portion of his curious table of the comparative merit of British singing-birds, 20 being the assigned point of absolute perfection, we shall conclude this article:—

| | Mellowness of Tone. | Sprightly Notes. | Plaintive Notes. | Compass. | Execution. |
|---|---|---|---|---|---|
| Nightingale . . | 19 | 14 | 19 | 19 | 19 |
| Skylark . . . | 4 | 19 | 4 | 18 | 18 |
| Woodlark . . . | 18 | 4 | 17 | 12 | 8 |
| Linnet . . . . | 12 | 16 | 12 | 16 | 18 |
| Goldfinch . . . | 4 | 19 | 4 | 12 | 12 |
| Hedge-Sparrow . | 6 | 0 | 6 | 4 | 4 |
| Thrush . . . . | 4 | 4 | 4 | 4 | 4 |
| Blackbird . . . | 4 | 4 | 0 | 2 | 2 |
| Robin . . . . | 6 | 16 | 12 | 12 | 12 |
| Wren . . . . | 0 | 12 | 0 | 4 | 4 |

(*Philosophical Transactions*, vol. lxiii., p. 249, for 1773.

SONG OF SOLOMON. [SOLOMON'S SONG.]

SONGA'RIA is the name of a country in Asia, which constitutes the north-western portion of the Chinese empire. The name is derived from the Songares, one of the great divisions of the Calmucks or Olöth, who had taken possession of this country, and erected a powerful empire, that was destroyed by the Chinese after the middle of the last century. Songaria lies between 42° and 49° N. lat., and extends from 76° to 95° E. long. In length it extends upwards of 900 miles; but the width varies so much, that on an average it probably does not much exceed 300 miles. This gives an area of 270,000 square miles, or about 70,000 miles more than the extent of France.

Songaria occupies a very remarkable position on the globe. It forms the most northern portion of an isthmus, which separates two great wastes, the largest deserts on the surface of the globe, with the exception of the Sahara in Africa. On the east of this isthmus is the Gobi, which, according to a rough estimate, has a surface exceeding 1,200,000 square miles. This desert constitutes an elevated tableland, and is called the Gobi or Shamo. [GOBI.] On the west of the isthmus extends a low desert. This desert, which may be called the Caspian Desert, as it surrounds the sea of that name on the north and east, is even larger than the Gobi, covering an area of nearly 1,300,000 square miles. In this estimate the Descht Kowar, between the Caspian Sea and the lower course of the Amoo, is considered as the most southern, and the Barabinza Steppe in Siberia, between the rivers Irtish and Obi, as the most northern portion: and it is assumed that the Calmuck Steppe, between the lower Volga and the Black Sea, constitutes its most western part. Both deserts, the Gobi and the Caspian Desert taken together, are equal in extent to the Sahara, and to two-thirds of the surface of Europe.

The isthmus which separates these two large deserts is connected on the south (near 36° N. lat.) with the range of the Hindu Koosh, and on the north (near 50° N. lat.) with the western extremity of the Altai Mountains. South of 40° it lies north and south, and comprehends the countries known under the names of Badakshan and Bokhara. North of 40° it lies south-west and north-east, and comprehends the countries called Kokand and Songaria. South of 40° N. lat. the descent from the elevated Gobi to the low Caspian Desert is formed by an elevated range a great part of which is always covered with snow, and the descent is rapid; but north of 40° N. lat., and especially in Songaria, it is formed by a number of extensive terraces, which taken together extend from east to west over a space of 500 miles.

On the east Songaria opens to the Gobi, and on the west to the Caspian Desert; but on the north and south it is bounded by two elevated mountain-ranges, the Thian-shan and the Altai Mountains. The space between the two ranges is traversed by numerous minor ranges, which lie in every direction, and divide the surface into several river-basins, which are entirely separated from one another, and each of which contains a lake, the receptacle of its drainage. Although such closed river-basins occur in other parts, sometimes in mountain regions, and still more frequently in deserts, they are nowhere so numerous as in Songaria, and they impress on this country a very peculiar character. It is desirable that such an extraordinary country should be open to the investigation of scientific travellers; but the policy of the Chinese prevents it, and all our knowledge of the country is derived from the scanty observations of travellers who have traversed the country with caravans, and the information given in the Chinese Imperial geography. These scanty materials have been collected by Ritter, in his 'Erdkunde von Asien,' with his usual industry, and have been compared with more than his usual sagacity.

*Thian-shan Mountains.*—This extensive range of mountains extends in its western prolongation far into the Caspian Desert. The most western branch is known by the name of Ak-tagh, which occurs about 50 miles north of Samarcand in Bokhara, near 41° N. lat. and 67° E. long. In these parts it rises with a moderate elevation above the adjacent steppe. From this point it extends eastward to the east of the meridian of the town of Hami in Chinese Turkistan; and seems, as far as is known, to terminate near 95° E. long. The extent from west to east is about 1400 miles, or 200 miles more than the length of the Appalachian Mountains in North America, if the Lookout Range in Alabama and the mountains at the mouth of the river St. Lawrence are considered as the extremities of the last-mentioned mountain-system. The Thian-shan do not greatly deviate from a circle of latitude, as their western extremity is near 41° N. lat., and their eastern between 43 and 44° N. lat.

The Ak-tagh rises boldly out of the steppe, but not to a great elevation, nor does it occupy a great width. Where it approaches the descent from the high table-land to the lower country, it increases in elevation and width, and takes the name of the Asferah Mountains. At the road which traverses the chain between Kashgar in Chinese Turkistan, and Khokhand in Fergana, the range is probably 100 miles across, and rises so high that it is covered with snow nearly the whole year round: some parts even seem to rise above the snow-line. East of this road the mountains are called Mus-tagh or Moossoor, and this name has been adopted to designate the range of the Thian-shan as far east as the great mass of the Bogdo Oöla Mountains, near 85° E. long. The western part of the Mus-tagh is stated to contain many high summits, which are always covered with snow; but south of the lake of Issikul or Temurtoo, where it is crossed by two roads leading from Kuldsha or Ili to Ushi and Kashgar, the mountains are much below the snow-line. About sixty miles farther east however, where the road between Kuldsha and Aksoo traverses the chain, the snow masses occupy from nine to ten miles of the central portion of the range, and those masses are stated to extend to a great distance east and west of the road. The higher portion is said to occupy about forty miles in width; and when the lower heights which are contiguous to it on both sides are added, the whole breadth of the Thian-shan at the road can hardly be less than eighty miles. East of 85° is the Bogdo Oöla, which lies north of Karashar, and seems to be the most elevated and most extensive mountain mass of the Thian-shan. According to the information of the natives, the masses of snow and ice, and the glaciers which cover its summit, occupy a great space, and attain a considerable elevation above the snow-line. There is no road over this range between that which leads from Kuldsha to Kutche (83° E. long.), and which has not been travelled by any European, and another, by which the range is traversed west of Turfan (89° E. long.), a distance of 300 miles. The most eastern part of the Thian-shan, or that which lies between 89° and 95° E. long., is very little known. Along the road west of Turfan, which leads from this place northward to Urumtsi, there are some snow-covered mountains; but farther west the range is considerably lower, and near 95° it terminates as abruptly in the eastern desert as the Ak-tagh rises in the western. It is indeed supposed that this mountain-range continues through the Gobi, until it unites, near 106° or 107° E. long., with the In-shan, which lies north of the great northern bend of the Hoang-ho; but this supposition is not borne out by the scanty information that we possess about this part of Asia, or if such continuation exists, it is only indicated by low hills and ranges which occur at great distances from one another.

*Altai Mountains.*—The Altai Mountains which bound Songaria on the north are described in vol. i., p. 397. We shall here only add, according to the most recent information, that the part of the range which lies south of the rivers Narym and Bukhtarma, and consequently within the Chinese empire, and in Songaria, has been found to be the most elevated part of this mountain system which is known. South-east of the Kolson Bielki, or the Snow-mountains of Kolson, which are the highest in Siberia, is what is called by the Russians the Kurtshum Bielki, or the Snow-mountains of Kurtshum, which attain a much greater elevation, and form on their snow-covered tops an extensive ice-field above which no summit rises. But a very high summit stands near 88° 20′, and this properly is called by the natives Egtag Altai, or Great Altai.

*Mountain-chains within Songaria.*—It was formerly supposed that a continuous elevated chain of mountains connected the Mus-tagh with the Altai Mountains, and that this chain ran in a direction south-west and north-east. Such a chain does not exist. There is however an uninterrupted continuation of high ground between both mountain systems. So far as is known, this high ground does not in any place fall to the common level of the country, nor even sink low enough to lose the appellation of mountains, and in some places it rises above the snow-line. The most elevated portion is the range called Iren Khabir gan, which at its eastern extremity is connected with the mountain-mass of the Bogdo Oöla. From the point of connection with that mass it first runs north-west, but afterwards turns west, and may be said to terminate with a considerable depression north of the town of Kuldsha. The length of this chain may be about 200 miles, and we infer that it must rise to a great elevation and contain much snow on its summits, from the circumstance that the great road from Peking to Kuldsha traverses the chain at the depression north of Kuldsha, and does not cross it farther east, though if it did, the road would be considerably shorter. The western continuation of the Iren Khabirgan is called the Tokty mountains. This chain soon turns to the north-west and north, and extends along the western banks of Lake Alakul or Alaktau-kul until it terminates at the Tarbagatai mountains. This last-mentioned chain runs east and west. The Tokty mountains are of moderate elevation, but it is stated that near Lake Alakul a summit occurs which is always covered with snow. The chain is much lower which extends from the northern declivity of the Tarbagatai mountains first northward and then north-eastward, until it terminates on the banks of the river Irtish, constituting in this part the boundary between the empires of China and of Russia. This most northern prolongation is called the Kheïrek mountains. The Kheïrek mountains are separated from the Altai mountains by the narrow valley of the Irtish. Another chain of mountains is connected with the Tokty mountains near the south-western corner of the Alakul lake. It is called Ala-tau, a name frequently occurring in these parts of Asia, and it extends first eastward to a short distance, and then north-east to a great distance, until it joins the Egtag or Great Altai near the sources of the Irtish. The eastern extremity of the Tarbagatai mountains is immediately connected with the Ala-tau. The Tarbagatai mountains run about 400 miles east and west, and terminate, like the Ak-tagh, abruptly in the western desert. They seem to rise from 4000 to 6000 feet above the sea, and in some places snow in small patches is found even in summer. These ridges, and some others, less elevated or less known, divide the greater part of Songaria into numerous closed basins.

The basin of Lake Issikul or Temurtoo occupies the most south-western part of Songaria. The lake is stated to be nearly 100 miles long from east to west, and about 35 miles wide on an average. At no great distance from its shores mountains enclose it on all sides, from which the river receives a great supply of water. The superabundance is carried off by a river, which leaves the lake at its western extremity, and, under the name of Chooi, traverses a great extent of the western deserts, which is possessed by the Great Orda of the Khirghis Cossacks. [TURKISTAN.] On the south of the lake is the Mus tagh, and on the north of it is a chain called Ala-tau. It is said that these mountains contain iron-ore which is worked.

East and north of Lake Issikul is the basin of the river Ili, which falls into the lake of Balkash. It is the largest and most important of the basins of Songaria; it extends more than 400 miles east and west, and about 100 miles south and north, and probably has an area of 40,000 square miles, which is equal to the state of Tennessee. The river Ili rises with two branches in the Thian-shan mountains: the larger originates between 81° and 82° E. long., and runs under the name of Tekes north-east for more than 100 miles, when it meets the other and smaller branch, which originates near the place where the Iren Khabirgan is united with the Bogdo Oöla, and runs westward. From the place where these branches unite, the river is called Ili, and runs to the west, inclining towards its termination to the north-west. It falls into Lake Balkash by several arms, after a course of more than 300 miles. Lake Balkash is the largest of the lakes of Songaria, and has no outlet, though it receives several other rivers from the north and east. The eastern half of the Ili basin has a very hilly surface, but it contains numerous tracts which are fit for agriculture. Even when the Songares were in possession of the country, some of the most favoured tracts were under cultivation. But as that nation derived its subsistence from its horses and cattle, and was not accustomed to agricultural labour, it occupied nearly the whole country as pasture-ground, and these pastures were very rich in comparison with those in the deserts farther east and west. Accordingly this country was the principal seat of the empire of the Songares. Since it has fallen under the sway of the Chinese, the government has sent there, and is still sending, a great number of settlers, partly as military colonies, and partly as cultivators of the ground, but all of them are bound to apply themselves to agriculture. The military colonies consist chiefly of Mongols, especially Tshagars and Sybés, and Mandshoos, who unite agriculture with the breeding of cattle. A number of Chinese also come annually, who are condemned to death according to the laws, but the punishment is in most cases converted into transportation to the banks of the river Ili. These Chinese are said to have already greatly contributed to change the face of the country by introducing several branches of cultivation. Though the army which is kept in those parts is rather large, as it is one of the frontier provinces, and surrounded by many wandering tribes, agriculture is already in such a forward state, that no great supply of grain is required from other parts of the empire. Farther west, about 80° E. long., the hills disappear, and the surface sinks to a level. The soil is much less fertile, and is chiefly covered with extensive bogs, in which only canes and rushes abound. It is nearly a desert, mainly inhabited by innumerable herds of wild hogs and other animals; but in approaching the country of the Khirghis Cossacks south of Lake Balkash it becomes a dry steppe, affording pasture-ground for horses, cattle, and sheep for several months in the year. This portion of the basin is abandoned to some tribes of the Khirghis Cossacks.

North of the eastern part of the basin of the river Ili, and separated from it by the Iren Khabirgan and the Tokty mountains, is the basin of the lake of Borotala, which is followed on the east by that of the lake of Ayar, whose eastern extremity is contiguous to the basin of the lake Khulussutai. The three basins occupy a line of at least 460 miles from west to east, near 45° N. lat. Only the western portion of the first basin has been visited by Europeans, and of the others some account is given in the Chinese geography According to this information, it seems that this region, which extends to the base and over the northern declivities of the Thian-shan, is well watered, as a number of small rivers descend from the snow-covered mountains, which in summer supply abundant means of watering the soil. It is stated that the Chinese and Mongols who have been transplanted to this country have made considerable progress in cultivating the ground, and that it is rather populous. But the cultivable and cultivated space is not of great width, as the rivers at a distance of 20 or 30 miles from the base of the mountains arrive at the lowest depression of the basins, and there form the three above-mentioned lakes, which are surrounded by extensive swamps, if they themselves are not rather to be considered as swamps, like the Hamoon in Seistan. [SEISTAN.] We have no information respecting the country to the north side of the lakes, nor respecting the extent of the lakes themselves.

North of the basins of the lakes of Ayar and Khulussutai are several smaller basins, and a larger one which is drained by the river Urunghu, which falls into a large lake called Kisilbash. We are entirely unacquainted with the natural capacities of this region, and only know that the greater part of the Turgut Mongols, who left Russia in 1771 and 1772, were settled in these parts, whence we may infer that it is more fit for pasture than agricultural purposes.

The basin of the lake Kisilbash lies south-east of the basin of the river Irtish, which occupies that extensive tract of country which is south of the Egtag or Great Altai, and north of the chain of the Tarbagatai mountains, and is closed on the west by the low ridge of the Kheïrek mountains, between which and the Altai mountains is the narrow valley by which the river Irtish runs off to the north. This extensive basin has not been seen by Europeans since the country has been subjected to the Chinese; but in the time of Peter I. of Russia it was visited by his command. The expedition sailed to the lake of Zaisang, from the north-western corner of which the river issues. The lake is about 70 miles long and 10 wide, and abounds in fish. The banks are swampy and overgrown with canes and reeds. The river Irtish, which originates in the Egtag Altai, enters the lake at the eastern extremity, after a course of about 250 miles, as it is supposed. It may be navigated to a considerable distance by large river barges. The country about the lake was, when first visited, in possession of the Songares, and no part of the basin at that time seemed to be cultivated. At present, some tribes of Khirghis Cossacks are found in these parts, and they occupy this country exclusively, with the exception of a few Chinese and Mandshoos, who are established along the boundary-line of Siberia. In the eastern districts of the basin however some tribes of the Songares have maintained their footing. Nearly all of them lead a wandering life, and some live by the produce of the chase. The Russians, who dwell farther north on the banks of the Irtish, with the permission of the Chinese authorities carry on an extensive fishery in the river below its efflux from the lake, and a few of them advance even across the lake to the upper course of the river.

Between the Tarbagatai mountains on the north, and the Ala-tau range on the south, is the basin of Lake Alakul and of the river Emyl. The lake is said to extend more than sixty miles east and west, and about half that length north and south. The course of the river does not much exceed one hundred miles. The level part of the basin has a soil consisting of gravel, and consequently of little fertility, but at the base of the mountains and along the rivers there are many fertile tracts of considerable extent, which are cultivated with care by the Khirghis Cossacks, who cam after the Songares had left the country.

*Volcanoes and Earthquakes.*—In the lake Alakul there is a lofty island called Aral-tube, which is an extinct volcano. Two other extinct volcanoes occur in the Thian-shan mountains, the western called Pe-shan, near 83° E. long., and the eastern called Hotsheou, north of Turfan, near 90° E. long. Along the northern declivity of the Thian-shan mountains there are several tracts which are covered with volcanic products, and on which sal-ammoniac and sulphur abound. It seems therefore that here, nearly in the centre of Asia, and at a distance of from 1000 to 1800 miles from the sea, an extensive volcanic system has once been in action, and the earthquakes which even in modern times have been felt in this country show that this powerful cause is still in operation.

*Climate.*—We are not acquainted with the climate of Songaria. The few Europeans who have visited the country have always stayed too short a time to give any account of the climate. As however this country is placed between two great deserts, which are no less distinguished by the great heat which is experienced in summer, than by the severe cold in winter, we may suppose that Songaria partakes of both in a considerable degree. Rain, which is so rare in the deserts, does not appear to be abundant in Songaria, as we must infer from the circumstance that where the ground is cultivated irrigation is practised; in winter however snow falls in considerable quantities.

*Productions.*—Wheat, barley, and millet are cultivated, but rice only in the southern districts, especially on the banks of the Ili. Tobacco is very extensively grown, and vegetables abound. There are excellent melons of several kinds. But fruit-trees are not frequent, nor is the fruit so good as that which grows on the south side of the Thian-shan. The lower declivities of the mountains are covered with trees, and likewise the valleys and some parts of the plains, but the greater part of the country is destitute of trees. The most common trees are, pines, mountain-ash, poplars, willows, lime-trees, and birch. In some parts there are good timber-trees, but in general timber is very scarce.

The herds of the wandering tribes consist of horses, camels, cattle, and sheep. Wild animals are numerous, especially deer. The argali occurs in the northern as well as in the mountainous districts. Wild hogs are extremely numerous in the extensive tracts covered with reeds and canes which surround most of the lakes. As most of the larger lakes, for instance the Balkash, the Zaisang, and others, are not Alpine lakes, but have the character of lakes of the desert, it is probable that all of them abound in fish. The Russian adventurers carry on their fishing in the river Irtish and in Lake Zaisang. The fish which are taken are chiefly sterlets (accipenser ruthenius, L.), sturgeons (accipenser sturio), white salmon (salmo nelma), salmo fluviatilis, and gadus lota.

The minerals which are mentioned are sal-ammoniac, sulphur, salt, iron, and coal. The last two minerals are found in abundance a few miles west of Kuldsha.

*Inhabitants.*—Songaria is placed between the two great deserts of Asia, and time out of mind the nations that inhabit the Gobi have been always wandering towards the west, and expelling the nations that they found in their way; we may therefore suppose that not a trace of the aborigines of these countries at present exists. We learn from the Chinese historians that the most antient nations in Songaria belonged to the Caucasian race, but the present inhabitants are Mongols, with the exception of the Khirghis Cossacks. This last-mentioned nation, which at present is nearly in exclusive possession of the western districts, seems to have occupied this part of the country at the time when the Songares were dispersed, after the downfall of their empire. For the proper country of the Khirghis Cossacks is the great western desert. In the others parts of Songaria the different nations of the Olöth or Calmucks [CALMUCKS] form the bulk of the population. The most numerous are the Turgut, or rather Toorgoot, who emigrated from Russia in 1771 and 1772, and were then estimated to amount to about 80,000 families, or 480,000 individuals. They are mostly settled in the north-eastern districts, but occur in small numbers in other parts. The two united nations of the Olöth Proper and Songares are dispersed over the whole country, and among them are settled the nations which, since 1757, have been sent there by the court of Peking, the Tshagar Mongols, the Mandshoos, and the Chinese themselves. The Mandshoos and Chinese are engaged in agriculture, commerce, trade, or employed by government. The Tshagars are soldiers and agriculturists, and chiefly live in the military colonies. The majority of the other tribes live on the produce of their herds, but many of them have begun to apply themselves to agriculture, when the soil and other circumstances concur to render cultivation profitable.

*Political Divisions and Towns.*—Since the country has become subject to China, it has been divided into three parts. The eastern districts, or those which extend along the northern base of the Thian-shan mountains, have been incorporated into the province of Kansi, which constitutes an integral part of China Proper. The western districts are united under a provincial government, established at Kuldsha on the Ili, and constitute the government of Ili. These two parts together are also known under the name of Thian-shan Pelu, or the North Road of Thian-shan, as the great road from Peking to the north-western boundary of the Chinese empire traverses them in their length. The northern districts, that is, the basin of the rivers Irtish and Urung-hu, and some smaller basins, constitute a part of the government of Khobdo or Gobdo, the greater portion of which lies east of the Egtag Altai.

That part which belongs to the province of Kansi contains the towns of Barkol and Oorum-tsi. Barkol, called by the Chinese Tshin-si-fu, is near the eastern extremity of the Thian-shan mountains, north of Hami, and a fortress with a considerable garrison, which begins to have some commerce on account of the great road passing through it. The country in which it is built seems to be very elevated, as it is stated that snow sometimes occurs in July. Oorum-tsi, or Urum-tsi, which lies about 250 miles farther west, near the base of some offsets of the Bogdo Oöla, in a very fertile district, consists of two towns, Old and New Oorum-tsi, which are about two miles from one another. They are well built, with wide streets. The military colony established at these places consisted, at the time of the establishment, of 8000 families The town has a large population, and is considered to be the most thriving and industrious place in Songaria. The Chinese have established several manufactures, and they have a grammar-school, a city school, and an elementary school. The Chinese name of Oorum-tsi is Ty-hua-tshew. It is a town of the second class, the capital of the western district of Kansi. It carries on a considerable trade with Kuldsha and Tarbagatai.

The capital of the government of Ili is Kuldsha, called also Ili and Kura, and by the Chinese Hoei-Yuan-shing. It stands about a mile from the banks of the river Ili, and is enclosed with a wall built of hewn stone eighteen feet high. It contains about 10,000 houses and 50,000 inhabitants, and is the seat of the provincial government, and of the military administration of the army, which is posted along the western boundary of the Chinese empire. It carries on a considerable trade with Oorum-tsi and Signan in Shensi, and also with Kashgar in Chinese Turkistan, and with Tarbagatai. About nine miles north of Kuldsha is Kashmir or Kashmir-huré, a new-built town with 3000 houses, mostly inhabited by Chinese settlers, who are very industrious. Tarbagatai, called by the Khirghis Cossacks Toogootshuk, and by the Chinese Soui-shing-tshing, is situated not far from the southern basis of the Tarbagatai mountains, and is fortified. It contains about 600 houses, and 5000 inhabitants, of whom 2500 belong to the garrison. It carries on a considerable commerce with the Khirghis Cossacks, and has some trade with Kuldsha, Oorum-tsi, and Khobdo.

That part of Songaria which belongs to the government of Khobdo appears to be almost entirely occupied by wandering tribes, and cultivation is hardly known. There are neither towns nor villages.

*Commerce.*—Since the country has been occupied by the Chinese, a considerable commerce has been established, and it is still increasing. The town of Kuldsha may be considered as the centre of this commerce. The most active branches seem to be the trade with China Proper, and with the town of Aksoo in Chinese Turkistan; that with Semipalatinskaya in Siberia is less important. The road which leads to China Proper crosses the western extremity of the Iren Khabirgan mountains, north of the town of Kashmir. Where it crosses the Iren Khabirgan mountains, which are rather steep, especially on the northern declivity, an artificial road has been made over two ridges, at the expense of the Chinese government. Where the level country round Borotala begins, the road runs eastward along the northern declivity of the Iren Khabirgan mountains, and of the Thian-shan, through Oorum-tsi and Barkol. At the last place it turns south, and traverses the eastern extremity of the Thian-shan range, and passing through Hami, it enters the Gobi. That part of the road which lies within the desert between Hami and Su-tscheu is nearly 400 miles along, and runs south-east. From the last-mentioned place it continues south-east through a more fertile and somewhat cultivated region to Lan-tcheou, the capital of Kansi, where the fertile part of China begins. The principal imports from China are the numerous articles manufactured in that country, which are consumed by the Chinese and Mandshoo families established in Songaria. Some of these articles, especially china-ware, are sold to the nomadic tribes. All that is imported seems to be employed for maintaining the military establishment.

The road from Kuldsha to Aksoo in Chinese Turkistan runs directly south, and crosses the Thian-shan Mountains a considerable distance east of the town of Aksoo. On the summit of the range a space ten miles wide is covered with snow. The principal imports from Aksoo are cotton stuffs, made in the place or imported from Kashgar and Khoten. By this route also a few of the manufactures of Hindustan are brought to Kuldsha, especially muslins of indifferent qualities; some stuffs, half silk and half cotton; and several kinds of calicoes.

The road from Kuldsha to Semipalatinskaya passes over the Iren Khabirgan Mountains, along the same artificial road which is travelled by those who go to China; but at the foot of the mountains the two roads separate: the road to Russia lies in a general north-north-east direction to Tarbagatai, and from this place it continues north, passing along the western banks of Lake Zaisang, until it enters Russia, where it turns north-west to Semipalatinskaya. The Russians do not import manufactures into Songaria, but only cattle and sheep. They are not permitted to enter the Chinese empire in these places as Russians, but only as the subjects of some khan of the Khirghis Cossacks. It is therefore not an open trade, but a kind of smuggling. As the subjects of a khan of the Khirghis Cossacks, they can only import cattle. Though all the nomadic tribes bring a great number of cattle to the market, the Russians find it advantageous to send there also a considerable number, which are generally sold to the government, and paid for by the cotton stuffs of Aksoo, Kashgar, and Khoten.

*Government.*—The government of this province is on a military footing. The commander-in-chief of the troops is also invested with the civil authority. The governor is called Ziangghium, and is assisted by a council of five persons, called galai-das. The army stationed in Songaria probably consists of more than 60,000 men, of whom 28,000 are quartered in Kuldsha and the neighbourhood. The whole population of the country probably falls short of two millions, and three-fourths of this number are wandering tribes, who are very lightly taxed. The expenses therefore are much greater than the revenues; and the Chinese government accordingly sends many goods from China, which are partly disposed of to the Khirghis Cossacks for cattle and sheep for the soldiers as part of their pay: a considerable quantity of silver also is annually received from Peking.

*History.*—We shall not state what nations successively in antient times settled in this country, nor at what times and under what circumstances they were obliged to give way to other intruders, who always advanced from the Gobi towards the West. The fate of the most distinguished of these nations is described in Ritter's 'Erdkunde von Asien,' vol. i., p. 431-441. We shall only give a short account of the events which led to the occupation of Songaria by the Chinese. After the Eastern or Proper Mongols had conquered China, in the second half of the thirteenth century, the greater part of that nation settled in the conquered countries. Thus the population of their own native country was considerably diminished; and their neighbours on the West, the Western Mongols or Olöth, also called Calmucks, which up to that time had been the less powerful branch of the great nation, began to extend farther to the east, and to increase in numbers. On the downfall of the Yuen dinasty, or that of the Mongols in China, in 1366, the greatest number of the Eastern Mongols who had been settled in China perished in the war which accompanied the destruction of their power, and only a small remnant returned to their native country, where they again united with those who had not emigrated to China. They found that their neighbours were now more powerful than themselves; but the great fame which the Eastern Mongols had acquired by the exploits of Ghengis Khan and the conquest of China, kept the Olöth in awe for more than two centuries. In the sixteenth century however the war between the chiefs of the Khalkas Mongols, and several claims on the part of the Olöth, led to a war between these two nations. The two other great branches of the Mongols had already submitted to the Mandshoos [MONGOLS], when that nation had succeeded in getting the government of China into its hands (1644). For some time neither of the two belligerent powers had a decided advantage; but when the Galdan, the khan of the Olöth Proper, who had compelled the Songares, another band of the Olöth, to acknowledge his supremacy, made the same claims on the Khalkas Mongols, a war arose (1685), in which the Khalkas were expelled from their country, and compelled to fly towards the country occupied by the Sunnites and Tshagar, two tribes which were already subject to the Mandshoos. To avoid destruction they submitted to the Chinese emperor (1688), and requested protection against their enemies. The emperor Kang-hi tried to settle the matter in a peaceable way, but without success. He then sent three armies against the Galdan; but he would hardly have been successful if Tse-vang Arabdan, the khan of the Songares, who had been offended by the Galdan, had not alienated his nation, and also a part of the Proper Olöth, from the Galdan. After having been defeated several times, and at last been abandoned by nearly all his followers, the Galdan died by taking poison (1697). By these wars the Chinese emperor gained only the submission of the Khalkas Mongols, who returned to the country from which they had been expelled by the Olöth. On the ruins of the empire of the Olöth rose that of the Songares. Tse-vang Arabdan was no less enterprising, and more successful, than Galdan had been. He subjected to his authority all the chiefs of the Olöth Proper, conquered Turkistan, obliged another branch of the Western Mongols, the Toorgut, who then occupied the greater part of the Caspian Desert, to abandon the country west of Songaria, and to retreat to the banks of the Volga and Don, and he took possession of Tibet. Thus nearly all the elevated region of Central Asia was subjected to his sway. A war with China seemed unavoidable. Arabdan tried to ward it off, by offering to submit to the emperor, but his offers were not accepted. The Chinese armies were generally successful in expelling the Songares from the conquered provinces, but they could not get possession of Songaria. The death of the emperor Kang-hi and that of Arabdan occurred about the same date (1723), and for some time the Chinese did not interfere with the disputes and internal wars which broke out after the death of Arabdan between the members of the royal family of the Songares. During the disorders which originated in these wars the throne of the Songares was occupied by two usurpers, called Davatsi and Amursana. Though at first closely united, they soon disagreed, and Amursana took refuge in China, where he was well received, and sent back (1755) with a Chinese army, as the lawful occupant of the throne of the Songares. The expedition was successful: Davatsi was taken prisoner, and died soon afterwards. But Amursana did not intend to be a vassal of the emperor: he soon collected a large force, and destroyed two Chinese armies which were sent against him; but he was obliged to yield to the third (1757), which took possession of the whole country of Songaria and Turkistan. Amursana went to Siberia, and died soon afterwards, at Tobolsk, of the small-pox. These continual wars, and the severity with which the Chinese punished Amursana's adherents, nearly extirpated the Proper Olöth as well as the Songares, and the country was turned into a desert. As a great portion of it is unfit for cultivation, the Chinese wished to re-people it with some nomadic tribes; and induced the Toorgut, who had taken refuge in Russia when pressed by Arabdan, to return to their native country in 1771 and 1772. [CALMUCKS.] It seems that the Khirghis Cossacks, who, upon the destruction of the Songares, had taken possession of the western districts of Songaria, joined the insurrection of the Turkish tribes in Chinese Turkistan in 1825, and that a great number of them have been put to death. It appears to be the policy of the Chinese emperor to punish all revolts of the nomadic tribes with unsparing severity.

(Ritter, *Erdkunde von Asien*, vol. i.; Humboldt, *Fragments Asiatiques*.)

SONNERA'TIA, a genus of plants of the natural family of Myrtaceæ, so named by the younger Linnæus in compliment to M. Sonnerat, well known by his 'Voyage à la Nouvelle Guinée,' and his 'Voyages aux Indes Orientales et à la Chine,' and who made known many new plants. The genus is characterised by having a 4-6-cleft campanulate calyx, adhering to the ovary at the very base; petals 4 to 6, alternating with the valvate lobes of the calyx; stamens numerous; styles filiform, with a peltate stigma; fruit baccate, appearing half-superior, many-celled; seeds numerous, nestling in a fleshy pulp, curved; the species form moderate-sized trees, with opposite leaves, which are entire, thick, and almost veinless; flowers usually solitary, large. *S. acida* is the best known species, being the Pagapate of Sonnerat, and the Blatti of Rheede, which has an acid eatable fruit. The branchlets tetragonal; leaves oval, oblong; calyx 6-cleft; petals 6; berry globose. The tree is forty feet high, and is a native of New Guinea and the Moluccas, as well as of the Malabar coast and of the delta of the Ganges. S. alba is another species of the Moluccas, and S. apetala, a native of Ava, near Rangoon, as well as in moist situations along the Burmese coast.

SONNET (Italian, *Sonata, Sonetto*), a form of poetry much used by the Italian and Spanish poets, but which our deficiency of rhymes has caused to be more sparingly used in English. The sonnet properly consists of two quatrains and two tercets. The last six lines are susceptible of various arrangements; the one usually adopted in English is the rhyming of the fifth and sixth lines together, frequently after a full pause, so that the sonnet ends with a point, as in an epigram. The Italians consider the best form to be the rhyming together of the three uneven and the three even lines; but our poverty of rhymes causes us to prefer the rhyming of the first and fourth, second and fifth, third and sixth lines: this, with a break in the sense at the third line, constitutes also a legitimate sonnet, of which the Italians have given abundant precedents. We need scarcely observe that all our poets have held themselves at liberty to vary the form of the sonnet. The lightness and richness of the Italian and Spanish languages enable their poets to express every feeling or fancy in the sonnet; but with us it has been found most suitable to grave, dignified, and contemplative subjects. Hence Milton and Wordsworth are our best writers of sonnets.

SONNITES. [MOHAMMED.]

SONNINI DE MANONCOURT, CHARLES NICOLAS SIGISBERT, was born at Lunéville, Feb. 1, 1751. He was the son of Nicolas Sonnini, seigneur of the fief of Manoncourt in Vermois, and councillor of Stanislaus, king of Poland. He was educated at the Jesuit university of Pont-à-Housson, and made rapid progress in his studies. At an early age he became acquainted with Buffon and Nollet, who encouraged his taste for natural history. Having a wish to travel, he obtained a commission in the marine engineer service, and in 1772 was sent to Cayenne in consequence. Here he showed great energy and courage in exploring the country and dislodging from their strongholds the savages with whom the colony was molested, and succeeded, at great personal risk, in making a passage by water from Cayenne to the mountain La Gabrielle, the accomplishment of which had been much desired by the colonists, but abandoned by reason of the natural difficulties of the route. He was, in consequence of this enterprise, promoted to the rank of lieutenant on his return to France. In 1775, after a visit to the western coast of Africa, he resumed his post as an engineer at Cayenne, and spent two years in researches in natural history. Returning to France, in consequence of ill health, he passed the winter of 1776 with Buffon, assisting him in his labours, till he joined the African expedition of Baron de Tott, in 1777. After remaining some time in Egypt, and exploring the country, he travelled in Greece, the Archipelago, and Asia Minor. He returned to France in 1780, and employed himself in the improvement of agriculture, introducing several valuable exotic vegetables into his country. At the beginning of the Revolution he was appointed one of the administrators of the département de la Meurthe; but being deprived of this office by St. Just, and reduced to poverty, on account of his noble birth, he employed himself in arranging and publishing the materials collected in his travels. He was afterwards placed at the head of the college of Vienne, in the département de l'Isère; but failing in his projects of reform there, gave up this situation after holding it two years, and returned to his literary labours. In 1810 he went to Moldavia, and, while traversing that country, caught a fever, from which he never recovered. He died at Paris, May 29, 1812. His principal works are, 'Voyage dans la Haute et Basse Egypt,' Paris, 8vo., 1799; 'Voyage en Grèce et en Turquie,' Paris, 8vo., 1801.

Buffon's 'Histoire Naturelle,' Paris, 1799-1808, to which he contributed 13 vols. of fishes and 1 vol. of cetacea, and, jointly with M. Latreille, 4 vols. of reptiles; and the 'Nouveau Dictionnaire d'Histoire Naturelle,' 8vo., 1803-4, were edited by him: in the latter he wrote the articles 'Man,' 'Quadrupeds,' 'Birds,' and 'Cetacea.'

Sonnini deserves great praise for his labours as a naturalist. Like other great travellers, though eager and enthusiastic, he was somewhat inconstant in the direction of his energies, as we may infer from the events of his life, not less than from the remarks of his French biographer. In his 'Travels in the East' he treats of the natural and artificial productions of each country, and gives also archæological and topographical notices not remarkable for their research or originality. (*Biographie Universelle*, by the author of his 'Eloge Historique,' where is a list of his other publications.)

SONO'RA. [MEXICAN STATES.]

SOODAN, or BELE'D EL SU'DAN ('the Country of the Blacks'), is a term applied by the Arabs to designate the interior of Africa; but, according to the geographical position of the country in which it is used, this term indicates different portions of that continent. The inhabitants of Egypt apply it to the countries south of the second cataract of the Nile (22° N. lat.), and the present pasha of that country has formed a province of all the countries in these parts which he has subjected to his sway, under the name of Beled el Súdan. [SENNAAR.] The Arabs who trade to or are settled in Bornou, which is about 400 miles west of the Egyptian province, call 'Soodan' the countries which are still farther west, towards the middle course of the Quorra. The geographers of Europe have given it a more comprehensive application, and they designate all the countries along the southern edge of the Sahara from Senegambia and Sierra Leone on the west, to Dar Fur on the east, by the term Soodan. Thus Soodan extends from 10° W. long. to 25° E. long., and is 2400 miles in length. Its northern boundary towards the Great Desert cannot be exactly fixed, as the fertile and cultivable country changes into the sandy waste so imperceptibly, that the boundary appears to vary according to the seasons, and in different years: it is also very imperfectly known. In one part, at the most northern bend of the Quorra or Joliba, the fertile country extends to 17° N. lat.; but in other places, as in the vicinity of Lake Tshad, it does not come up to 14° N. lat. The southern boundary-line is almost entirely unknown. West of the course of the Quorra it is formed by the Kong Mountains, which, according to information obtained from the natives, occupy the greater part of the space between 8° and 10° N. lat., and, on the banks of the river, occur between 7° and 11° N. lat. East of the Quorra, the extent of Soodan toward the south is entirely unknown. If we suppose that the average width of Soodan is about five degrees, or 350 miles, the surface will cover an area of 880,000 square miles, which is more than four times the area of France.

Nearly up to the end of the last century this country was only known by the descriptions of the Arabian geographers and of Leo Africanus. At that time (1790) the first European traveller, Houghton, entered Soodan from the west; but he was killed in 1791. Mungo Park however succeeded in traversing the north-western portion of Soodan in 1796 and 1797, and collected very valuable information. The expedition under Denham and Clapperton (1822-24) made us acquainted with a large portion of Central Soodan (between 6° and 17° E. long.), to which Clapperton, by his second journey (1826), added the south and south-west countries of Central Soodan; and Richard Lander, the vale of the river Quorra (1830). Caillié succeeded in traversing a large portion of South-western Soodan in 1828. As these travellers, with the exception of Denham and Clapperton, who remained there for more than two years, traversed these countries only in one direction, our knowledge would be very limited were it not for the great uniformity which the country exhibits, and which enables us to form a general idea of a large portion of it. We shall take a survey of the western and central districts, observing that the eastern (between 17° and 25° E. long.) has not been visited by Europeans, and that the information collected from the natives is very scanty, and cannot be relied upon.

*Western Soodan* comprehends the country west of the course of the Quorra, from Timbuctoo to its entrance into the delta at Abbazaca. The elevated tract which divides Soodan from Sierra Leone and Senegambia, and along the base of which the Joliba runs in a north-western direction as far north as Yamina, appears to be rather a huge swell of the country overtopped by rocky masses, than a mountain-range: at least it is traversed by the native traders in many places with little difficulty. The southern border of Western Soodan is formed by the Kong Mountains, with which we are still less acquainted, no part of the mountains having been seen by European travellers. Caillié, who seems to have approached the place where they are laid down in our maps, between 6° and 7° W. long., saw only one elevated peak at a distance. It would therefore seem that this range too is rather an extensive and elevated swell of the country than what may be called properly a mountain-chain. Most of the rivers that descend from it to the south and north have also very little water in the dry season, though several of them run many hundred miles. This leads us to believe that its elevation is not very considerable. The most eastern portion of the Kong Mountains (between 3° and 5° E. long.) has been traversed by Clapperton and Lander; and, according to their account, in passing from Ekwa to Katunga, they ascended many short and gentle acclivities, until they had attained an elevation of about 2500 feet above the sea-level, when they descended in nearly the same way towards the vale of the Quorra. This elevated region occupies not much more than a hundred miles in width, but we must include in it the country north of Katunga as far as Yaouri, which is about 150 miles farther north; for though it is less uneven and hilly, it resembles the more southern parts in soil and productions. In this eastern mountain-tract the highest part of the country hardly anywhere, except in the centre and at the southern edge, takes the appearance of a continuous ridge; but the surface is a succession of wide valleys and plains of considerable extent, and single hills connected by rising grounds slightly elevated above the general level. The surface generally consists of a fertile soil, which, in many parts, is covered with forests, but in others is cleared and cultivated. The forests consist chiefly of tall trees, with very little underwood, and the intervening places are covered with luxuriant grasses. These forests abound in deer, antelopes, lions, leopards, elephants, wild asses, buffaloes, and hyænas; and in the Quorra the hippopotamus is common. The country, where cultivated, yields plentiful crops of indigo, tobacco, yams, wheat, and other kinds of corn, rice of a superior quality, onions, and several other vegetables; and in the extensive pastures, great numbers of horses, bullocks, sheep, and goats are fed. Between Yaouri (11° N. lat.) and Rabba (9° N. lat.) the hilly country approaches the banks of the Quorra, and only a comparatively narrow tract of well-cultivated alluvial soil extends along the river. Between Rabba and Egga, where the river runs south-east, the alluvial valley is much wider; but a great part of it is a swamp even in the dry season, and destitute of wood. But between Egga and Abbazaca the rocky masses advance so close to the banks of the river, that there is very little level ground along them. The hills on both sides rise nearly to the height of mountains. They are entirely covered with wood, and the trees are higher than farther upward. This region is rather densely inhabited, and villages are very numerous, as well near the river as farther inland. There are also several large towns.

The country extending from the northern base of the Kong Mountains to the edge of the Sahara may be considered as a plain, which in extent exceeds the area of France. No continuous ridges of high land branch off from the Kong Mountains. In the vicinity of the range indeed hills are met with, and many of them are rocky; but they occur at considerable distances from one another, and never form ridges more than a few miles in length. The level country which lies between them sometimes extends fifty miles in every direction. This part of the plain is rather uneven when compared with that farther north, and occupies along the base of the mountains a belt about a hundred miles in width. Only one of the hills was observed by Caillié to rise about 500 feet above its base: in several places large granite blocks are dispersed over the surface, rising about six or seven feet above it. The soil of this extensive tract is chiefly grey sand, alternating in some places with red sand. This sand is very frequently mixed with gravel, but sometimes with argillaceous earth, clay, and mould. In some places occur red and porous stones. In the vicinity of the watercourses it is subject to inundations for more than six months of the year. The more distant parts have the advantage of abundant rains, and are so far fertilised by them that no considerable part of the country can be called a useless waste. There occur indeed large tracts covered with trees, many of which are applied to no uses; but among them are also many shea-trees and nedés, the fruits of which are much esteemed by the natives; and the indigo plant abounds in several parts. The more fertile tracts are cultivated. Caillié is of opinion that the agricultural industry of the inhabitants of Wassoolo is not inferior to that of most parts of France. The most common objects of cultivation are maize, millet, rice, tobacco, which however is inferior to that brought from the coast, yams, onions, cotton, French beans, water-melons, and calabashes. Near the base of the mountains a kind of long pepper and pimento is grown. In the same districts the colat or gora nuts are collected, which constitute an important article of commerce all over Western Soodan, and are carried from the Kong Mountains to Timbuctoo, and even to Tripoli, a distance of respectively 500 and 2000 miles. As the places where these nuts are collected have never been visited by Europeans, the tree or plant on which they grow has never been described. Besides the shea-trees and nedés, the forests contain several other useful trees, as the baobab, some kinds of mimosas, and the *Nauclea Africana*. The most common fruit-trees are pistacias, which are grown to a great extent, tamarinds, and oranges; wild fig-trees occur in the forests. Domestic animals abound in most parts, especially black cattle of good size, sheep, and goats; the horses are of a small breed, except at Tangrera, where they are rather large and of fine form. There are also asses and abundance of poultry. Dogs, serpents, lizards, rats, and mice serve as food to the natives. Other wild animals are not numerous. Caillié mentions only gazelles and wild boars, and of wild birds, green parrots, Guinea-fowls, and Barbary ducks. Fish abounds in the rivers, and is prepared for sale by drying. Wild bees are extremely numerous, and wax and honey are not only largely consumed, but also sent to other parts of Africa.

Caillié, who remained in this country about six months, gives some account of its climate from the beginning of August to the end of January. The month of August is exceedingly stormy; the rains pour down day and night, the sky is cloudy, and the air heavy and cool. The south-west wind prevails, but at intervals eastern winds blow, and they are followed by a small cold rain. The sun is rarely seen. The natives always keep a large fire in their huts. In September the rains are more interrupted, but still they fall every day until October, when they become less frequent, but they continue to be heavy, and set in with hurricanes from the south-east. In proportion as the rain diminishes, the heat increases, and the air becomes less damp and more salubrious. About the end of October the rains cease entirely, the days become exceedingly hot, and the nights cool. In November and December the weather is very fine, and the wind blows frequently from the north-east and sometimes from the north. A cold north wind begins to prevail at the end of December, and the natives then cover themselves with woollen wrappers, and kindle larger fires than usual in their huts. At this season the trees shed their leaves.

The country between 10° 30′ and the southern banks of the Joliba river is still more level, but less fertile. Even small hills are of very rare occurrence; the highest appear to be those which Mungo Park saw at Bammakoo, and considered as an offset of the Kong mountains. The surface of the country is slightly undulating or a level. Several tracts which are a little depressed below the general surface are swamps during the greatest part of the year, whilst others are always in this state. The first are either used as pasture-grounds, or rice is cultivated on them, as well as on the borders of the others, and along the alluvial banks of the rivers. The soil of the higher grounds consists chiefly of grey sand and gravel, often intermixed with ferruginous stones. In some places bushes are met with, but there are no forests. Shea-trees and nedés are dispersed over large tracts, and here nearly all the vegetable butter is collected, which is consumed on the banks of the Joliba as far as Timbuctoo; for farther north the shea-tree becomes rare, and disappears at some distance from the banks of the river. In a few places the baobab-trees abound, whose leaves and fruits supply another article of trade to the countries farther north. In the more fertile tracts millet is extensively cultivated, but other grains and vegetables are scarce or do not grow at all, as yams and maize. Of fruit-trees only tamarinds and the Rhamnus lotus occur. The Hibiscus cannabinus abounds in many places, and ropes are made for the markets on the Joliba, where these ropes are used to fasten together the boards of which the barges are made. The marshes are frequented by numbers of aquatic birds, as pelicans, egrets, trumpet-birds, marabous, puffins, Barbary ducks, and teals. From the ferruginous stones, which are so frequent in this region, iron is extracted, and is an article of export to the banks of the Joliba. The country along the banks of this river is a dead flat, and is annually inundated to a considerable extent. A great part of it has been converted into marshes, which serve as pasture-grounds; but on the drier parts rice, maize, and other grains are cultivated. This low country is destitute of trees.

That part of Western Soodan which is north of the Joliba and the marshes contiguous to the river is tolerably fertile to a considerable distance from its banks. It is a plain, but here and there interspersed with sandy hills, and in other places with rocky eminences. The soil is rather fertile, and produces plentiful crops of millet and maize. Villages and towns are frequent. But in proceeding farther north, the soil becomes less fertile, as the sand of the Sahara is frequently thrown upon it by the strong north-eastern winds. The surface in many places is covered with hillocks of white sand, between which numerous bushes, but only a few large trees grow. The wild animals, which hardly appear south of the Joliba, as elephants, lions, panthers, leopards, and wild hogs, are frequent, as well as wolves, antelopes, and ostriches. Park also mentions wild horses, which are eaten. Among the domestic animals are camels, which are not found south of the Joliba.

The country on both sides of the Joliba is sultry and oppressive before the setting in of the rains. About the middle of June the heated atmosphere is agitated by violent gusts of wind, accompanied with thunder and rain. These usher in the rainy season, which continues to the month of November. During this season the diurnal rains are very heavy, but not so continual as near the Kong Mountains. The prevailing winds are from the south-west. The termination of the rainy season is likewise attended with violent tornadoes, after which the wind shifts to the north-east, and continues to blow from that quarter for the rest of the year. With the setting-in of the north-east wind the face of the country begins to change. The grass soon becomes dry and withered, the rivers subside very rapidly, and the trees shed their leaves. At this period the *hamattan* is commonly felt, a dry and parching wind blowing from the north-east, and accompanied by a thick smoky haze, through which the sun appears of a dull red colour. As this wind passes over the Great Desert, it becomes exceedingly hot and dry as it approaches Soodan, and parches up everything which is exposed to it.

A great part of Western Soodan, lying on both sides of the meridian of Greenwich, and extending along the banks of the Joliba or Quorra from Timbuctoo to Yaouri, has never been visited by Europeans, and it is remarkable that the travellers who visited the countries west, south, and east of this tract, have not been able to collect any important information respecting this country. Lander states that many years before his stay at Yaouri a large boat arrived at that town from Timbuctoo on a trading voyage, and that the crew returned by land to their native town. This proves that the navigation on the middle course of the Joliba is far from being so active as on the upper part, and, together with the scanty information which travellers have collected, it seems to show that this part of Soodan is much less populous than the other districts.

*Central Soodan* comprehends that portion which extends from the river Quorra, where it flows southward, as far east as Lake Tshad and the river Shary, which falls into the lake, or from 5° to 16° E. long. It may be divided into two regions, a hilly and an alluvial plain. The first occupies the country west of 11° E. long., and the plain occupies the remainder.

The hilly region seems to extend to the very border of the Sahara, which in these parts occurs between 14° and 15° N. lat. The surface is extremely diversified. In many places the higher grounds extend in level plains, some of which are of considerable extent, but in others these tracts are diversified by a succession of open valleys and gentle rising grounds. In several places however ridges of hills extend across the region, mostly running from south to north, or rather from south-west to north-east. Where the country is traversed by watercourses, the surface is more broken, the valleys being in general much narrower, and the hills rising with a steep and sometimes a perpendicular ascent. The highest hills which have been seen are not much more than 700 feet above their base, and the general level of the country seems to be about 1000 or 1200 feet above the sea. A great part of this region extends in level plains, which are chiefly converted into large swamps or temporary lakes during the rainy season, but this circumstance is favourable to fertility. There is however a large tract in which the swamps exist all the year round. This tract is situated north of 13° N. lat. and between 6° and 8° E. long., east of the town of Soccatoo, and is known by the name of the Gondami Swamps. Hills of granite, of moderate elevation, enclose this tract on all sides, and prevent the water which collects on its surface from running off in any direction. These hills are covered with stunted trees, whilst the country between them and the swamps is overgrown with forests. Though the soil is of the best quality, this tract is nearly uninhabited, and the haunt of wild animals. Nearly all the rivers and watercourses of this region are very rapid and deep during the rainy season, but in the dry season only pools, sometimes single, sometimes in rows, occupy the lowest part of their bed. The soil retains moisture all the year round. Clay constitutes the predominant soil; in several places it is intermixed with gravel, and in others covered with a thin layer of sand. In some places large blocks of granite rise out of the earth like towers, and in others rocks of sandstone are embedded in the clay; but clay, mostly of a light or deep red colour, is found nearly everywhere. Its quality of retaining moisture for a long time, even under a burning sun, renders this region the most fertile tract of Africa north of the equator, and is populous in spite of the continual wars between its sovereigns, and its being situated in the centre of Africa, and being nearly secluded from commercial intercourse with other parts of the world. In some parts the villages are very numerous, and the towns are of considerable extent and contain a great population. Where the country is not cleared for cultivation, it is covered with forest trees, especially mimosas and acacias; only the more elevated and dry ridges are overgrown with bushes or stunted trees, and rarely a spot is without vegetation.

The products are extremely various. Wheat succeeds in some of the more elevated tracts, but the grains which are generally cultivated are rice, Indian corn, Guinea corn, and millet. Cotton, tobacco, and indigo are grown to a great extent. Other objects of cultivation are yams, sweet potatoes, beans, French beans, water-melons, musk-melons, and onions. In the districts south of 10° N. lat. palm-oil and cocoa-nut trees abound, but they do not thrive farther north. In the same places plantains and bananas are grown in abundance. In the eastern districts date-trees are common, but they do not occur in the western. The fruit-trees which are most common are figs, pomegranates, limes, papaws, cashew-nuts, plums, Guinea nuts, shaddocks, nuttabeans, and tamarinds; the butter-tree also abounds in several places; the mango-tree is cultivated, and occurs also in a wild state. The fields are often watered from deep wells.

The domestic animals are goats, sheep, asses, horses, and cattle. The horses are small, but along the northern border they are large and of a good breed, which is derived from that of the Tuaricks of the Sahara, but it is not equal to the Arab breed. In these districts many camels are also raised. Poultry abounds. In some woody parts, especially in the neighbourhood of the swamps of Gondami, elephants and lions are numerous: Lander mentions tigers, hyænas, tiger-cats, jackals, and monkeys. Buffaloes are only found in the southern districts, but wild hogs and several kinds of deer are met with in many places, and among the latter the karigoom, which is as high as a full-grown mule. Guinea-fowls, partridges, the ibis, storks, cranes, adjutant cranes, jays, and several kinds of pigeons are enumerated. The hippopotamus and alligator are found only in the Quorra. Iron is the only mineral: it occurs in many places, and a small quantity is exported to the countries farther east.

As no European has stayed a whole year in this region, we are only in possession of partial meteorological observations. According to these, the rainy season sets in at the end of May or beginning of June, and continues to the middle of September. It differs greatly from that of the coast of Guinea. The rains are much less abundant, and not so continual. Even in the height of the season, in August, there are several days without rain, and a continuation of rain for twenty-four hours is a rare occurrence. The prevailing wind changes regularly to all quarters of the compass. From October to March it blows almost always from the north-east, turning occasionally to the north and east, but in March it varies between east and south, and in April between south and west. In the beginning of the rainy season its direction is more variable, but it usually varies between south-west and north-west. The diurnal change of the temperature is very great. The difference between six o'clock in the morning and three o'clock in the afternoon is hardly ever less than 12 degrees, often amounts to 20 degrees, and sometimes rises to 25 and even 30 degrees, especially during the north-eastern winds. The natives keep fires all the year round in their huts. The greatest heat which was observed was 104°, and the least was 57°.

The Plain of Central Soodan extends from 10° E. long. to Lake Tchad and the river Shary, and from 14° to 10° 30′ N. lat., where it lies contiguous to a hilly country. The greatest part if not the whole of this plain is alluvial. It is probably the largest alluvial tract on the globe which occurs far inland, if the plain surrounding the Caspian Sea is excepted, which is of a different character. The alluvial plain of Soodan is nearly a dead level. It is very fertile, but not easily cultivated, as a large part of it is converted into lakes during the rains, which give rise to a rank vegetation, and thus create great obstacles to the clearing of the ground. The southern districts however are in general rather populous, and a considerable portion of them is cleared and cultivated, but the country on both sides of the river Yeou is not much cultivated, and it is exposed to the predatory incursions of the Tuaricks, who inhabit that part of the Sahara which extends north of the plain. Thus by far the greater part of the plain is covered with thick underwood, high coarse grass, and parasitical plants; in many parts there are extensive forests. The soil is a dark clay, which cracks during the dry season.

The climate of this region differs considerably from that of the hilly region. It is in general much hotter, but the daily range of the thermometer is much less. The country therefore, notwithstanding the moisture of the air during and after the rainy season, is more healthy than in the hilly region. According to the meteorological observations of Denham, which embrace nearly two years, the mean annual temperature is 83·6°, that of the winter (December-February) 76·2°, of the spring (March-May) 90·8°, of the summer 84·6°, and of the autumn 82·7°. From the beginning of March to the end of July the heat is excessive, but not uniform. About two o'clock the thermometer sometimes rises to 105° and 107°, and occasionally to 110°, and at this season winds from the south and south-east prevail. The nights are oppressively hot, but towards sun-rise the thermometer usually falls to 86° or 85°. Towards the middle of May the rains set in with violent tempests of thunder and lightning. The rain pours down in torrents, and continues sometimes for two or three days. Up to the end of June, the ground, having been parched during the dry season, absorbes all the rain, but towards the end of July the lakes and rivers begin to overflow, and tracts of many square miles in extent are quickly converted into large lakes. The weather is without interruption cloudy, damp, and sultry; the wind hot and violent, and generally from the east and south. In October the rains are less frequent, the air mild and more fresh, and the weather serene; the wind blows from the north-west. December and January are rather cold. Clapperton and Oudney experienced on the morning of the 27th of December an unexpected degree of cold. The water in the shallow vessels was crusted with thin flakes of ice, and the water-skins were frozen as hard as a board. The thermometer generally does not rise higher than 74° or 75°, and at sunset it sinks to 58°. In February the heat increases rapidly.

The principal objects of cultivation are gussup, which is a kind of millet, Indian corn, cotton, and indigo; the two last grow wild near Lake Tchad and the overflowed grounds. Rice is not much grown, and is of inferior quality; large quantities are exported from the hilly region. Kasheia and meloheia are two kinds of grass growing wild, the seeds of which are used as grain. Onions and four kinds of beans are extensively grown. The senna-plant is found wild. The fruit-trees consist of limes, tamarinds, figs, jujube, and locust-trees. Near the Sahara are date-trees, and towards the hilly region mango-trees in the forests. Several wild trees bear edible fruits.

The domestic animals constitute the wealth of this country. Sheep, goats, cows, and oxen are numerous. In the lowlands, along the banks of Lake Tchad and the river Shary, many thousand head of cattle are pastured, and all over the country black cattle are very numerous. There is also a good breed of horses, much superior in size and form to those of the hilly region, to which great numbers are exported. Domestic fowls are very common: they are small, but well flavoured. Bees are very numerous, and honey constitutes an important article of food. Locusts frequently lay waste a part of the country, but the natives eat them with avidity, both boiled and roasted, and formed into paste. The wild animals are lions, panthers, tiger-cats, leopards, hyænas, jackals, civet-cats, foxes, monkeys of different kinds, and elephants, which are so numerous on the low banks of Lake Tchad, that they are frequently seen in herds of from fifty to four hundred. Buffaloes, wild hogs, gazelles, antelopes, and several kinds of deer abound; among the last is the kurigoom. The most common wild birds are pelicans, spoonbills, and Balearic cranes of large size. The woods abound in Guinea-fowls, large partridges, small grouse, and the tuda, a bird resembling the thrush. In the lower grounds are geese, wild ducks, and snipes. Ostriches are found along the northern boundary-line. Fish are very numerous in the lake and the lower course of the river, and fishing is much attended to by the inhabitants of these tracts. No minerals are found in this region.

*Rivers.*—The largest river is the Quorra, which in the upper part of its course is called Joliba. Though in the lower part of its course, where it divides the mountain region of the Kong from the hilly region of Central Soodan, the bed is traversed at several places by ledges of rocks, which render the navigation difficult during low water, this river is navigated in its whole extent, nearly from its source. [QUORRA.] Its tributaries are still less known than the principal river. In the upper part of its course the Quorra is joined from the right, above the town of Sego, by the rivers Bagoe and Kuaraba, which are navigable for small craft more than 100 miles from their junction with the Quorra. The largest affluents of the Quorra, in the lower part of its course, are the Mayarrow, the Coodonia, and the Shary, which fall into it from the left. The first does not appear to be navigated, and nothing is known of the second as to its navigability. The Shary has been ascended about 100 miles from its junction with the Quorra, but the navigation is much impeded by shoals and sand-banks. The other rivers of Soodan fall into Lake Tchad. The largest are the Yeou and the Shary. The Yeou does not appear to be navigated to any extent, but the Shary is navigated to a distance of more than a hundred miles.

Lake Tchad is of great size, and its length is stated to be five days' sail. Its eastern and north-eastern shores have never been visited by a European traveller. It is nearly surrounded by a low flat country, which for several miles from its banks is overflowed during six months of the year, and the other six months is mostly a swamp.

*Inhabitants.*—The population is composed of aborigines and foreigners. The aborigines belong to the negro race. The negroes are almost exclusively the inhabitants of the mountain region of Kong, but in the plain north of that range they live intermixed with Mandingoes and Foolahs. In the hilly region of Central Soodan the negroes constitute the bulk of the population, but they are governed by Fellátahs, and in the eastern plain they are intermixed with Arabian tribes, which have nere obtained the ascendency, which the Fellátahs have acquired in the hilly region. These negroes have attained a certain degree of civilization. They live in small well-built huts, and generally wear a slight but decent dress, which is adapted to the climate. They apply themselves to agriculture, and in some parts the ground is cultivated with a considerable degree of skill. Their isolated situation has also obliged them to manufacture several objects. They manufacture great quantities of cotton-cloth, only from five to six inches wide, but of good texture. The cotton-cloths made at Nyfi are of a superior kind, and fetch a high price on the coast of Guinea. They are also expert in forging iron. Clapperton mentions several villages which were inhabited almost exclusively by blacksmiths. They make arms, especially daggers, knives, and axes; agricultural implements, especially hoes, fire tongs, and even needles. They also make earthenware of a greyish colour, which they glaze, and which constitutes an important article of inland trade. Where the Fellátahs or Arabian tribes have acquired the ascendency, many negroes have been converted to the religion of Mohammed, but by far the greater part of them are pagans, and have their fetishes and greegrees.

The foreigners settled in Soodan are Mandingoes, Fellátahs, and Arabian tribes. The Mandingoes are only met with in the plain north of the Kong Mountains, where they have settled as merchants. Though they have not acquired any political power over the negroes, they have attained a superiority by their higher degree of civilization, and still more by being Mohammedans. [MANDINGOES.] Their language is generally spoken in all that part of the country in which they have settled.

The Fellátahs are the same nation which in Senegambia is known by the name of Foulahs [FOULAHS], and they speak the same language. Clapperton and Denham agree in this statement, and the latter found that a native of Footatoro in Senegambia easily made himself understood by an inhabitant of Mandara, though their native places were 1500 miles distant from one another. It appears that the Fellátahs first settled in considerable numbers in the negro towns, like the Mandingoes, but towards the end of the last century they entered the country as conquerors, under the conduct of Danfodio, with a large army, and were eminently successful, subjecting in a few years the whole of Central Soodan to their sway. After the death of Danfodio however the sheik of Bornou succeeded in expelling them from the alluvial plain [BORNOU], but in the mountain region south of Mandara they have maintained their footing. Several of the negro tribes that inhabit the hilly region have risen against their new sovereigns, but it does not appear that they have been so successful as the inhabitants of Bornou. Lander observes that the Fellátahs have even passed the river Quorra and obtained a firm footing in the region of the Kong mountains.

The Arabs settled in Soodan are only found in the neighbourhood of Lake Tchad, where they lead a wandering life, living on the produce of their cattle, and are known by the name of Shouaas. They are a very extraordinary race, and have scarcely any resemblance to the Arabs of the north; they have fine open countenances, with aquiline noses and large eyes. Their complexion is a light copper colour, and they resemble some of the best formed gypsies in England, particularly the women. Their Arabic is nearly pure Egyptian.

*Political Geography and Towns.*—Soodan contains many large and small states, and there occur also extensive tracts, in which the inhabitants live in a peaceful state of society, without having entered into a political union. We shall notice these political divisions in the order of the natural regions.

1. The ***Mountain Region*** of Western Soodan, or that of the *Kong Mountains*, is only partially known between 3° and 7° E. long., and comprehends two extensive countries, Yarriba and Borgoo. The first occupies the southern portion, and extends to a short distance from the shores of the Bight of Benin. The small river Moussa, which falls into the Quorra near 9° 20′ N. lat. here divides Yarriba from Borgoo. Borgoo, of which we are only acquainted with the tract adjacent to the banks of the Quorra, seems to extend westwards to a great distance. This region is very populous, and judging from the numerous villages and towns which Clapperton and the Landers saw in passing through it, must be compared with the best inhabited regions of the continent of Europe, with the exception of some parts of Italy and the Netherlands.

The kingdom of *Yarriba* seems to extend westward to the very boundary-line of Ashantee: on the south-west and south it is separated from the Bight of Benin only by the kingdom of Dahomey and a country called Jaboo, of which we have no knowledge. It is not known if it immediately joins the kingdom of Benin, or if some other independent country lies between them. The Quorra divides Yarriba from the kingdoms of Nyfi and Yaouri. Though only the banks of the river and the road leading from Badagry to Eyeo, the capital of Yarriba, have been visited by European travellers, they have seen upwards of thirty towns of large or middling size, each containing a population of from 5000 to 30,000 individuals. The present capital is Eyeo, or Katunga, which is situated in a fertile plain, or rather a wide valley, about 20 miles from the river Quorra. It is enclosed by walls built of clay, about 20 feet high, and surrounded by a dry ditch. They are about 15 miles in circumference, of an oval shape, about four miles in diameter one way, and six miles the other. At the south end of the town are hilly rocks. The king's houses and those of his women occupy about a square mile: they are built of clay and have thatched roofs. A considerable part of the space enclosed by the walls is laid out in gardens or cultivated, and the population does not exceed 20,000 individuals. The second town of the kingdom is Bohoo, which was the capital of the kingdom about fifty years ago. It has an immense triple wall, which is rather more than 20 miles in circuit, and is built on the slope of a very gentle and fertile hill, in an exceedingly well cultivated country, in appearance not inferior to any part of England in the best season of the year. The population is not stated.

There are several large towns built on the banks of the Quorra, as Lever or Layaba, near the boundary of Borgoo, which is very extensive and has a great population; Bajiebo, a flourishing and important trading town of great extent; Lechee, a very large and thriving place; Egga, which is of prodigious extent, and has an immense population, but a large portion of it is frequently inundated by the river; and Kakunda, which is governed by a sovereign independent of Yarriba, and consists of three or four considerable villages, situated within a short distance of one another, but unconnected.

On the road leading from Badagry to Eyeo several other large towns are situated. Between Eyeo and Bohoo are Eetcho, Atoopa (6000 inhabitants), and Jagúta, a large and well fortified town. South-west of Bohoo is Kooso, a large double-walled town, which has at least 20,000 inhabitants, and is a place of great trade; Chaadoo, with 7000 inhabitants; Duffoo, with 15,000 inhabitants, and considerable manufactures of cotton-cloth: Assoudo, with 10,000 inhabitants; Assula, with 6000 inhabitants; and Jenna, with from 8000 to 10,000 inhabitants.

Within the territories of the kingdom of Yarriba the Fellátahs have established some independent states, among which the towns of Racca, not far from Eyeo towards the north-east, and Alorie, south-west of the capital, are said to be very populous. These places have not been visited by Europeans.

*Borgoo*, which lies to the north of Yarriba, consists, so far as we know, of ten states, governed by independent kings, and loosely connected with one another. The most powerful is the sovereign of Niki, and he is styled, by way of distinction, king or sultan of Borgoo. His country has never been visited by Europeans. Only the countries of the kings of Wawa, Kiáma, and Boosa are partly known, having been visited by Clapperton and the Landers. These countries are inferior in population and cultivation to Yarriba, and there occur tracts of considerable extent which are without cultivation. The capitals have the names of the countries

Kiáma is built on the southern side of a rocky ridge, and surrounded by an extensive low clay wall; it is a commercial town, with 30,000 inhabitants. The houses consist of circular huts, built of clay and thatched; a number of these houses enclosed in a square fence of matting generally form but one house. Inside the walls are plantations of corn and yams. Wawa, or Wowow, is a very neat and compact built town, in the form of a square, and may contain from 18,000 to 20,000 inhabitants; it is surrounded by a good high clay wall and dry ditch. The streets are wide and airy, and the houses as in Kiáma. The town of Boossa is built on the banks of the western arm of the Quorra, which at this place divides into three branches, and it contains from 10,000 to 12,000 inhabitants. The houses are built in clusters inside the wall, and do not occupy above one-tenth of the ground enclosed.

Two caravan roads traverse this region, and are much frequented by merchants from Haussa and other countries of Central Africa. The most northern passes through Kiáma, and the southern through Bohoo and Kooso. These two roads lead to Gonja, a country lying west-north-west, either within the range of the Kong Mountains or along their northern base. In this country alone the colat or gora nuts are found, which are carried by the caravans all over Soodan, as far north as Timbuctoo, and as far east as the Lake Tchad, whence a small quantity finds its way to Tripoli. This important article is exchanged for elephants' teeth, trona, rock-salt, and cotton-cloths made in Soodan, which are brought from the eastern countries. The frequent fairs and market-days, which are regularly held in all the larger towns, show the degree of civilization which this country has attained. All articles grown or manufactured in the country and in places situated at a great distance farther east, are exposed for sale, and generally in considerable quantities. European articles are chiefly obtained from Dahomey and the European settlements east of the river Volta or Adiri.

II. The southern part of the *Plain of Western Soodan* presents a remarkable instance of people living in society and having attained a certain degree of civilization without entering into a closer political union. Towards the west, near the boundary of Soolima in Sierra Leone, and of Foota Jallon in Senegambia, there are indeed some small states, among which we know Sangara, Amana, Kankan, and Wassoolo; but east of 7° W. long., each town and village, according to Caillié, is independent of the neighbouring towns and villages, and what renders this circumstance more remarkable, each place is inhabited by a mixture of Mandingoes, who are Mohammedans, and of Bambarras, most of whom are pagans. Still they live peaceably together, and the elders of each nation decide the differences arising among the people belonging to their nation. The Mandingoes however have acquired some ascendency by their wealth and greater civilization, but their pre-eminence is nowhere supported by law or political establishments. In this region no large towns are met with; some of them, which are situated on the caravan roads, contain a population of from 5000 to 7000 inhabitants, as Kankan, Tangrera, Toomaneh, and Doonsso. Kayaye is said to be a larger place, but it has not been visited by Europeans. The commerce of this country is not considerable, and consists almost exclusively in the transport of the colat-nuts from Gonja to the countries on the banks of the Joliba, where salt is the principal article taken in exchange. No beasts of burden are usually employed in this trade, but the merchandise is transported by the merchants and their slaves on their heads.

On the banks of the Joliba several kingdoms occur. That of Booreh comprises the greater part of the country between 9° and 7° W. long. on both sides of the river. It is entirely inhabited by Mandingoes, according to the information of the natives, and the mountains which divide it from Senegambia are very rich in gold, of which a considerable quantity is annually got, which partly goes to the European settlements on the western coast, and is partly carried down the Joliba to Yamina, Sego, Sansanding, Jenneh, and Timbuctoo, whence some of it finds its way to the countries situated on the shores of the Mediterranean. The town of Booreh is said to be of considerable extent, but it has never been visited by Europeans.

East of Booreh is the kingdom of Bambarra [Bambarra], in which several towns of considerable extent are situated on the banks of the Joliba: Bammakoo, a town from which the gold obtained from Booreh is sent downward; Marraboo and Koolikorro, two places of some extent, which trade extensively in salt; Baba; Yamina, a place of considerable trade; Sai; Sego [Sego]; Sansanding [Sansanding], and Silla.

East of Bambarra is the kingdom of Jenneh, which comprehends the country on both sides of the river where it makes its great bend, after which it flows northward. This country seems to extend to the vicinity of 15° N. lat. It has obtained its name from Jenneh the principal commercial town, but the capital and residence of the sultan is called Ellam doo Lillahi ('to the praise of God'), which has never been visited by Europeans, and where there are said to be public schools in which children are taught gratuitously, and also schools for adults. The town of Jenneh is about six miles from the banks of the Joliba, but the whole country between the town and the river is cut up by numerous watercourses, so that river vessels of 80 or 100 tons of burden can come up to the town in the rainy season, and smaller vessels all the year round. This place is about two miles and a half in circumference, and surrounded by a wall ten feet high and fourteen inches thick, and the houses are built of sun-dried bricks. The population may amount to 10,000 individuals, all of whom are occupied in commerce, Mandingoes, Foulahs, Bambarras, and Moors. The sultan is a Foulah. The principal merchants are the Moors. They send great quantities of ivory, gold, rice, millet, honey, bees'-wax, cured provisions, and onions, and also tamarinds, pimento, long pepper, leaves and fruits of the baobab, pistachia nuts, beans, and colat-nuts to Timbuctoo. Great numbers of wax candles are made in Jenneh, and sent to Timbuctoo.

North of the kingdom of Jenneh is Masina, on the left side of the Joliba, and Banan on the right; they extend to the lake Debo. [Quorra.] These countries are unknown, except the tract along the banks of the river, which is alluvial. North of the lake Debo, and on the east of the river, is an extensive country, called Dirimans, whose capital is said to be Alcodia. This country apparently extends to the vicinity of Timbuctoo, with which place our knowledge of this part of Soodan terminates. [Timbuctoo.]

In the north western corner of Soodan, and contiguous to the boundary of Senegambia, are the two kingdoms of Kaarta and Ludamar. Kaarta lies partly within the mountain-range which constitutes the boundary between Senegambia and Soodan; and Kassan, which formerly was an independent kingdom, but has been conquered and united to Kaarta, is properly within Senegambia. Kaarta contains several very fertile plains and valleys. The capital is Kemmo, which was visited by Mungo Park, but he says nothing respecting this place. Gray visited the large towns of Asamangatary and Somantari. The walls of the first-named place are higher, stronger, and better constructed than those of any other town in these parts of Africa, and the town is an extensive plain, noted for the quantity of earthenware which is there manufactured, and its great fertility in rice and onions. The kingdom of Ludamar borders on the Sahara, and consists of a succession of fertile and cultivated tracts and sandy deserts. The capital, Yarra, is of considerable extent, and the houses are built of stone cemented with clay. Other large places are Deena and Sampaka, which lie farther east than Yarra.

That large tract of Soodan which extends along the southern border of the Sahara, between Ludamar and Timbuctoo, has not been visited by Europeans. According to the information which was obtained from the native merchants, the greater part of it belongs to the kingdom of Boroo, which appears to resemble Ludamar in productive powers, but is separated from the neighbouring states by sandy deserts. Its capital, Wallet, is said to be as large as Timbuctoo, and to carry on a very extensive trade in salt, which is brought from the great rock-salt mines of Shingarin [Sahara], and sent to Sansanding, Sego, and Yamina, in Bambarra, where it is exchanged for corn and provisions.

III. The greater part of the hilly region of Central Soodan constituted at the beginning of the present century an integral part of the kingdom of Haussa, or was subject or tributary to it. This kingdom was either founded by Danfodio, or he raised a small state to a decided eminence in Central Africa by continual wars, which were always attended with success, subjecting or annexing to it several large and populous countries, inhabited by negroes, and governed by kings of that nation. But after his death most of these countries rose against his successor Bello, and though in the beginning Bello was rather successful, it seems that several of those countries have recovered their independence; but our information on this point is very incomplete. The most populous districts are those which lie along the course of the Quorra, and the northern districts, between 11° and 13° 30′ N. lat. Those which are at a great distance from the river, or farther to the south, appear to be much less cultivated and less populous.

Along the banks of the river Quorra, from north to south, are Yáoori, Nyfi, and Funda. The capital of Yaoori bears the same name. It is a place of great extent, and very populous. The wall is high and excellent, though made of clay alone, and may be between 20 and 30 miles in circuit. The space enclosed is not laid out in streets, but covered with clusters of huts, between which are cultivated tracts. In this place very neat saddles, country cloth, and gunpowder are manufactured. Where the countries of Yáoori and Nyfi join one another, is the basin of the river May-yarrow, which is extremely fertile and thickly inhabited. Several large towns are found here: Tabra, on both sides of the river, about 30 miles above its mouth, with from 18,000 to 20,000 inhabitants; Koolfu, on the northern banks of the river, a central point of inland trade, with from 12,000 to 15,000 inhabitants; Rajadawa, with from 6000 to 7000 inhabitants; Womba, with from 10,000 to 12,000 inhabitants; and Guari, a large and well fortified place, the seat of a negro chief, who has made himself independent of Háussa. The capital of Nyfi is Nyfi, a town known over all Western Africa for the excellent cotton cloth which is made there. It has not been visited by Europeans. In Nyfi is the town of Rabba, built on the banks of the Quorra, on a gentle slope. It is the emporium of all the surrounding countries to a great distance, and several articles are brought to this place from Tripoli on the Mediterranean. It contains a population exceeding 40,000, and has rather extensive manufactures of saddles and bridles, made of red and yellow leather, cloth, shoes, boots, and sandals. Opposite the town, and near the western banks of the Quorra, lies the island of Zagózhi, which is 15 miles long and three in breadth, and though low and partly inundated in the rainy season, it is covered with clusters of huts, which, taken together, constitute a populous town. The inhabitants are partly sailors and fishermen, and partly employed in the manufacture of country cloth, which is of excellent quality. They make also a variety of caps of cotton interwoven with silk, of the most excellent workmanship; and also wooden bowls and dishes, mats of various patterns, shoes, sandals, cotton dresses and caps, brass and iron stirrups, bits for bridles, hoes, chains, saddles, and horse accoutrements for the Rabba market. Funda, the capital of the kingdom of the same name, is situated some miles from the banks of the river Shary; it contains about 30,000 inhabitants, and has some manufactures of cotton-cloth.

In the central districts of this region we are only acquainted with the countries of Zegzeg, Kano, Kashna, and Haussa Proper. Zegzeg apparently extends between 8° and 11° E. long. and 9° and 12° N. lat. In this country Richard Lander visited, among other smaller places, the towns of Kuttup, Eggebee, and Zaria or Zegzeg. Kuttup, the most southern (near 9° 40′ N. lat.), consists of nearly 500 small villages, almost adjoining each other, which occupy nearly the whole of a vast and beautiful plain, and in which a considerable traffic is carried on in slaves and bullocks. Eggebee (near 9° E. long. and 10° 50′ N. lat.) is a very large and extremely neat town, surrounded with a high wall, and situated in the centre of a fine and highly cultivated plain. Zaria or Zegzeg, the capital of this country, is enclosed by good walls, and contains a population of between 40,000 and 50,000 individuals, but a large portion of the area is occupied by swamps, corn-fields, and green plots. Rice of the finest quality is raised in the neighbourhood, and sent to distant countries.

North of Zegzeg is Kano. Among the most remarkable places is Baebaegie (11° 34′ N. lat. and 9° 13′ E. long.), which is built in the midst of a large plain, and contains about 20,000 or 25,000 inhabitants, who are all engaged in trade. East of it is the town of Girkwa, a large place, and north-west of Girkwa is Kano, the capital of the country, and, as it appears, the most commercial town of Central Africa. It may contain from 30,000 to 40,000 resident inhabitants, of whom more than one-half are slaves. During the dry months this place is resorted to by numerous travellers from all parts of Africa, from the Mediterranean and the Mountains of the Moon, and from Sennaar and Ashantee. The city is of an irregular oval shape, about 15 miles in circumference, and surrounded by a clay wall thirty feet high, with a dry ditch in the inside, and another on the outside. Not more than one-fourth of the ground within the walls is occupied by houses. The vacant space is laid out in fields and gardens. A large morass nearly intersects the city from east to west, and is crossed by a neck of land on which the market is held. The houses are built of clay, and are mostly of a square form, in the Moorish fashion. They have generally two floors. Clapperton observes that the commercial intercourse is regulated with the greatest fairness, and the regulations are strictly and impartially enforced. If a tobe (cotton dress) purchased at Kano is carried to a distant place without being opened, and is there discovered to be of inferior quality, it is immediately sent back as a matter of course, the name of the *dylala*, or broker, being written inside every parcel. In this case the *dylala* must find out the seller, who, by the laws of Kano, is forthwith obliged to refund the purchase money. This traveller was solicited by some merchants of Ghadamis settled at Kano to takes supplies of goods or money to any amount for a bill on the British Tripolitan consul. Nearly every day during the dry season caravans arrive from all parts of Northern Africa, and sometimes they consist of 3000 camels. Kano is not only a commercial, but also a manufacturing town; and the division of labour is carried to a considerable extent. Cotton, before it is fit to be consumed, passes through five or six hands. The weaver, the dyer, and the cloth-glazier are separate persons, and carry on their business in separate establishments. Tanning is executed with considerable skill, and ingenuity is shown in the manufacture of leathern jars, which are used to hold fat, melted butter, honey, and bees'-wax. Within the walls of the city is a separate district or village for blind people, who are maintained at the expense of the government.

In the country of Kashna are the large towns of Jaza, Ratah, and Kutri, but the largest is the capital, also called Kashna, which is still a commercial town of the first rank, though it has lost some part of its business by the rise of Kano. The walls are of clay, but the houses do not occupy one-tenth of the space within them. The commerce of this place is now limited to its intercourse with Ghadamis, Tuat, and the Tuaricks. From the first two places unwrought silk, cotton and woollen cloth, beads, and a little cochineal are imported, and in return are taken the blue cotton-cloths manufactured in the country, especially tobes and turkadoes. The Tuaricks bring salt, and buy several kinds of provisions, especially corn and dried beef. The principal manufactures are of leather, such as tanned bullocks' hides, water-skins, red and yellow cushions, and bridles of goat skin.

In Haussa Proper, which lies west of Kashna, is the large town of Zirmie, and the capital, Sackatoo, or Sockatoo, which is built on the banks of the river Zirmie, which runs south-west, and is said to join the Quorra. Sackatoo was built about the year 1805, by Danfodio, the Fellátah conqueror. Clapperton considers it the most populous town in the interior of Africa. The houses are not thinly scattered, as in other towns, but laid out in regular well-built streets, and come close up to the walls. The walls are between 20 and 30 feet high, and have twelve gates, which are regularly closed at sun-set. The inhabitants are principally Fellátahs, and possess numerous slaves, of whom a considerable number are employed in manufacturing cotton-stuffs, and in tanning and iron-work. The slaves from Nyfi are numerous, of whom the men are considered the most expert weavers and the women the best spinners in Soodan. The commerce of Sockatoo is much less important than that of Kashna. The exports are principally civet and blue-check tobes, and the imports gora-nuts, coarse calico, and woollen-cloth, with brass and pewter dishes, and some few spices from Nyfi. The Arabs from Tripoli and Ghadamis bring unwrought silk, otto of roses, spices, and beads, and take in return principally slaves. The Tuaricks take Guinea corn in exchange for their salt.

IV. Nearly the whole of the *alluvial plain of Central Soodan* constitutes the kingdom of Bornou, or may be considered as an appendage of it. [BORNOU.] It contains many towns, some of which are very populous. The capital, Kouka, is only a few miles distant from the banks of Lake Tchad. It is the residence of the sheik, and may have a population exceeding 10,000. The walls are well built of clay, and the whole space enclosed by them is occupied with houses, but the extensive market in the centre and some other open places take up about one-fourth of the area. Angornou, the largest and most populous place in Bornou, is likewise only a few miles from the Tchad. It contains above 30,000 inhabitants, but is a straggling place without walls. It is the principal commercial town of the country, where the caravans arriving from Fezzan or from Kano dispose of their goods. A few miles west of Angornu is New Birnie, the residence of the sultan, which contains about 10,000 inhabitants. Farther south are the towns of Dugoa, with 30,000 inhabitants, and Affagay, with 20,000. On the banks of the river Shary is Loggan, where much cotton-cloth is made and dyed. On the banks of the river Yeou are several towns of middling size, as Kabshari, which had been destroyed by their neighbours, when Denham was there; Kukabonee, with 6000 inhabitants; Bedeekarfi, a large and populous town; and Katagum, with from 7000 to 8000 inhabitants. Burwha, north of the mouth of the river Yeou, and not far from Lake Tchad, is a well fortified place, with about 5000 inhabitants.

South of Bornou is the kingdom of Mandara, which comprehends the northern portion of the hilly region south of the alluvial plain of Central Soodan, and extends from 10° 30′ to 9° 30° N. lat.. Steep and rather high ridges enclose wide and open valleys, which are abundantly watered, and on this account, as well as the fertility of the soil, it is rich in natural productions, well cultivated, and densely peopled. The inhabitants are exclusively negroes, and are governed by a sovereign of their own race, who is independent both of the sheik of Bornou and the Fellátahs, who are in possession of the more elevated and mountainous country which lies farther south. These mountains have only been seen at a distance by Denham, and, according to information obtained from the natives, they are connected with still higher mountains, which appear to be the Jebel al Kamar or Kumri (the Mountains of the Moon) of the Arabian geographers. The valleys of Mandara contain some considerable towns. Delow contains at least 10,000 inhabitants, and Mora, the residence of the sultan, is a strongly fortified place, but of less extent.

Eastern Soodan extends from 17° to 25° E. long. We have no account of this extensive country from eye-witnesses, as no part of it has ever been visited by a European traveller, and the information collected from the natives of Africa, who have penetrated so far, is very scanty. According to them it is divided into three countries or states. Kanem is contiguous to the eastern banks of Lake Tchad, and south of it lies Begharmi. Between those two countries and Dar-Fur, which is considered as lying to the east, and without the boundary-line of Soodan, lies Dar-Zaleh, or Wadai, which seems to extend over the greater part of Eastern Soodan. A large river is said to traverse Wadai in a north-west direction, and to be lost in a large lake, called Fittreh, which lies east of and at a considerable distance from Lake Tchad.

As a comparatively small portion of Soodan has been seen by Europeans, it would be premature to give a decided opinion as to the relative importance of this part of Africa. But if we may judge from what we know of it, we must pronounce it superior to any other part in fertility, cultivation, and population, not excepting the countries situated along the Mediterranean or even Egypt. It must therefore be very satisfactory to every person interested in the extent of English commercial enterprise, that the government has taken decisive measures for gaining a firm footing for Englishmen in the most populous parts of Soodan, namely, those which are contiguous to the lower course of the Quorra. [QUORRA, vol. xix., p. 227.]

(Park's *Travels in Africa;* Caillié's *Travels through Central Africa to Timbuctoo*, &c.; Gray's and Dochard's *Travels in Western Africa;* Denham's, Clapperton's, and Oudney's *Narrative of Travels and Discoveries in Northern and Central Africa;* Clapperton's *Journal of a Second Expedition into the Interior of Africa;* Richard and John Lander's *Journal of an Expedition to explore the Course and Termination of the Niger;* Laird and Oldfield's *Narrative of an Expedition into the Interior of Africa*, &c.)

SOOFFEE DYNASTY. [PERSIA—*History*.]

SOOLIMA'S, a people of Western Africa, who take their name from, or, it may be, give their name to, their proper country of Soolimana. This country is situated among the sources of the rivers which enter the sea at and immediately to the north of Sierra Leone. This territory extends between 9° 20′ and 10° 28′ W. long., and mostly south of the 10th parallel of N. lat., being about sixty miles in breadth from north to south, and reaching from the present site of Falaba to the left bank of the Joliba or Niger. This is the native country of the Soolimas; but they now chiefly occupy a strip of land in the adjoining Kooranko territory, which is bounded on the south by the river Rokelle, on the north by Foota Jallon, on the west by Limba and Tamisso, and on the east by Kooranko Proper and Soolimana, which latter is now used merely as a farming-ground, and only as a temporary residence.

The Soolima country is exceedingly picturesque, being diversified with hills, extensive vales, and fertile meadows, belted with strips of wood, and decorated with clumps of trees of the densest foliage. The hills are composed of a light whitish granite, principally consisting of mica and felspar, with occasional strata of blue mica-slate imbedded in the granite. The valleys have a rich vegetable and mineral soil mixed with sand. This soil is remarkable for its fertility, and requires very little labour to prepare it for the seed. In its cultivation, a hoe, shaped like a carpenter's adze, supplies the place both of the plough and the harrow. After sowing, which is generally before the 15th of June, the Soolima leaves his farm in Soolimana, until October, to the care of his wives, who clear the crop of weeds in the early stages of its growth. In October the husband returns from Kooranko, and both sexes labour together in getting in the harvest. Rice is the chief object of culture. Yams and ground-nuts, bananas, pineapples, and oranges are the principal fruits, but the first only in any degree of perfection. The Soolimas have numerous herds of cattle; and they also rear sheep, goats, and poultry, the last of a very diminutive sort. Horses are few, and not reared in the country. The wild animals are numerous, principally elephants, buffaloes, a species of antelope, monkeys, leopards, and wolves.

All the principal towns of the Soolimas are in Kooranko. These are Falaba, the capital, Sangouia, Semba, Mousaiah, and Konkodoogore, containing in all about 25,000 souls, of which Falaba has about 6000. This town, which appears to have been built in 1768, is a favourable specimen of the first-class native towns of Western Africa. It derives its name from the Fala-Ba, or river Fala, on which it stands, and is nearly a mile and a half long by a mile in breadth although closely built for an African town. The town is fortified, impregnably according to the African system of warfare, by being surrounded by a thick stockading of hard wood, and by a ditch 20 feet deep by as many broad. The town is of an oblong shape, containing about 4000 circular houses or huts, which, though built of clay, and covered with conical roofs of thatch, are extremely neat, clean, and in many cases elegant. The palaver or court house stands on an open piece of ground towards the south end of the town, and is a place of recreation as well as business. In the centre of the town, a large open piece of ground is left vacant for the purposes of exercise, of receiving strangers, and of holding grand palavers. Here, on such occasions, the king sits on the root of a large tree for his throne, the branches serving as his canopy, as simple in his appearance as the meanest of his subjects.

In Major Laing's time (1822), the king and some of the elders were Moslems, while the younger part of the community were pagans; but it is more than probable that in the steady progress which Islam has since been making in this quarter of Africa, it has by this time acquired the predominance among the Soolimas.

The Soolimas are short and muscular: their stature averages from five feet six inches to five feet eight inches. They are thus well formed for the warlike enterprises to which they are much addicted. In battle they use the spear, musket, sling, and bow:—the first more for ornament than use; the second more for noise than effect; but in the use and management of the two latter they are most expert. Warlike songs and exercises figure largely in all their public rites and amusements. Where their predatory habits do not interfere, their dispositions are mild and inoffensive, and they exercise the most open hospitality to the strangers who visit them as traders.

The king monopolises the whole trade of the country, and no barter takes place without his knowledge and actual presence. The trade is chiefly with the Sangaras on the one side, and with the Mandingoes on the other. The former bring horses and gold, for which they receive a share of the goods—cloth, powder, flints, beads, &c.—brought from the coast by the Mandingoes, who, in their turn, receive slaves and other spoils of war, with a little ivory.

Men and women seem to have exchanged occupations among the Soolimas. Except sowing and reaping, the principal cares of husbandry are left to the females, while the men look after the dairy and milk the cows. The women build houses, plaster walls, act as barbers and surgeons, while the men employ themselves in sewing, and often in washing clothes. The dress of both sexes is very similar to that of the Mandingoes. Indeed the dress among the pagan nations of Western Africa differs little. There is another dress, essentially Arabian, which spreads together with the Mohammedan faith. This dress was affected by the Soolimas before their great contest with the Foulahs in the early part of this century, since which it has been the fashion to make themselves as different as possible from their enemies, in dress as well as in religion.

Among the Soolimas murder is the only crime punished with death; for all other crimes, fines, stripes, or slavery are the punishments. Death is inflicted by strangling; but there is a reluctance to inflict it, unless for a peculiarly atrocious murder, and there is a disposition to lay hold of any mitigating circumstances. The mode of trial appears to be very fair, not unlike our trial by jury; and the desire to decide justly is strongly manifested in the sentences.

The general customs of the Soolimas do not differ materially from those of other nations in this part of Africa; and therefore need not be particularly described. Major Laing thinks them peculiarly open to the operations of the missionary and the civilizer.

(Laing's *Travels in Western Africa*, London, 1825.)

SOOLOO ARCHIPELAGO, which is called by the Spaniards Archipelago de Felicia, consists of a considerable number of islands, situated in the Indian Ocean, between the Philippines on the north-east and the island of Borneo on the south-west. They consist of two chains of islands, which lie nearly parallel in a south-western and north-eastern direction, and, together with Borneo and the Philippines, enclose a portion of the ocean which is usually called the Sooloo Sea, and also the Mindoro Sea, the latter name being derived from that of one of the Philippines which lies at its northern extremity. The southern chain of islands, which is properly called the Sooloo Islands, begins on the west opposite to the peninsula of Unsang in Borneo, near 119° 30′ E. long. and 5° N. lat., and extends east-north-east to 122° 30′ E. long. and 6° 50′ N. lat., where it is separated from the south-western part of the island of Magindano by the Straits of Basilan. The northern chain, which is called the Palawan Islands, begins on the south near 7° N. lat. and 116° 30′ E. long., opposite Cape Pirate's Point or Sampanmangio in Borneo; and its southern portion, which is on both sides of the Straits of Balabac, lies nearly south and north, but the remainder lies south-west and north-east. It terminates with the island of Busvagon on the Straits of Mindoro, near 12° 20′ N. lat. and 120° 30′ E. long. Large vessels enter and leave the Sooloo Sea by the Straits of Basilan, Balabac, and Mindoro; that branch of the last-mentioned straits which is on the west of the Bajo de Apo is called Northumberland Strait.

Though there are volcanoes in the islands which lie east and south east of the Sooloo Archipelago, as in the Philippines and Moluccas, it does not appear that any of the numerous islands that compose these groups is of volcanic origin. The larger islands of the chain are of moderate height, but the mountains on the island of Palawan attain a considerable elevation. Some of them are covered to the very summits with lofty trees, and others with rich pasturage, here and there intersected by cultivated grounds, whilst others again exhibit cultivation to the highest point, and are only chequered with groves of fruit-trees. Along the foot of the hills there are level grounds two or three miles wide, which are partly swampy, but mostly cultivated or planted with fruit-trees.

The wet season occurs from May to September, during the prevalence of the south-western monsoon, and the dry season lasts from October to April. But neither of these seasons has that invariable character by which they are distinguished in Hindustan; for showers frequently occur during the dry season, and the rains of the other season are much more interrupted and irregular than in Hindustan. The monsoons themselves are very irregular. In April and May the winds are light and variable, but rather inclining to the south-west; they are often interrupted by calms. In June and July strong gales from the west prevail, and often blow for many days. In August and September southerly winds blow, and sometimes in very hard gales. In October and November the winds are again light and variable, inclining to the north-east. In the following two months it blows in hard gales from the north, but in February and March the variable winds return. The heat is considerable, but not oppressive, being mostly tempered by the land and sea breezes. In summer it varies between 76° and 87°. The thermometer however falls to 75° only early in the mornings. The interior mountainous districts have a much lower temperature.

The soil of the country is generally rich, and the crops are abundant. But though agriculture is not so neglected as in many other islands of the Indian Archipelago, the produce of the rice, of which eight species are cultivated, is not sufficient for the consumption of the inhabitants, partly because the population is comparatively very great, and partly because the rains frequently fail, and consequently the crops of rice also. Rice constitutes one of the most important articles of importation, and it is brought from the Philippine Islands, especially from Panay and Magindano, and from the eastern coast of Borneo, which is subject to the sultan of Sooloo. Many roots however are cultivated with the best success, as two kinds of yams, sweet potatoes, and the Chinese potato, with many others which are peculiar to the Indian Archipelago. Wheat is cultivated in several districts, but not on a large scale. Their gardens produce pumpkins, cucumbers, radishes, and a great number of plants peculiar to the country. Their fruit-trees are well attended to. From their intercourse with the Chinese, many of whom have settled here, the inhabitants have learned the art of ingrafting and improving their fruit, which is extremely plentiful and of a delicious flavour. The mangoes are small, but sweet and luscious; the oranges are equal to those of China; the mangustan, durian, jack, champaka, and all the varieties of the plaintain kind are equal to those cultivated in Java, and the dukoo is thought to be superior. A great number of other fruits are cultivated, which are unknown in Europe, except the pine-apple and the cocoa-nut. The sago-trees are numerous, and part of the produce is exported to China. Pepper was formerly cultivated with success, but this branch of agriculture has been discontinued in modern times for want of demand; only a little is grown for home consumption, and some parcels occasionally sent to China. The cinnamon is particularly fine, not so pungent as that from Ceylon, but it differs essentially from the *Laurus cassia*. The cacao-tree is not mentioned by Forrest (1775), who found only a few of them on Magindano; but Hunt, who was in the Sooloo Archipelago in 1814, says that it grows all over the island of Sooloo, and that it is used for the common beverage of all classes. The Spaniards generally export from 100 to 200 peculs (1 pecul = 133 lbs.) to Manilla, where it is much esteemed. Indigo equal to that of Manilla is manufactured to some extent, but consumed in Sooloo. Very good cotton is grown in various parts, but not exported; tobacco also is grown. The plant from which the Manilla white rope is made and the gamuty are plentiful, and also a species of hemp and flax, of which the inhabitants manufacture their fishing-lines. Turmeric and ginger grow to perfection.

The woods, with which a large part of the surface of the islands is covered, supply many articles for domestic use and exportation. Timber-trees of the best quality and of the largest dimensions may be got in any quantity. The teak-tree flourishes in great luxuriance, and is abundant in nearly all the higher islands. The mahogany is equal to that of Honduras; and the black wood or ebony, to that of Luzon; masts and slabs of these woods are exported to China. Many of the useful trees which grow in this archipelago are not yet known to botanists. The camphor barus collected in these woods is not inferior to that of Sumatra, and sells well in Japan and China. Sapan-wood, red-wood, and various dyeing-woods are exported to Amoy in China. The sandal-wood, and the clove and nutmeg trees are said to exist here, and the bread-fruit and laka trees are abundant.

Buffaloes are not numerous; but Sooloo black cattle abound, and they are used as beasts of burden, and even for the saddle. The horses are of good breed and hardy. Hogs are not rare, though the inhabitants, being Mohammedans do not eat them: they are consumed by the Chinese. Wild hogs are abundant. There are goats, some with skins spotted like leopards, and some beautiful small antelopes. The Sooloo Islands are the most eastern country in which the elephant is found. The elephant was introduced from Borneo, but it is no longer used for religious purposes, since the Islam has spread among the inhabitants. The breed of elephants is now kept up only in one place; but there are still wild elephants in the more extensive forests, and as they damage the crops, there is a grand hunt of them every year. The swallow which makes the edible bird's-nest is common in most of the islands.

The seas are abundantly stocked with fish. Hunt enumerates thirteen species which are found in Europe or the West Indies, and forty-one which are peculiar to these seas. The most important productions of the sea, as yielding articles of commerce, are the sea-slugs, which under the name of *tripang* are sent to China, and the prawns and shrimps, which, after being pounded in a mortar into a soft mass, are an important article of commerce all over the Indian Archipelago and the countries beyond the Ganges, under the name of *blachang*. Sea-weed, collected from the rocks that surround the islands, is exported to China. There are several places in which excellent pearls are found; the pearls go to China.

A little gold has been found. Common salt is not used, but a salt made from burnt sea-weed is in general use.

The Sooloo chain consists of three groups, those of Basilan on the east, Sooloo in the middle, and Tawi-Tawi on the west. The first-mentioned group is composed of the large island of Basilan and several smaller ones. Basilan is about 45 miles long, and the average width may be 12 miles; the surface is therefore 540 square miles, or somewhat more than Monmouthshire. The centre is hilly, but the sea-coast low and woody. It is very fertile, and sends much rice to Sooloo. It exports besides birds'-nests, tepoy or mother-of-pearl shell, some tortoise shell, and a few pearls; cowries are abundant. The principal ports are Maloza on the south west side and Gubawang on the north east coast.

The Sooloo group consists of the larger island of that name and of several small islands. Sooloo is about 40 miles long and 10 wide on an average. The area is about 400 square miles. The surface presents two hilly tracts, separated by a low and level plain. It is very populous. Forrest estimated the population at 60,000, but Hunt states it to be 200,000, or 500 to each square mile. There are many small towns on the coast. The largest is Sooloo, or Soog, near the western extremity of the island, with a permanent population of 6800 souls, among whom are 800 Chinese. More than half of the inhabitants are always engaged in trading voyages, in the pearl and tripang fisheries, and the collecting of birds'-nests. On the north coast is Bokol, with 6000 inhabitants, and on the south coast Parang, with 8000. It exports all the products which have been mentioned as articles of export. The larger of the other islands belonging to this group are Pargutaran, Tapul, and Sihasi, lying north-west and west of Sooloo.

Tawi-Tawi is about 40 miles long and 12 wide. The surface may amount to 400 square miles. In the centre are some hills of considerable elevation, and two lakes of some extent. One of the lakes, called Dungon, is united to the sea by a channel which is from five to seven fathoms deep, but has a bar, on which there are only 1¾ fathoms at low-water, and about four at spring-tides. The lake itself is about eight fathoms deep and is fresh at low water. It is an excellent harbour for vessels which can pass the bar. The island is thinly inhabited. It exports tepoy, white and black tripang, white and black birds' nests, and many valuable pearls, but does not produce rice enough for the consumption. The principal town is Dungon, on the banks of the lake. The chain of small islands which extends along the southern coast of Tawi-Tawi consists of low islands, with numerous shoals between them. The channels that divide them are from six to eight fathoms deep, but they are extremely intricate, and so narrow that the Chinese junks in some places require to be pushed on with poles. The most valuable pearl fishery is in those straits, which are accessible at all seasons, and fish is very plentiful and of large size. North of Tawi-Tawi is the Tahaw Bank, which consists of coral rocks covered with a layer of sand, and is in some places overgrown with shrubs and trees. It has no fresh water, but the pearl fishery is very valuable.

Between the north-eastern extremity of Borneo and the large island of Palawan are several smaller islands, and the three islands of Banquey, Balambangan, and Balabac, which are of some extent. They are thinly inhabited, and overrun with jungle and timber trees. They produce chiefly wax, tripang, and tortoises. Balambangan, together with the north-eastern part of Borneo, was ceded to the British by the sultan of Sooloo, and a settlement was established there in 1763. But the British were expelled in 1774 by the Sooloos, who, finding the garrison weak and sickly, and off their guard, murdered them and set fire to the settlement. In 1803 the settlement was re-established, but again abandoned in the following year, on account of the expense of maintaining it.

The large island of Palawan, or Palwan, is more than 275 miles long, and on an average 32 miles wide. The area is therefore about 8700 square miles, which exceeds that of Wales by 600 square miles. A continuous range of hills runs along the west side of the island. But along the eastern shores a low and generally level country extends from 10 to 20 miles inland. The northern portion of the island is subject to the Spaniards, and called Paragua. It forms a part of the province of Calamianes, one of the political divisions of the Philippines, and contained in 1818 a population of 11,097, among which there was only one Spaniard and 28 Spanish creoles. In this census some adjacent islands were included. The low country south of 10° 20′ N. lat. is tolerably well peopled, and subject to the sultan of Sooloo, but the hilly and mountainous region is in possession of the aboriginal inhabitants, who resemble the Papuas, and are continually at war with the inhabitants of the plains. The productions of the low lands and the adjacent seas are canes, especially ratans, cowries, wax, tortoises, tripang, and gum copal, of which last forty or fifty peculs may be had yearly. Rice is also exported. The principal town is Babuyan, which is well fortified, and has a population of about 2000.

The islands north of Palawan, viz. Linacapan, the Calamianes, and Coron, form politically a portion of the Philippines, and are little known.

Besides the islands hitherto noticed, the sway of the sultan of Sooloo extends over a large portion of the north-eastern part of Borneo. This country, which was ceded to the English in 1763, extends from the river Kimanis, which enters the Chinese sea opposite the island of Pulo Tiga, not many miles east of the town of Borneo, to Cape Kaniongan, which forms on the west the entrance of the Straits of Macassar, comprehending a sea-coast probably exceeding 800 miles in length. It may seem strange that the sovereign of such comparatively small clusters of islands has been able to subject to his sway such extensive countries, and to preserve his dominions, but the peculiar constitution of his government and the want of powerful neighbours account for this apparently extraordinary fact.

The government of Sooloo resembles that which existed in the last century in Poland, and in the beginning of this century in the Mahratta dominions. Each chief or nobleman is sovereign in the country which belongs to him, and his authority depends on the number of his followers, or rather slaves, called ambas, who are his soldiers. The sultan is a mere cipher, and his orders are disputed by the meanest individual; he is unable to decide the most trivial points without the concurrence of his privy council called 'Ruma Bechara.' In 1814 this council was composed of eighteen members, the most wealthy and powerful of the chiefs, and most of them were relations of the king, and assumed the title of 'datu.' They hold their seat however not by hereditary title, but may be deprived of it by the sultan with the advice and consent of the Ruma Bechara. The sultan seems to derive all his revenues from his own estates, as no taxes are paid by the noblemen or their subjects, and the only revenue, consisting of the customs on goods imported, is shared in unequal proportions among the sultan and the members of the Ruma Bechara, according to their rank. The petty chiefs of the more remote islands and those on the coast of Borneo do not appear to have any share in the government, but they acknowledge the authority of the sultan, in order that they may be protected from the piracy of his subjects, or share the advantages arising from such predatory expeditions.

The Sooloos belong to the Malay race, and most of the chiefs speak the Malay language. But the indigenous language is the Bisayan, which is generally spread over the southern Philippines, also commonly called the Bisayas and contains a great number of words which are used in the language of Sumatra. Many of the chiefs speak the Spanish language, and some the Chinese fluently; the former they have learned from the Christian slaves, kidnapped by the pirates in the Bisayas, and the latter from the Chinese, who are settled all over the Sooloo possessions. The Sooloos have made considerable progress in civilization in the last two centuries. From their commercial intercourse with the Chinese and Spaniards they have learned the comforts of various articles of civilised life, and though their houses are small and mean, they are usually furnished with various objects of Chinese and some of European and Indian manufacture. Every rich man has a considerable number of Chinese chests with locks for holding his valuables, and many of them dress in silks and satins of all colours imported from China. The court-dress of the datus on solemn occasions is of the most splendid Chinese mandarin robe, made of costly silks and satins, embossed and filagreed with gold, and pink satin breeches decorated with gold dragons and splendidly embossed. The people are Mohammedans, but they know little of the tenets of their faith, and observe its religious rites still less, which is partly ascribed to the great number of Christian slaves annually imported by the pirate prows from the Philippines.

Besides the Christian slaves, there are two classes of men, the 'Bajows' (fishermen), also called 'Orang lant,' and the Lanuns or Illanos. The Bajows fish for the pearls, tripang, and sea-weed. They are very numerous in all the eastern islands of the Indian Archipelago, where a great number of them are continually fishing, shifting their places according to the prevalence of the moonsoons. In the Sooloo Islands they are stationary, and inhabit the small towns on the sea-shore. They speak the same language as the Sooloos, and are Mohammedans. Though free, they are much oppressed by the datus and other chiefs.

The Lanuns, or Illanos, are properly from the island of Magindano, the most southern of the Philippines, and, without exception, the greatest pirates on the globe. Their depredations are conducted in large fleets of small prows in the Straits of Macassar, among the Moluccas, but more particularly among the Bisayas. The whole produce of their enterprises is sold at Sooloo, which is their grand entrepôt. But they have many stations on most of the other islands. Hunt has enumerated twelve larger stations. They are intimately connected with the piratical establishments on the island of Magindano. They have obtained the protection of the sultan by giving to him and the Ruma Bechara 25 per cent. on all their captures; but they must respect the Sooloo flag, and commit no depredations on vessels actually at anchor in Soog roadstead. The chiefs advance them guns and powder, for which they are paid by a stipulated number of slaves.

The principal force of the sultan and chiefs consists of their personal slaves (*ambas* or *humbes*), who are Christians purchased from the pirate prows. They are very numerous all over the islands, and constitute the bulk of the population of the capital, Soog, but hundreds annually effect their escape to the Philippines or to the interior. The Chinese who are settled in these islands are for the most part engaged in traffic. They keep shops in the towns, or in the trading prows, and many of them carry on the pearl and tripang fisheries, or birds'-nesting, but as soon as they have scraped together a small competency, they retire to their native country. At Soog alone more than 800 of them are settled; but in all places they are much oppressed by the chiefs.

The manufacturing industry of the inhabitants is very limited; but a large number of prows is built. Certain cotton-cloths, called *sarongs* and *tanjam*, are of a very fine texture and tartan-striped; some of them are exported to the neighbouring islands. Sugar, indigo, saltpetre, and chocolate are only made for home consumption. There are cutlers who make *creeses* or daggers, and some goldsmiths who make jewellery.

The position of the island of Sooloo is very favourable for commerce, being situated between the Moluccas, Celebes, Borneo, the coasts of Cochin China, China, and the Philippines, and the trade would be very considerable if it were not continually interrupted by the pirates. At present it is limited to the produce of the country, which chiefly goes to China, being less adapted for other markets. It is carried on by the Chinese from the province of Fukian, and especially from the harbours of Amoy and Pactow. The Chinese junks always arrive from the middle of March to the middle of April. They are from one to five in number, and from 3000 to 7000 pekuls burden. They leave Sooloo by the 1st of August. Their cargoes consist of furniture, particularly of chests, brass utensils and wire, iron unwrought and iron pans, raw silk, nankeens, linen, a great quantity of porcelain and crockery, some piece-goods of flowered silk, cutlery, sugar-candy, tea, and some smaller articles. They take in return tepoy or pearl shells, cut betel-nuts, tripang, wax, sugar, agar-agar, or sea-weed, white and black birds'-nest, shark fins, camphor barus, tortoise shells, pearls, ebony, sapan-wood, clove-bark, cinnamon. cowries, pepper, and sago. Sometimes British vessels from Singapore visit the Sooloo Islands. Their cargo consists mostly of opium, cotton goods from the coast of Coromandel and from Bengal, with some others from Java, English chintzes, Swedish flat iron and steel, large spike nails for prow building, and some hardware. They receive in return the various products of the country, which they take to Canton, and thence return with a cargo of tea and other Chinese articles. The trading season in the town of Sooloo does not extend beyond August. After the departure of the junks, the fair, which up to that time is actively maintained at the port, is broken up, and the remaining produce is either sent to the port of Yloylo, in the island of Panay, or retained on hand for the next season. The people then disperse to Borneo and the other islands in search of articles of commerce for the next season.

(Forrest's *Voyage to New Guinea*; Moor's *Notices on the Indian Archipelago*, Singapore, 1837.)

SOOT is that portion of fuel which escapes combustion, and which is mechanically carried up and deposited in chimneys. The soot of coal and that of wood differ very materially in their composition; the former indeed does not appear to have been accurately analysed, but it evidently contains more carbonaceous matter than the latter. Coal-soot contains substances usually derived from animal matters; it contains sulphate and hydrochlorate of ammonia, and has been used for the preparation of the carbonate; to hot water it yields a brown bitter extract, and it contains an empyreumatic oil; but its great basis is charcoal in a state in which it is capable of being rendered soluble by the action of oxygen and moisture, and hence, combined with the action of the ammoniacal salts, it is used as a manure, and acts very powerfully as such. Sir H. Davy observes that for this purpose it is well fitted to be used in the dry state, thrown into the ground with the seed, and requires no preparation.

The soot of wood has been minutely analysed by Braconnot, who found it to consist of the following substances:—

| | |
|---|---|
| Ulmin (about) | 30·20 |
| Azotised matter | 20·00 |
| Carbonate of lime and traces of carbonate of magnesia | 14·66 |
| Water | 12·50 |
| Acetate of lime | 5·65 |
| Sulphate of lime | 5·00 |
| Acetate of potash | 4·10 |
| Carbonaceous matter insoluble in alkalis | 3·85 |
| Ferruginous phosphate of lime | 1·50 |
| Silica | 0·95 |
| Acetate of magnesia | 0·53 |
| Asbolin (a peculiar acrid and bitter principle) about | 0·50 |
| Chloride of potassium | 0·36 |
| Acetate of ammonia (about) | 0·20 |
| Acetate of iron (a trace) | — |
| | 100· |

Braconnot considers the ulmin as absolutely similar to that obtained artificially by the action of potash on wood-sawdust, but Berzelius is of a different opinion, and calls it *geine*. The azotised matter is very soluble in water, and insoluble in alcohol. As coal-soot contains much more carbonaceous matter than wood-soot, and also a much larger portion of ammoniacal salts, it must be more active as a manure, and altogether a more useful substance.

SOPHIA CHARLOTTE. [FREDERIC I. of Prussia.]

SOPHIA of RUSSIA. [PETER of Russia; RUSSIA—*History*.]

SOPHISM (Σόφισμα), that superficial and incomplete aspect of the truth, which at first sight looks like the truth, but on closer inspection turns out to contain some radical error. This seems the most correct definition, but the word is used loosely. Its general signification, viz. a *specious* proposition, is perhaps nearest the mark. Truly considered, most errors are sophisms, for errors are not direct contradictions to the truth, but simply the leaving out of view one or more elements of the truth, and seizing on only one or two elements, and declaring them to constitute the whole truth. Victor Cousin defines error to be 'One element of thought considered exclusively, and taken for the complete thought itself. Error is nothing but an incomplete truth converted into an absolute truth.' (*Introduction à l'Hist. de Philosophie*, Leçon 7.) Spinoza had before defined 'falsity to be that privation of truth which arises from inadequate ideas.' (*Ethica*, b. ii., prop. xxxv.) A selection of some of the celebrated sophisms of antient philosophers will best illustrate the meaning of the definition. The 'lying' sophism was this: if, when you speak the truth, you say you lie, you lie; but you say you lie, when you speak the truth, therefore in speaking the truth you lie. The 'occult' sophism: Do you know your father? Yes. Do you know this man who is veiled? No. Then you do not know your father, for it is your father who is veiled. The 'sorites:' Is one grain a heap? No. Two grains? No. Three grains? No. Go on adding one by one, and if one grain be not a heap, it will be impossible to say what number of grains make a heap. (Enfield, *Hist of Philos.*, i., p. 200.) In all of these we see that important omission, or confusion of ideas or names, constitutes the apparent contradiction. In the common example of—Bread being better than paradise; because bread is better than nothing, and nothing is better than paradise —the confusion arises from both the 'nothings' being used substantively; whereas it is only the first that is so used; the second is affirmative, and expresses 'there is nothing better.' A sophism is therefore the use of some word in a different sense in the premises from that in the conclusion, and this is the definition of Aristotle (*Top.*, viii. 11): 'When the discourse is a demonstration of anything, if it contains anything which has no relation to the conclusion, there will be no syllogism; and if there appears to be one, it will be a sophism, and not a demonstration.'

This confusion of words and ideas, though carried to a ridiculous excess in the above examples, is the origin of all errors and sophisms; but though errors and sophisms are logically constituted alike, yet the instinctive sense of mankind marks the difference between incomplete views (error) and wilful perversion (sophism). In all cases a sophism is supposed to be recognised as such by the sophist. It is an endeavour on his part to 'make the worse appear the better reason.' It is the consciousness then of the sophist which distinguishes and renders odious his error as a sophism.

SOPHIST (Σοφιστής). 'It is well known,' says Dr. Wiggers, 'that the word σοφιστής at first had an honourable meaning, and was synonymous with σοφός, a sage, a scholar in its widest sense, for even artists were comprehended in it. Protagoras was the first who adopted the name of σοφιστής, to distinguish more decidedly one who makes others wise, especially one who taught eloquence, the art of governing, politics, or, in short, any kind of practical knowledge. From that time the word sophist acquired that odious meaning which it retains at the present day. Afterwards, in the time of the Roman emperors, the name of sophist again became an honourable appellation, and was applied to the rhetoricians.' (*Life of Socrates*, p. xiii., trans.)

The race of Sophists, whose enmity to Socrates, their great opponent, has perhaps been the principal cause of their celebrity, was not without influence on the philosophy and literature of Greece. They were a class of men who went about Greece discoursing and debating, and sometimes educating the youthful sons of rich and noble families. The cause of their success lay in the very nature and habits of the Greek people, who were so much addicted to talk and so little to study—who were so passionately fond of and so easily led by rhetoric. And the easy triumph which a fluent talker can always attain by a rapid and artful confusion of words and ideas, must also have operated in their favour. The period at which the Sophists flourished was one of obsolete creeds—one lifeless from the want of some vivifying faith. Religion was attacked by open scepticism; the whole sect of the Eleatæ, with the exception of Empedocles, appear to have handled the history of the gods with arbitrary and allegorising boldness. Even the pious Pythagorean adopted the old religion merely in a peculiar sense of his own; Heraclitus argued against its probability; Anaxagoras understood it allegorically; and lastly, Hippo was regarded as an open and avowed atheist. Euripides, Protagoras, Diogenes, Prodicus, and Critias, all denied the existence of the gods. (Ritter, *Geschichte der Philosophie*, vol. i.) Everything human and divine had lost its earnest nature, and came to be regarded as an art—an exercise of ingenuity. The art of the Sophists was oratory. Assuming that there was nothing right in its nature, but only by position (τὸ δίκαιον καὶ τὸ αἰσχρὸν οὐ φύσει, ἀλλὰ νόμῳ. Plato, *Gorg.*, p. 482), it was their boast that they could make the worse appear the better cause. (Aristotle, *Rhet.*, ii. 24.) Their doctrines closely resemble those of the Sceptics, since they equally denied the possibility of truth, and even interdicted inquiry into it; but the distinction between these sects consists in the Sophists' not masking their arrogance under doubt, but boldly and distinctly averring that there was no truth at all, and seeking to communicate this wisdom to others, to save them the trouble of investigation.

The doctrine of Protagoras tends to deny the possibility of anything objective being represented by thought, and by making human thought the standard of all truth (πάντων χρημάτων μέτρον ἄνθρωπος, Plato, *Craty.*, 385), and affirming that each manner of viewing things has its contrary, so that there is as much truth on one side as on the other, it is deduced as a consequence that the end of philosophy is persuasion; and oratory being the art of persuasion, it was to that which they directed their greatest attention. (Plato, *Theætetus.*) Ritter however observes that 'Plato, it is certain, attributed much to Protagoras that did not actually belong to him.' (*Geschichte der Phil.*, vol. i.)

But Protagoras, however sophistical his doctrines, appears to have been in earnest, and to have deduced them rigorously from his premises. Among his followers, as always happens, this earnestness was wanting, and accordingly we find Gorgias (as sketched by Plato) without a single claim to respect; and Euthydemus a despicable babbler. With these latter men it was truly sophistry—quackery; and answered their purposes, for they amassed considerable wealth thereby. (Ritter, vol. i.)

Gorgias wrote a work on nature, or non-being, fragments of which are preserved in Aristotle and Sextus Empiricus, in which he endeavoured to prove that nothing is; that if anything is, it cannot be an object of knowledge; and finally, that if even anything is, and can be known, it cannot be imparted to others. (Ritter; Tennemann, *Manuel*, p. 123.) He reasons thus: if anything is, it must be either being or non-being, or even at one and the same time both being and non-being. (Sextus Emp. *adv. Math.*, vii. 66.) All these cases are impossible; for a non-being cannot *be*, because it is the opposite of *being;* and therefore, if the latter is, the former cannot be; because if it were, it must be at the same time being and non-being. Aristotle, according to Ritter, gives the reasoning and proofs differently, but his text is so corrupt as to prevent any confidence being placed in it. Nor is being possible: for it cannot be either produced or unproduced, neither one, nor many, nor yet both at once. Nor can it be at once being and non-being; for if there is both that which is and that which is not, then must they, in reference to being, be one and the same. But if they are the same, then that which is is also that which is not; the non-being however is not, and consequently the being cannot be. (Sext. Emp. *adv. Math.*, vii. 75; Ritter.) As consequences of this arid sophistry, he deduces that if we suppose being to be an object of thought, it must be similar to being; or in other words, that it must be being itself, for otherwise being cannot be an object of thought. Now if thought is being, then every thought must be true, and non-being is inconceivable. In vain do we object that only those thoughts are true which are confirmed by perception; for as the object of sight is true, though it be not heard, so a thought may be true, though it cannot be perceived. (Sextus Emp., *ib.*, 77, *et seq.*) A notable instance of the sophistical argument which assumes an analogy as a proof, taking care the analogy itself shall be false.

It is curious to contemplate a highly intellectual nation delighting in such barren quibbles as these, and the fact of the prevalence of sophistry indicates an important phasis in Greek history. We have a parallel in our schoolmen of the middle ages, who were quite as sophistical and as trifling. But it is also important to notice the influence which such a sect had on philosophy and literature. It was the practical demonstration of the incompetence of all previous philosophy, by carrying out their principles to the ludicrous extreme (as Hume's doctrines were but the consummation of all the materialism of Hobbes and Locke), and thereby necessitating an entire reformation and rebuilding of principles. In the person of Socrates, philosophy again recommenced its attempts to solve its own mysteries. We must also add what Ritter says with regard to the effects on language. It is not to be denied, he thinks, that the Sophists contributed greatly to the perfection of prose; which was in itself a great benefit to philosophy. The Sophists applied themselves to manifold arts of persuasion, and in their attacks upon each other, labouring to expose and lay bare the delusions of appearance, they acquired great nicety in the distinction of terms. Prodicus was celebrated for his skill in the distinctions of synonymous terms (as we learn from Plato, who ridicules him for it (Protag., p. 337; Crat., p. 384); but Prodicus is honourably mentioned by him (Euthyd., p. 277-305). The sophisms turning upon the words 'to learn,' 'to understand,' to know,' also contributed to the more accurate knowledge of these terms. The very circumstance that their rules were intended to be subservient to the ends of fallacy and deception, must have afforded a stronger motive to the philosophical spirit to bring under investigation the true forms of thought and expression which had been neglected by earlier philosophers; and accordingly we find that they occupied much of the attention of Socrates. (See Ritter's Remarks on the Sophists, *Geschichte der Philosophie*, vol. i.)

**SO'PHOCLES**, son of Sophilus, was born in the Attic demus or village of Colonus, and, according to the most authentic accounts, in the year B.C. 495, fifteen years before the battle of Salamis, when Æschylus was thirty years old. He appears to have received as good an education as could be had at the time. In music he was instructed by Lamprus, and in this art, as well as in gymnastic exercises, he gained laurels even when a youth. At the age of fifteen, when the Greeks had defeated the Persians in the battle of Salamis (480 B.C.), Sophocles, on account of his beauty, was selected by those who had the management of the solemnities which followed the victory, as leader of the chorus which danced around the trophies in Salamis and sang the hymn of victory. (Athen., i., p. 20.) The anonymous Greek biographer of Sophocles states that Æschylus was his master in tragedy, but such a relation between the two poets is improbable, and is contradicted by a passage in Athenæus (i., p. 22), where Sophocles says of Æschylus, that he followed the rules of his art without knowing them. It is a favourite practice with antient historians and grammarians to describe the relation of two persons who lived at the same time and practised the same art, as that of master and pupil, when there is no evidence of such fact, except that the one was younger than the other. The first time that Sophocles produced a tragedy on the Attic stage was in the year B.C. 468, and the piece was probably the 'Triptolemus,' which is now lost. (Euseb., *Chron.*, p. 167; Plin., *Hist. Nat.*, xviii. 12.) Æschylus was at this time the great dramatist of the Attic stage, but his young rival, who ventured to contend with him for the prize, won the victory, which was attended by the following memorable circumstance. On the day when the drama was acted, Cimon had just returned from the island of Scyrus, bringing with him the remains of Theseus, who was believed to have been murdered and buried in that island. When Cimon, with his nine colleagues, entered the theatre to offer the customary libations to Dionysus, he was detained by the chief archon Aphepsion, whose duty it was to preside at the dramatic performances and to nominate the judges. Aphepsion appointed no judges, but called upon Cimon and his colleagues to determine the prize. Cimon, recognising the great genius that the tragedy displayed, gave the prize to Sophocles. (Plut., *Cim.*, 8.)

From this time twenty-eight years of his life passed without any memorable event being recorded, though Sophocles must have been extremely active in the exercise of his art, for during this period he is said to have composed thirty-one dramas, not including the 'Triptolemus.' (Aristoph. Byz., *Argum. ad Antig.*)

In the year B.C. 440 he brought out the 'Antigone,' his thirty-second drama; and he gained the prize. The Athenians, who perceived in this play the wisdom of a statesman and general, appointed him one of the commanders to conduct the war against the aristocrats of Samos, who, after being expelled from the island by the Athenians, had returned from Anaea in Caria (whence the Greek biographer calls it the war of Anaea), and endeavoured to induce the Samians to revolt against Athens. In this campaign Sophocles was the colleague of Pericles. No military feat is recorded of him, and it is only stated that he availed himself of the opportunity to enrich himself. In Samos he is said to have made the acquaintance of Herodotus, for whom he wrote a poem. (Plut., *An Seni sit gerenda resp.*, 3.) Whether Sophocles, after this expedition, which ended in 439 B.C., took any further part in public affairs, is not certain. His life seems to have passed in the glorious career of a successful dramatist, and has left no traces in history; we only hear that several kings invited him to their courts, but that he preferred staying at home. He was married twice. His first wife was Nicostrate of Athens, by whom he had a son, Iophon; his second wife was Theoris of Sicyon, by whom he had a son called Ariston. Ariston again had a son called Sophocles, who is generally distinguished from his grandfather by the epithet 'the Younger.' Sophocles was very partial to this grandson, and it was believed that during his lifetime he intended to transfer to him a considerable part of his property. Iophon, fearing lest his inheritance should be diminished, brought a charge of mental incapacity against his father before the members of his phratria, and proposed that he should not be allowed to have the control over his property. Sophocles is said to have made no reply to this charge, but with a strong conviction of the excellence of the 'Œdipus in Colonus,' which he had just composed, to have only read to his phratores, who had to examine him, the parodos of this play. The consequence was that he was allowed to retain the management of his property.

Sophocles died in the year 406 B.C., at the very advanced age of ninety. The accounts of the cause of his death are not consistent. Some state that he was choked by a grape, which stuck in his throat; others, that in the loud reading of the 'Antigone' he exerted himself so much, that at last his voice failed him and he expired; and others again, that he died of joy at the announcement of a victory gained by one of his dramas. He was buried in the tomb of his fathers near Decelea.

As regards the private life of Sophocles we know nothing, except that he was addicted to sexual pleasures (Athen., xii., p. 510); but the anecdotes in Athenæus (xiii., p. 603, &c.) seem to belong to that sort of scandal from which no great man can escape.

Sophocles is said to have written 130 dramas, but Aristophanes of Byzantium declared seventeen of them spurious, which would leave 113 genuine dramas, which number includes his satyric dramas. At the age of forty-five he had written 32 dramas, so that more than two-thirds of his works were composed during the latter half of his life. The 'Œdipus in Colonus,' his last production, was written a short time before his death, but was not brought out till the year B.C. 401. With these plays he disputed the prize with the greatest dramatists of the day, Æschylus, Euripides, Chœrilus, Aristias, Iophon, and others; and gained twenty times the first prize, several times the second, but never the third. Of all his plays there only remain seven; of others we only possess some fragments, and sometimes no more than the titles. The earliest of the extant pieces is the 'Antigone,' and the probable chronological order in which the others followed is this: 'Electra,' 'Trachiniæ,' 'King Œdipus,' 'Ajax,' 'Philoctetes' (first acted in B.C. 409), and the 'Œdipus in Colonus,' which was first acted in B.C. 401.

The antients themselves regarded Sophocles as the most perfect of all dramatic poets; they called him the tragic Homer, and the Attic bee, to express the unrivalled beauty and sweetness of his productions. Their admiration was well-founded, for the tragedies of Sophocles, as far as we can judge, excel everything of the kind that appeared in Greece either before or after him. Sophocles abandoned the pomp, grandiloquence, and harshness of Æschylus, for which he substituted the noble simplicity and tenderness which the antients admired: his heroes are not beings of a superior nature, his men are not the sport of an inscrutable destiny: the world which he represents is peopled by men, agitated indeed by sufferings and passions, but the good and the beautiful do not appear under the iron rule of destiny; all his characters are men in the truest sense of the word, beings with whom we can sympathise. Hence his dramas are of an ethical and practical character, while those of

Æschylus are more calculated to inspire religious awe. Sophocles knew the laws of his art and what it required, as appears from an expression ascribed to him by Plutarch (*De Prof. Virt.*, *Sent.* 7). During his whole career he appears to have been striving to realize the idea which he had formed of tragedy. In the three earliest of the extant plays there appear occasionally traces of an artificial style and studied obscurity, but the remaining four are entirely free of this fault. But even the 'Antigone' is so different from any play of Æschylus in design and execution, that he must have long before been aware of the necessity of the changes which he introduced. The more particular changes to which we here allude are as follows. Each drama of Sophocles turns upon one great action, the 'Antigone' perhaps excepted; and one idea, which is the leading idea of the drama, is perfectly developed in one play; while with Æschylus the three plays of a trilogy are like so many acts of one drama. Although therefore Sophocles may usually have brought out three tragedies at once, each of them was complete in itself. The lyric part, or the chorus, in Sophocles has no longer that prominent place which it has in Æschylus, nor does it take part in the action in the same degree; it no longer expresses the feelings supposed to be called forth in the audience; but the tragic development of the characters of the drama, or, in other words, the action, is the most prominent part of the drama. The chorus is subordinate, and it would seem that Sophocles used it as a means to let the spectator see what was going on in the minds of the actors rather than in that of the spectators. As the action was thus extended, Sophocles also introduced a third actor, or the tritagonistes, so that now three actors might appear upon the stage at once, whereas before his time there had not been more than two at a time, which rendered the action, as well as the dialogue, monotonous. Lastly Sophocles introduced several improvements in scene-painting and in other mechanical parts of stage performance. At first he is said, like Æschylus, to have acted in his own dramas, but as his voice was too weak, he gave it up.

Besides his dramas, Sophocles also wrote an elegy, several paeans, and other minor poems, and also a prose work on the chorus, which was directed against Thespis and Choerilus. Several antient grammarians, such as Didymus, Horapollon, Aristophanes of Byzantium, Androtion, Praxiphanes, and others, wrote commentaries upon the dramas of Sophocles.

Respecting the life and works of Sophocles, see the Life, by an anonymous Greek writer, which is prefixed to several editions of his works; Suidas, *s. v.* Σοφοκλῆς; the masterly treatise of Lessing, 'Leben des Sophocles,' which has unfortunately been left a fragment by the author; Ferd. Schultz, 'De Vita Sophoclis Poetæ,' Bonn, 1836, 8vo.; Adolph Schöll, 'Sophocles, sein Wirken und Leben,' Frankfurt, 8vo.; Müller, 'Hist. of the Lit. of Antient Greece,' i., p. 337-356; A. W. v. Schlegel, 'Lectures on Dramatic Literature,' vol. i., lect. 4.

The works of Sophocles were first printed by Aldus, Venice, 1502, 8vo. The best of the subsequent editions are those of H. Stephens, Paris, 1568, 4to., with valuable notes, and that of Brunck, Strassburg, 1786, 2 vols. 8vo., with a Latin translation and notes. In the same year Brunck published his great edition in 2 vols. 4to., or 4 vols. 8vo. It was reprinted in London, 1823, in 3 vols. 8vo., with some additions by Burney. The text of Brunck has served as the basis for all subsequent editions. The best among them are that of Musgrave, Oxford, 1800, &c., 2 vols. 8vo.; of F. H. Bothe, Leipzig, 1806, 2 vols. 8vo., the last edition of which appeared in 1827 and 1828; of Erfurt, Leipzig, 1802, &c., 7 vols. 8vo.; of Elmsley, 1826, reprinted at Leipzig in 8 vols. 8vo.; of Erfurt and G. Hermann, Leipzig, 1823-25, 7 vols. 12mo. An edition by G. Hermann including the notes of Erfurdt has been published in parts. The plays that were published last are: 'Antigone' (1830), 'King Œdipus' (1833), and 'Philoctetes' (1839), forming vols. 1, 2, and 6; vols. 3, 4, 5, and 7 having appeared before, at Leipzig, 1822-1825. The most useful edition of Sophocles for students is that by E. Wunder, Gotha and Erfurt, 1831-1841. The editions of single plays and dissertations upon them are almost innumerable. The titles and remains of the lost pieces of Sophocles have been collected by Welcker, in his 'Die Griechischen Tragödien,' p. 59, &c. He has classed them according to the legendary cycles to which they belong, and also given the probable contents or the leading idea of each play, as far as this can be made out from the fragments.

The translations of Sophocles are very numerous. The best German is that by Solger, the last edition of which appeared at Berlin, 1824, 2 vols. 8vo. There are numerous English translations: in prose, by George Adams, London, 1729, 2 vols., and others subsequently; in verse, by Franklin, London, 1758-9, 2 vols. 4to., and 1766 and 1788, 8vo.; by Robert Potter, London, 1788; and by Thomas Dale, 1824.

SOPHONISBE. [Numidia.]

**SOPHORA**, a genus of plants of the natural family of Leguminosæ, said to be so named from an Arabic name (*Sophera*) of one of the species. These are ornamental shrubs and trees, found in central and tropical Asia, also in the warm parts of North America and the equinoctial and subtropical parts of South America. The genus is characterised by having a 5-toothed campanulate calyx; corol papilionaceous; petals of the keel usually united together at their apex; stamens 10, distinct; legumes moniliform, without joints or wings, and containing several seeds; the leaves are impari-pinnate, usually exstipulate and terminal; the inflorescence is in racemes or panicles of yellow, white, or blue flowers. The species best known in England are S. japonica and S. chinensis, which, being from the northern latitudes of the countries from which they are named, are hardy enough to withstand the climate of England; and it has been proposed to engraft the Nepaul *S. velutina* on the S. japonica. Being handsome trees, with both leaves and trees differing much from European trees, they are well adapted for standing singly in lawns. They are raised from layers, but also from seeds, and require a little protection when young.

SO'PHRON, son of Agathocles, a native of Syracuse, was born about the year B.C. 420. He is believed to have been the inventor of a peculiar kind of poetry called mimes. [Mimes.] He wrote his works in the vulgar dialect of the Doric Greek as spoken in Sicily, and in a kind of rythmical prose. Plato, who had become acquainted with the productions of Sophron through Dion of Syracuse, valued them very highly, and is said to have made the Athenians acquainted with this species of poetry. (Quinctil., i. 10, 17.) Besides the few fragments of the mimes of Sophron which yet remain, we only know the titles of some others of his poems, so that we are scarcely able to form an exact idea of this species of poetry. The circumstance that Sophron wrote in a popular dialect full of peculiarities and solecisms, was probably the reason why his works were studied by the grammarians. Apollodorus of Athens wrote a commentary upon them.

The fragments are collected by C. J. Blomfield, in the 'Classical Journal,' vol. iv., p. 380, &c., to which a supplement and some corrections were added by the same scholar in the 'Museum Criticum,' No. VII., p. 640, &c. Compare Grysar, 'De Sophrone Mimographo,' Coloniæ, 1838.

SOPORIFICS. [Anodynes; Narcotics.]

SOPRA'NO (Italian), the highest of the various voices; the Treble. [Voice.]

SORA. [Lavoro, Terra di.]

SORA'NUS (Σωρανός), an eminent antient physician, the son of Menander, was born at Ephesus, probably about the end of the first century after Christ, and raised the sect of the Methodici to its highest degree of reputation. He had been brought up at Alexandria, but under the reign of Trajan and Hadrian he came to Rome, where he taught and practised medicine with great success. (Pseudo-Gal., *Introduct.*, cap. 4, p. 184, tom. xiv., ed. Kühn; Suidas.) He passed some time also in Aquitania, and very successfully treated the leprous diseases which prevailed there. (Marcell. Emp., *De Medicam.*, cap. 19, p. 321, ed. H. Steph.) In his time the leprosy, which had been brought from the East into Italy and Gaul, was making there the greatest ravages; and the physicians, who were not yet well acquainted with this disease, were anxious to recommend certain preparations against each of its particular symptoms. Some of those employed by Soranus have been preserved to us by Galen. (Gal., *De Compos. Medicam.*, *sec. Loca*, lib. i., cap. 2, 8, p. 414 et sq., 493 et sq., tom. xii.) Their object was in a great measure to effect a metasyncrisis, or the re-establishment of the pores in their natural state. To him we are indebted for the first observations (Paul. Ægin., *De Re Med.*, lib. iv., cap. 59, p. 73, ed. Ald.) upon the species of worm called by the Greeks δρακόντιον, by the Latins *Gordius*, *Filaria*, or *Vena Medinensis*; for an account of which see a dissertation by Justus Weihe, entitled *De Filaria Medinensi Gmel. Commentariolum*, Berol., 1832, 8vo., and especially the very learned work by Georg. Hieron. Velschius, entitled *Exercitatio de Vena Medinensi, ad Mentem Ebnsinæ* (*i.e.* Avicennæ), *sive De Dracunculis Veterum*, 4to., August.-Vindel., 1674. He made the interesting remark, that children while at the breast are sometimes attacked with hydrophobia. (Coel. Aurel., *De Morb. Acut.*, lib. iii., c. 11, p. 221, ed. Amman.) His theory on the Nightmare (Id., *De Morb. Chron.*, lib. i., c. 3, p. 289), and his opinion on the use of magical songs and incantations in the treatment of diseases, prove how little he was imbued with the prejudices of his age. He seems to have been the first to reduce the opinions of his predecessors to certain principles (Id., *De Morb. Acut.*, lib. ii., cap. 9, p. 91), and therefore did not, like them, show contempt for the antients, but tried to refute them by the arguments of the Methodici. (Id., *ibid.*, cap. 19, p. 127; cap. 29, p. 142.) Indeed he was the first who gave a plausible reason for the necessity of rejecting purgatives, in saying that they evacuated indiscriminately the healthy humours as well as the bad ones. (Id., *ibid.*, cap. 9, p. 91.) He always employed venesection in pleurisy, because it proceeds evidently from the *strictum*, and had no regard to the difference of climate. (Id., *ibid.*, cap. 22, p. 132.) In pneumonia he considered that the whole body suffered, but that the lungs are particularly affected; for Soranus did not admit a single local disease, in the strict acceptation of the term. (Id., *ibid.*, cap. 28, p. 139.) The cholera morbus, said he, is a relaxation of the stomach and intestines, accompanied with imminent danger. (Id., *ibid.*, lib. iii., cap. 19, p. 254.) Sprengel (*Hist. de la Méd.*) thinks that he is not the Soranus who is mentioned by Coelius Aurelianus (*De Morb. Chron.*, lib. ii., cap. 10, p. 391) as having recognised three causes of hæmorrhage, viz. eruption, lesion, and putrefaction, because the study of these particular causes would not agree with the spirit of the school of the Methodici. We know also from Suidas that at least two different physicians bore the name of Soranus. His work, Περὶ Γυναικείων Παθῶν, *De Arte Obstetricia Morbisque Mulierum*, shows that he possessed very considerable anatomical knowledge, though he introduces the description of the sexual organs by saying that the study of anatomy is quite useless (ἄχρηστος), and that he only inserted these chapters in order that people might not say he disparaged anatomy because he was himself ignorant of it (cap. 3, p. 5, ed. Dietz). Indeed he described the uterus in such a manner as to prove (what he himself assures us) that he derived his ideas of anatomy from the dissection not of animals, but of human bodies. (*Ibid.*, cap. 4, 5, p. 11, 13.) He denies the existence of the cotyledons (*Ibid.*, cap. 4, p. 10), but he still gives to the ovaries the name of testicles, compares the form of the uterus to that of a cupping-glass, points out the relations of this viscus with the os ilii and the sacrum, and mentions the changes that its orifice experiences during pregnancy. (*Ibid.*, p. 10, sq.) He attributes the prolapsus of the uterus to the separation of its internal membrane (*ibid.*, p. 11); he speaks of the sympathy that exists between it and the mammæ (*ibid.*, p. 12), and accurately describes the hymen and the clitoris (*ibid.*, cap. 5, p. 13).

A fragment by Soranus, Περὶ Σημείων Καταγμάτων, *De Signis Fracturarum*, was published by Cocchi, in his *Græcorum Chirurgici Libri*, Gr. et Lat., Florent., 1754, fol. It is also inserted by Jul. Lud. Ideler, in his *Medici et Physici Græci Minores*, Berol., 1841, 8vo., Gr. His work *De Arte Obstetricia Morbisque Mulierum* consisted originally of one hundred and sixty-four chapters, of which only one hundred and twenty-seven remain, which were first published, Regim. Pruss., 8vo., 1838, Græcè, from a manuscript prepared for the press before his death, by the late learned professor F. R. Dietz. An anatomical fragment of this work, Περὶ Μήτρας καὶ Γυναικείου Αἰδοίου, *De Utero et Pudendo Muliebri*, was published in Greek, together with Rufus Ephesius, Paris, 1554, 8vo., and is to be found in Ideler's collection mentioned above. A Latin translation is added to the edition of Oribasius, by Rasarius. There is also a dissertation by H. Häser, *De Sorano Ephesio, ejusque* Περὶ Γυναικείων Παθῶν, *Liber nuper reperto*, Jenæ, 1840, 4to. Whether the Life of Hippocrates, that goes under the name of Soranus, was written by the author who is the subject of this article, is uncertain; and indeed the writer is not quite sure that all that has been said refers to the same individual. The Life of Hippocrates (which is of little or no authority) is prefixed to several editions of his works, and is also inserted by Fabricius in his *Biblioth. Græca*, vol. xii., p. 675, ed. Vet., and by Ideler in his collection above mentioned. A work which exists only in Latin, and which bears the title *In Artem Medendi Isagoge*, is undoubtedly the production of a later writer, as Galen is mentioned in it by name (cap. 13). It is in the collection edited by Torinus, Basil., 1528, fol., and in that published 'apud Aldi Filios,' Venet., 1547, fol.

SORBONNE, a celebrated College which existed in France for several centuries. Its founder was Robert de Sorbonne, an ecclesiastic of the thirteenth century, born (A.D. 1201) at the village of Sorbon, in the territory of Rethel, now in the department of Ardennes, of poor and obscure parents. His talents and acquirements introduced him to the notice of Louis IX. (St. Louis), king of France, who retained him at his court as his confessor and chaplain, and showed him great favour. In 1251 he was made a canon of Cambray, and, mindful of the difficulties which he had experienced in early life, he formed the plan of an institution for the assistance of poor students. His intention was to establish a society of secular priests, for whom a maintenance in common should be provided, and who should devote themselves wholly and gratuitously to the work of instruction in theology. A society on this plan was founded by him with the aid of his friends, all of them ecclesiastics, A.D. 1252 or 1253; and was encouraged by the liberal patronage of the king. Robert de Sorbonne was the first head of the establishment, *directeur;* and it was not until after eighteen years' official experience that he settled the constitution and regulations of the establishment, which were not in any respect changed until the suppression of the college at the Revolution. Robert established another college, for the study of the humanities and philosophy, that of Calvi, sometimes called 'the little Sorbonne,' near his principal foundation, to which it seems to have been preparatory. This minor establishment was destroyed in order to erect the church when Richelieu rebuilt the college premises. In A.D. 1258 Robert was made canon of the cathedral at Paris, and died in 1274, bequeathing all his property to the college which he had founded.

The members of the college were all either doctors or bachelors of theology. There has been some difference of opinion as to their number in the first instance. Du Boulay, in his *Historia Universitatis Parisiensis* (*History of the University of Paris*), gives it as sixteen; but Ladvocat, himself a professor of the Sorbonne, contends strenuously that the number was larger. The original regulations indicate that the members were more than thirty; but these were not finally settled till the college had been established eighteen years. The members of the college consisted of two classes, 'socii et hospites,' or 'fellows and commoners,' and persons of any nation or country were eligible. The socii, if not the hospites, were in holy orders. The hospites were bachelors of the faculty of theology at Paris, and were elected by a majority of the socii, after a triple scrutiny, having previously maintained a thesis called Robertine, after the name of the founder. The hospites were boarded and maintained in the college, and were allowed to study in the library, but they had no voice in the assemblies of its members, and they were obliged to quit it upon taking a doctor's degree. The socii were either bachelors or doctors, were obliged to pass through the same ordeal as the hospites, besides having to deliver gratuitously a course of lectures on philosophy, and then to be elected by the fellows after two additional scrutinies. A bursary of trifling value was granted from the revenue of the college to those fellows whose yearly revenue, whether arising from private property or from an ecclesiastical benefice, was under forty livres of Paris (the livre of Paris was equal to twenty-five sous, or rather more than a shilling): these bursaries were granted for a limited term, ten years, not for life; and ceased immediately upon the bursar acquiring a private income of forty livres a year: after the decree of the Council of Trent, which required a certain income as a title to priests' orders, they sunk into disuse. At the end of seven years the bursars were strictly examined, and those who were found incapable of serving the public usefully as teachers or preachers, or in some other way were deprived of their bursaries. The fellows who were not bursars (*socii non bursales*) paid to the college a sum equal to that which, as bursars, they would have received. Every fellow bore the title of doctor or bachelor of the House and Society of the Sorbonne; the commoners were doctors or bachelors of the House of the Sorbonne. The whole management of the society, and, so far as appears, its property, were vested in the fellows, among whom there was no gradation of authority; all were equal; there was neither 'Superior' nor 'Principal;' some distinctions of office and precedence there appear to have been, but no power of one over another; and so strictly was this equality observed, that no regular ecclesiastic could be a fellow, because he was subject to his 'principal' or 'superior;' and a fellow entering into any religious order, forfeited his fellowship thereby. The fellowships appear to have been appointments for life. The officers appear to have been elected by the fellows from among themselves; they were - the superintendant (proviseur), who was always a man of eminence; the prior, who presided at their assemblies, examinations, &c., and was always chosen from among the bachelor-fellows; the elder (senieur); the professors, the librarian, the conscripteur, the procureurs, &c. There were apartments in the college for thirty-six persons, and latterly thirty-seven. The doctors and bachelors were from the first allowed to receive poor scholars as pupils They taught theology gratuitously, and from 1253 to the suppression of the college there were at least six professors who gave gratuitous instruction in the different branches of theology.

The college was from time to time enriched by legacies and donations. Robert de Sorbonne took great pains in the establishment of a library, which became one of the most valuable in France: in 1289-90, when a catalogue was made, it consisted of above a thousand volumes, worth more than 30,000 livres, or 1500*l.*, a large sum in those days, and so far increased in 1292, that it became necessary to make out a new catalogue. The accessions between this year and 1338 amounted in value to 3812 livres, or 190*l.* All the more valuable books were antiently chained to little desks or stands (tablettes), and were arranged according to their subjects. Antient catalogues of the dates of 1289-90 and 1338 were in existence when Ladvocat wrote (A.D. 1760).

The buildings of the college, which are in the south of Paris, near the palace of the Luxembourg, having become much dilapidated, were rebuilt by Cardinal Richelieu, who demolished the college of Calvi in order to build the church. He had engaged to restore this smaller college, but died before he could effect his purpose, and it was never restored. The church itself, after the suppression of the college, was appropriated to other purposes, but has since been restored to its original use as a place of public worship. The other buildings of the college are occupied by the three faculties of theology, science, and literature of the Académie Universitaire of Paris.

The college of the Sorbonne was one of the four constituent parts of the faculty of theology in the university of Paris; and though the least numerous part, yet from the number of eminent men belonging to it, this college frequently gave name to the whole faculty; and graduates of the university of Paris, though not connected with this college, frequently styled themselves doctors or bachelors of the Sorbonne. The high reputation of the college caused it to be continually appealed to for the judgment of its members on questions of theology or morals. One question referred to their decision, illustrative of the character of the age, was the validity of the gift made by Philippe le Bel, king of France, of the heart of his father (Philippe le Hardi) to one of the churches of the Dominicans; and which heart the monks of St. Denis claimed to have interred in their abbey. It was more to the honour of the doctors of the Sorbonne that the first printing-presses in Paris were established in their house. They supported the faction of the Guises in the religious wars of the sixteenth century.

(Ladvocat, *Dictionnaire Historique;* Duvernet, *Histoire de la Sorbonne; Biographie Universelle;* Dulaure, *Histoire de Paris.*)

SORBUS, the Linnæan name of a genus of plants, comprising the mountain-ash, rowan-tree, and service-tree. It is now made a subgenus of Pyrus. [PYRUS; ROWAN-TREE.]

SORE'CIDÆ, or, more accurately, *Soricidæ*, Mr. Swainson's name for the family of *Shrews* or *Shrew-mice*, genus *Sorex* of Linnæus.

Mr. Swainson observes, that the Shrew-mice stand at the head of the *Sorecidæ*, the second aberrant family of the order *Feræ*, according to his views, and which, he states, corresponds, without any variation, to the INSECTIVORA of Cuvier a name which he says that he would have retained for the group, were it not highly expedient to preserve a uniformity of nomenclature throughout the animal kingdom; and he acts upon the rule of naming every family from the typical genus by which it is represented.

Mr. Swainson enters among these 'carnivorous mice, as he terms them, by the genus GYMNURA, which bears the closest affinity to *Cladobates* [TUPAIA], and also bears a strong resemblance to *Didelphys*. Cuvier, he remarks, was of the same opinion, and adverted to the affinity of *Gymnura* with the shrews, as seen in its pointed snout and scaly tail, &c., although he omitted to remark that the stiff *setæ*, or bristles, interspersed among the woolly hairs of the body, point out another and a very important link of connection, namely, to the *Hedgehogs*, close to which however he admits that Cuvier arranged that interesting genus.

'The Sorecidæ,' says Mr. Swainson, in continuation, and following Cuvier, 'like the bats, have the grinders furnished with conical points; but they are destitute of wings or lateral membranes, and they possess clavicles: they have no cæcum, and they all press the entire sole of the foot on the ground in walking. In their economy they are nocturnal, leading for the most part a subterraneous life, and deriving their principal support from insects: those that are natives of cold countries pass the winter in a lethargic state: their feet are short, and their motions, when on the surface of the earth, slow and feeble.' Mr. Swainson, then, after some remarks tending to show that Cuvier's views indirectly favour the natural analogy which Mr. Swainson holds to exist between the *Sorecidæ*, *Tarsius*, the *Glires*, and the *Vespertilionidæ*, each of which, in Mr. Swainson's opinion, truly represents the other in their respective circles, observes, that in the moles there are four large canine teeth, separated from each other, between which are small incisors; an arrangement, he remarks, more in unison with the general dentition of the *Quadrumana* and the *Carnivora*.

Mr. Swainson then proceeds to notice the group more particularly, observing, that the genus *Gymnura* will probably connect the hedgehogs, so well known by their prickly spines, and their remarkable property of rolling themselves up into a ball when disturbed, either with *Cladobates*, or that the latter may come in between the shrews and the hedgehogs, the former being much the most numerous. These, with but two exceptions, he remarks, one of which is the *Sorex Indicus*, are peculiar to the European continent. They are remarkable, he observes, for having on each flank, under the ordinary skin, a little band of stiff and close hairs, from which an odoriferous humour can be distilled. They dig holes in the earth, which they seldom quit until the evening, when they search for insects and worms. He then notices the Desmans (*Mygale*) as being also European animals, and much resembling the shrews, from which they chiefly differ in their teeth. *Scalops*, in his opinion, seems to represent either these animals, or the moles in the New World. Lastly, he observes, we find in the African CHRYSOCHLORIS a representation of this little group. *Macroscelides* does not appear to have been known to Mr. Swainson, though the genus was described in the fourth volume of the 'Zoological Journal,' in 1829; neither does he seem to have been aware of Brandt's description of SOLENODON (1832).

The second division of the family, according to the same author, is composed of mole-like animals, apparently connected to the shrews by the American *Scalops*, and the African *Crysochloris*, and includes three genera, the Tenrecs (*Centetes*, Ill., *Centenes*, Desm.) [TENREC], TALPA, and CONDILURA. At the end of the volume, the Family *Sorecidæ* is made to contain the Shrews, Moles, and Hedgehogs, with the following character:—

Muzzle lengthened, pointed; legs short, feeble; feet pentadactylous; lower incisors generally very long, pointing forwards; no lateral membranes; mammæ ventral. The family thus characterized includes the genera *Erinaceus*, L.; *Sorex*, L.; *Mygale*, Geoff.; *Scalops*, Cuv.; *Chrysochloris*, Cuv.; *Talpa*, L.; *Centenes*, Cuv.; and *Condylura*, Desm.

The *Insectivora* of Cuvier consist of the Hedgehogs (*Erinaceus*); the Tenrecs (*Centenes*); the Shrews (*Sorex* and *Scalops*); the Desmans (*Mygale*); *Chrysochloris*; *Talpa*; and *Condilura*.

The genus *Sorex* of Linnæus is placed between *Talpa* and *Erinaceus*; and this article will be confined to the true

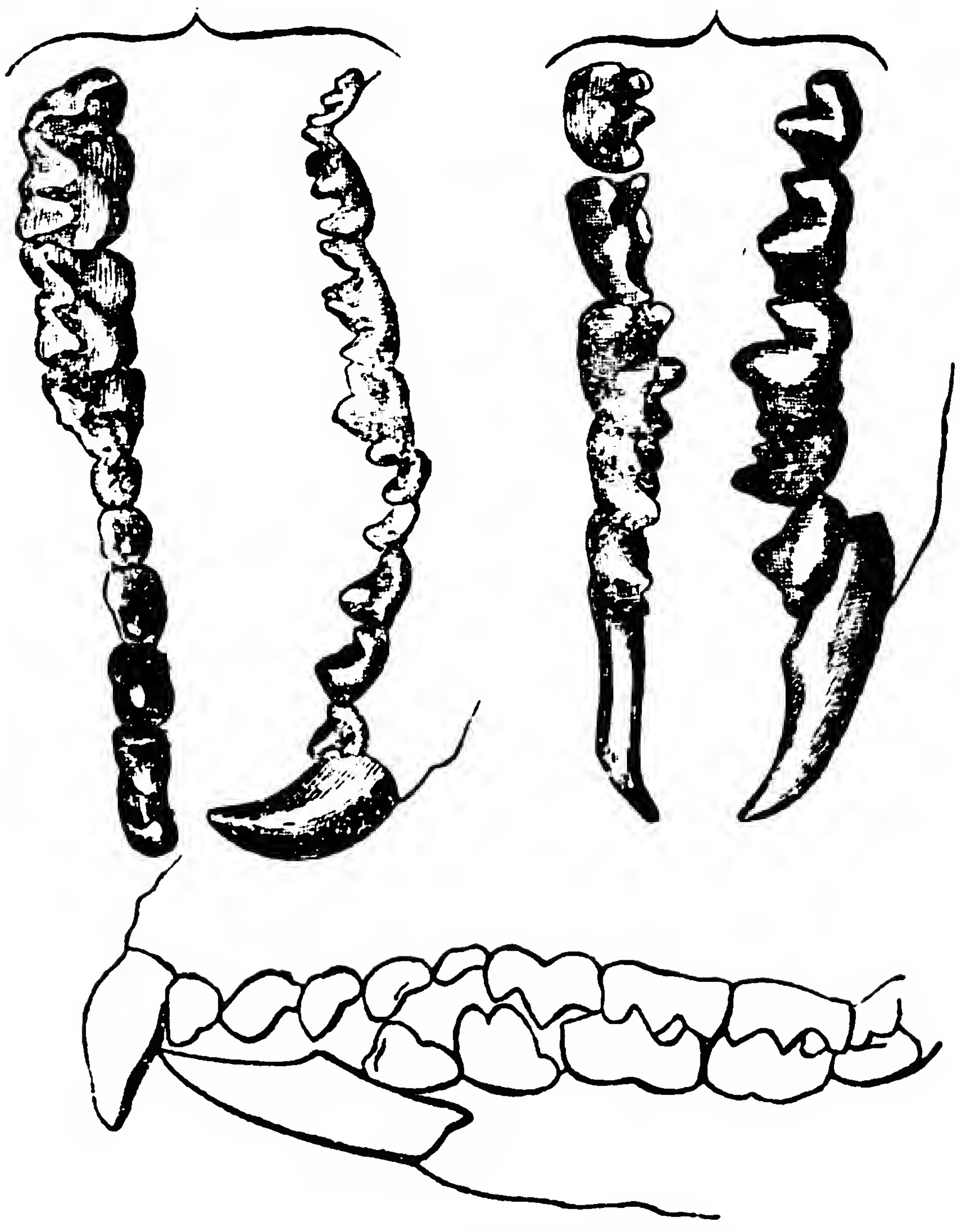
Shrews (*Sorex*), and the forms which most closely approximate to that genus.

The *Geographical Distribution* of the forms of these *Soricidæ* is wide: examples of them occur in Europe, Asia, Africa, and America.

Sorex.

*General Character.*—Upper incisors curved and toothed or notched at the base; lower incisors nearly horizontal, all much produced. Body covered with soft and velvety fur. Muzzle very much attenuated; ears short and rounded. Five toes with moderately strong claws on each foot. Tail generally long.

Dental Formula:—incisors $\frac{2}{2}$; canines 0; molars $\frac{8-8}{5-5}$ = 30.



Teeth of Sorex, from a large species taken in the Isle of France, six times larger than nature.

Example, *Sorex araneus*.

*Description.*—Reddish mouse-colour above, paler beneath; tail somewhat quadrangular, rather shorter than the body, not ciliated beneath.

This appears to be the *Musaraigne* of the French; *Toporango* of the Italians; *Murganho* of the Spanish; *Spitzmaus* and *Zismaus* of the Germans; *Nabbmus* of the Swedes; *Næbmuus* and *Muaseskier* of the Danes; and *Llygoden goch*, *Chwistlen*, and *Llyg* of the antient British.

Mr. Bell, whose description we have above given, states that he has ventured, after some consideration, to retain the name of *Araneus* for the common Shrew of England, notwithstanding the doubts which have existed in the minds of many zoologists, and in which he had till lately participated. These doubts, he observes, have arisen from what he believes to be an erroneous statement of Geoffroy, who, in his paper on the Shrews, in the *Annales du Muséum*, has given as a character of *Sorex araneus*, that the teeth are all white; and as Daubenton, in his memoir on the same subject, in the *Mémoires de l'Académie des Sciences*, does not mention the colour of the teeth at all, the authority, he adds, of Geoffroy has been sufficient to produce considerable hesitation as to whether the *Sorex araneus* of the Continental authors be identical with our common Shrew, which has invariably brown teeth. 'It seems however,' says Mr. Bell in continuation, 'to have been overlooked, that Daubenton, in his description of the Shrews in Buffon's *Histoire Naturelle*, has set the question at rest, as far as regards the colour of the teeth; for, in describing the 'Musaraigne,' *Sorex araneus*, he refers, for the account of the teeth, to his description of the 'Musaraigne d'eau,' *S. fodiens*; and we there find that the teeth of the 'Musaraigne' are brown at the tips. Now, as he invariably speaks of this species without any adjunct to the name, in contradistinction to the Water Shrew, there can be no doubt, as far as this character is concerned, that the Continental and British animals may be identical; and there appears to be no reason, from any other characters, to doubt that such is the case. That more than one species have been confounded amongst the common Shrews of this country, I have long entertained a decided prepossession; but I have not at present sufficient ground to warrant me in describing them as distinct.' (*History of British Quadrupeds.*)

*Food, Habits, Nest, &c.*—Insects and worms are the food of the Common Shrew. Pennant states that it inhabits old walls, heaps of stones, and holes in the earth, and is frequently found near hay-ricks, dunghills, and similar places. The annual autumnal mortality among these animals, at which season (about August) they are so often found dead, has been observed by most, and satisfactorily accounted for by none, as far as we know. Pennant says, and Agricola, as we shall presently see, noticed the fact before him, that cats will kill but not eat them, being probably disgusted by their peculiar and somewhat musky smell; and the bodies of the dead shrews have been observed to be marked by a nip near the loins, as if by the bill of some rapacious bird. Kestrels and Owls however are known to prey upon them, and the bones of the head have been found in the stomach of the Barn Owl. Mr. Turner, of Bury St. Edmunds, detected among twenty casts from that owl, taken from a considerable mass, the skeletons of seven Shrews.

Shrews are very pugnacious; and Mr. Bell remarks that, if two be confined in a box together, a very short time elapses before the weaker of the two is killed and partly devoured; he also gives his reasons for supposing that shrews fall victims to the rapacity of moles. The nest, which is framed of soft grasses and other plants, s generally found in a hole more or less shallow in the ground, or a dry bank, and is entered at the side, being, so to speak, roofed over. Here the female produces in the spring from five to seven little Shrews.

Among the antients, the Shrew-mouse had a very bad reputation. Thus Aristotle declares that its bite is dangerous to horses and other beasts of burthen; and that it is more dangerous if the Shrew-mouse be with young. The bite, he says, causes boils (φλύκταιναι), and these burst, if the Shrew-mouse be pregnant when she inflicts the wound; but if she be not, they do not burst. (*Hist. Anim.*, viii., 24.) Pliny states that the bite of the Italian Shrew-mice is venomous:—'In Italia muribus araneis venenatus est morsus.' (*Nat. Hist.*, viii., 58.) With reference to this supposition, it is worthy of remark that the French apply the term 'musaraigne,' or 'musette,' to a disease of the horse, which manifests itself in a small tumour (*anthrax*) on the upper and internal part of the thigh, and is often accompanied by very severe symptoms.

Agricola, in his book *De Animantibus Subterraneis*, does not forget the antient traditions of the Shrew's venom, and thus hands them on:—'The *Mus Araneus*,' says he, 'took its name among the Latins, because it injects venom from its bite, like a spider.' The Greek name, μυγάλη, he derives from the facts that it is of the size of a mouse, whilst it is of the colour of a weasel. In his description of the animal, he notices the termination of the teeth in both jaws in bifid points, whence, he remarks, animals bitten by it receive quadrifid wounds. He tells us that its bite in warm regions is generally pestiferous; but that in cold climates it is not, consoling those who may suffer by the not unusual assertion in such cases, that the animal itself torn asunder or dissected and placed upon the wound is a remedy for its own venom. Agricola states also that cats kill it, but abhorring this same venom, do not eat it.

This harmless little animal was also an object of fear and superstition to our ancestors. Mr. Bell gives the following etymological observations made by Mr. Thompson, of the London Institution:—'*Schreava*, Angl.-Sax., a Shrew-Mouse; which, by biting cattle, it venometh them that they die.' (Somner.) Lye adds the orthography of *Schreova*. The etymon may possibly be found in *Schreadan*, to cut, or *Schrif*, to censure bitterly; or rather *Scheorfian*, to bite or gnaw (all Angl.-Sax.); and the ordinary notion is that the biting disposition expressed by the word Shrew comes from the name of the Shrew-Mouse; though Todd prefers deriving it from the German *Schreien*, to clamour, or from the Saxon *Schryvan*, to beguile. In the word Erdshrew the prefix is clearly the Anglo-Saxon *Eorth*, earth—designed to express the animal's habitation.' The cry of the Common Shrew is shrill, but feeble.

The etymological remarks here noticed prepare us for White's account of the superstition itself, involving the supposed injury and the alleged remedy. 'At the south corner of the *Plestor*, or area near the church,' says the author of the 'History of Selborne,' there stood about twenty years ago a very old grotesque hollow pollard-ash, which for ages had been looked on with no small veneration as a *shrew-ash*. Now a shrew-ash is an ash whose twigs or branches, when gently applied to the limbs of cattle, will immediately relieve the pains which a beast suffers from the running of a *shrew-mouse* over the part affected: for it is supposed that a shrew-mouse is of so baneful and deleterious a nature, that whenever it creeps over a beast, be it horse, cow, or sheep, the suffering animal is afflicted with cruel anguish, and threatened with the loss of the use of the limb. Against this accident, to which they were continually liable, our provident forefathers always kept a shrew-ash at hand, which, when once medicated, would maintain its virtue for ever. A shrew-ash was made thus: into the body of the tree a deep hole was bored with an auger, and a poor devoted shrew-mouse was thrust in alive and plugged in, no doubt with several quaint incantations long since forgotten. As the ceremonies necessary for such a consecration are no longer understood, all succession is at an end, and no such tree is known to subsist in the manor or hundred. As to that on the *Plestor*—

"The late vicar stubb'd and burnt it,"

when he was way-warden, regardless of the remonstrance of the bystanders, who interceded in vain for its preservation, urging its power and efficacy, and alleging that it had been—

"Religione patrum multos servata per annos." '

Thus do old superstitions die away. It would seem that the antidote was not confined to an ash-tree, but that different kinds of trees were used for the same purpose. If a person or animal, thus shrew-afflicted, was passed through the arch of a bramble, both ends of which were rooted and growing, his cure was considered as effected. In Staffordshire a tree endowed with the curative power was called *a nursrow-tree*. Those who saw one of these little animals running over cattle and attributed that action to its malignity, never stopped to inquire whether their approach had not suddenly disturbed it from its feast of insects harbouring in cattle droppings, which are generally to be found in the close vicinity of the spot where the cattle are lying.

The Common Shrew.

The other British Shrews are the Water-Shrew, *Sorex fodiens*, Pallas, and the Oared Shrew, *Sorex remifer*, Geoff.


Under surface of hinder feet of Shrews. (Bell.) *a*, Common Shrew. *b*, Water-Shrew. *c*, Oared Shrew.

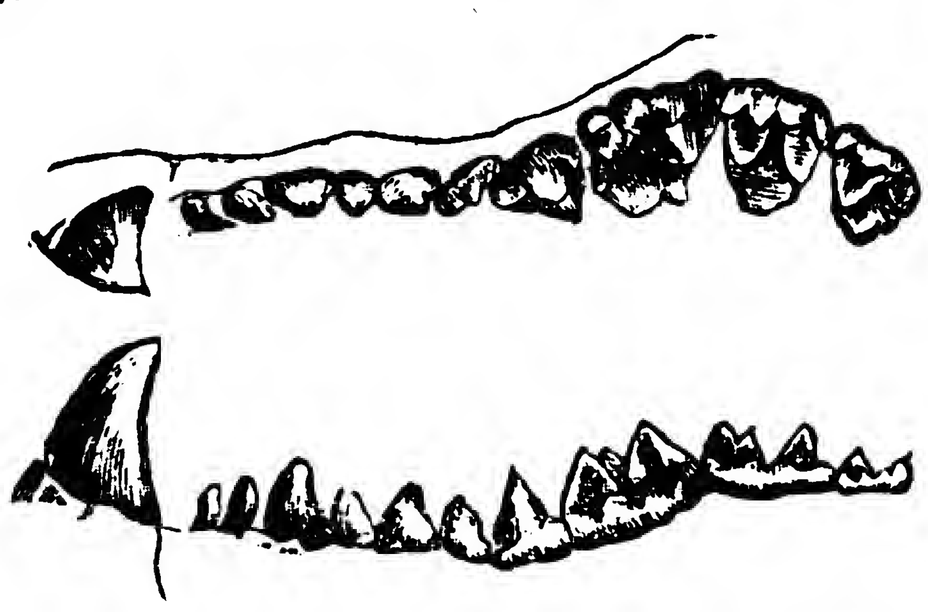
The Water-Shrew, whose habits are graphically described by Mr. Dovaston, in *Loudon's Magazine* (II.), appears to be the *Musaraigne d'Eau* of the French. The Oared Shrew seems to have been first published as British in Sowerby's *British Miscellany*, from a specimen taken by Dr. Hooker in Norfolk, under the name of *Sorex ciliatus*.

The *Sorex Indicus* (*S. myosurus*, Pallas), or *Musk-Rat of India*, has much the same appearance in point of colour and the size of its naked ears as our common Shrew, but is nearly as large as our common brown rat, and the tail is round and thinly furnished with hairs. This species diffuses a most powerful odour of musk, which impregnates everything that is touched by it. It has been alleged that even the wine in a well-corked bottle over which the animal has run has been rendered unfit for use in consequence of the flavour imparted to it. Cuvier states that this species is found throughout the East Indies and in a part of Africa, and that it is among the animals embalmed by the antient Egyptians; but, according to others, it is *Sorex Olivieri*, Desm., which Olivier found in a mummy state in the catacombs of Sakkara.

Mygale.*

*Generic Character.*—Great lower incisors having between them two very small teeth. Muzzle in a very small and very moveable proboscis. Ears short. Five unguiculated toes on each foot united by a membrane. Tail long, scaly, compressed laterally.

Dental Formula:—incisors, $\frac{2}{8}$; canines, $\frac{0}{0}$; molars, $\frac{10-10}{7-7}$ = 44.†



Teeth of the upper jaw of Mygale moschata, F. Cuv.

Example, *Mygale moschata*, *Castor moschatus*, Linn.

*Description.*—Tail shorter than the body, scaly, nearly naked, contracted at its base, cylindrical, and convex in its middle, very much compressed vertically at its extremity; fur brown or dusky above, whitish ash below: total length, including the tail, about 15 inches, of which the tail measures eight.

This appears to be the *Dæsman* of the *Fauna Suecica*; *Le Desman* of the French; the *Biesamratze* of the Germans; the *Wychozhol* of the Russians; and the *Muscovy* or *Musk-rat* of the British.

*Locality.*—The river Wolga, and the adjacent lakes from Novgorod to Saratov.

*Habits, &c.*—This species does not appear to have been seen on dry land; and indeed it is broadly asserted that it never goes there, but wanders from lake to lake in fortuitous floods only. It is often seen swimming or walking under the water, and coming for air to the surface, where, in clear weather, it is apt to sport. Stagnant waters shut in by high banks are its favourite localities, and in such places it makes burrows some twenty feet in length. Its principal food is alleged to consist of fish, leeches, and the larvæ of water-insects; but fragments of roots have been found in its stomach. Its pace is slow; but it does not seem to be torpid in winter, at which season it is often taken in nets. The holes which it makes in cliffs and banks have the entrance far beneath the lowest level of the water, and the animal works upwards, never however reaching the surface, but only sufficiently high to secure itself from the highest rise of the river. Fish, as we have seen, forms part of its food, but the quadruped in its turn falls a victim to the Pikes and *Siluri*, whose flesh becomes so impregnated with the flavour of musk in consequence, as to be not eatable.

* N.B. This name having been pre-occupied among the moderns for a genus of insects, Fischer proposes that of *Myogalea*, and Brandt that of *Myegale*; but Ælian uses Μυγάλῃ to designate a Shrew-mouse, and so does Aristotle.

† This formula, given by M. Lesson, has the authority of M. F. Cuvier for the teeth of the upper jaw, and of Geoffroy (in the case of *Mygale Pyrenaïca*) for those of the lower jaw.

*Utility to Man.*—From the region about the tail a sort of musk, resembling the genuine sort, is expressed; and the skins are put into chests and wardrobes among clothes, for the purpose of preserving them from moths. These skins were also supposed to guard the wearers of them from fevers and pestilence. The price at Orenburg for the skins and tails was formerly twenty copecs per hundred. They were so common near Nischnei-Novgorod, that the peasants were wont to bring five hundred each to market, where they sold a hundred of them for a ruble.

Mygale Moschata.

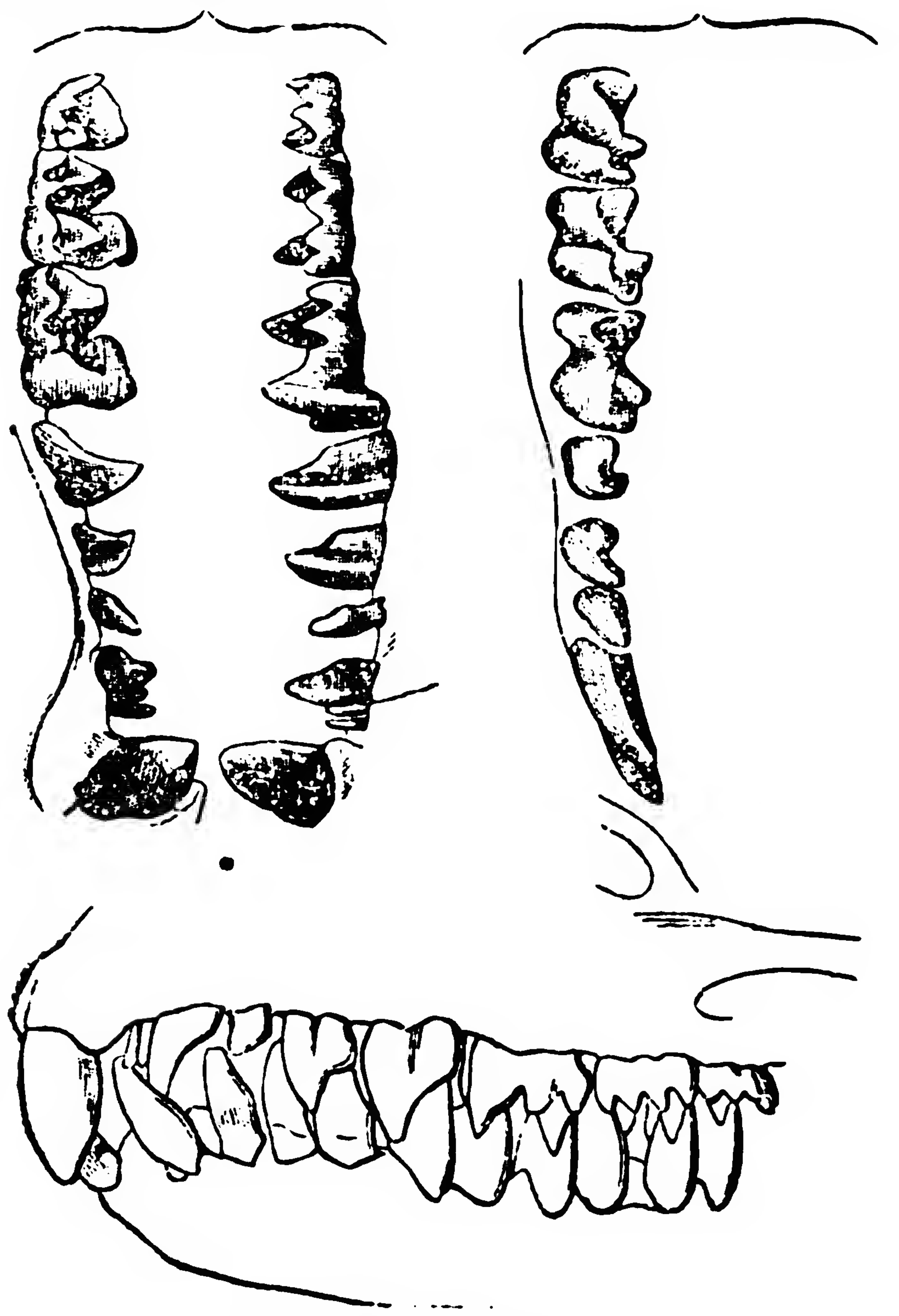
There is a species more than eight inches in length (*Mygale Pyrenaïca*) inhabiting Tarbes at the foot of the Pyrenees.

Scalops.

*Generic Character.*—Muzzle pointed and cartilaginous; no external ears. Three toes on the anterior feet, which are short, wide, and armed with strong claws fit for burrowing; posterior feet feeble, with five toes. Tail short.

Dental Formula:—Incisors $\frac{2}{2}$; grinders $\frac{10-10}{10-10} = 44$.

The above is the formula given by Dr. Richardson; but F. Cuvier (and he is followed by Lesson) makes the number 36, viz. Incisors $\frac{2}{4}$; canines $\frac{0}{0}$; molars $\frac{9-9}{6-6} = 36$. We subjoin the teeth as given by F. Cuvier, but Dr. Richardson's description appears to be very carefully given, and his accuracy is well known.



Teeth of Scalops.

Example, *Scalops Canadensis*, Cuv, *Sorex aquaticus*, Linn.

*Description.*—Body thick and cylindrical, like that of the common mole, without any distinct neck; limbs very short, being concealed by the skin of the body nearly down to the wrist and ankle-joints; fore extremities situated nearly under the auditory opening; the moveable snout almost linear, and projecting about four lines and a half beyond the incisors, naked at its extremity, particularly above, thinly clothed with hairs below for about two-thirds of its length next the incisors: a conspicuous furrow extends nearly its whole length, on the upper surface, and beneath there is also a furrow, reaching half its length from the incisors, beyond which last the snout is transversely wrinkled beneath, and its small, flat, or truncated extremity is smooth and callous; the small oblong nostrils open in an inclined space immediately above this circular callous end. The eyes are concealed by the fur, and scarcely to be found in dried specimens. According to Godman the aperture in the skin is just big enough to admit an ordinary human hair. The auditory openings covered by the fur, and no external ear; tail thickest about one-third from its root, and tapering thence to the acute tip; it is whitish, sparingly clothed with short hairs, and its vertebræ are equally four-sided; fore-arm slender, projecting about three lines from the body, and consequently concealed by the fur; the five extremely short fingers, united to the roots of the nails, form, with the wrist, a large nearly circular palm; the nails are large, white, and semilanceolate in form, with narrow obtuse points, convex above, and slightly hollowed beneath; the middle one is the largest, the others gradually diminish on each side, and the exterior one is the smallest; the palms are turned outwards and backwards, and the whole fore-foot bears a close resemblance to that of the common mole; the hind-feet are more slender than the fore-feet, and the nails are one-half shorter, much more compressed, and sharper, in fact nearly subulate. They have a slight curvature laterally corresponding with the direction of the toes inwards, and are somewhat arched, but cannot be said to be hooked; they are excavated underneath. Both fore and hind feet are thinly clothed above with adpressed pale hairs; the palms and soles are naked, but are bordered posteriorly with white hairs, which curve a little over them; the fur has the same velvety appearance with that which clothes the common mole, and is considerably lustrous on the surface. In most lights it is brownish-black; when blown aside, it shows a greyish-black colour, from the roots to near the tips. Such is the general colour over the whole body, but there is a slight chesnut-brown tinge on the forehead and about the base of the snout. On the throat the fur is shorter and paler. Length of head and body 7 inches 8 lines, and of tail 1 inch 6 lines. Such is, in substance, the accurate description by Dr. Richardson of this species, which, according to him, is the *Brown-Mole* of Pennant; the *Shrew-Mole* of Godman; the *Mole* of Lewis and Clarke; and the *Musaraigne-Taupe* of Cuvier.

*Locality.*—The banks of the Columbia and the adjoining coasts of the Pacific, where it occurs in considerable numbers. (Richardson.)

*Habits, &c.*—Dr. Richardson states that the Shrew-Mole resembles the common European mole in its habits, in leading a subterranean life, forming galleries, throwing up little mounds of earth, and in feeding principally on earth-worms and grubs. The individual domesticated by Mr. Titian Peale is described by Dr. Godman, who paid much attention to the manners of these animals, and who relates that they are most active in the early part of the morning, at mid-day, and in the evening, coming daily to the surface, when in their natural state, at noon. Then they may be taken by driving a spade beneath them, and throwing them on the ground, but they are hard to be caught at any other time of the day. They burrow in a variety of soils, but in wet seasons they retire to the high grounds. Mr. Peale's shrew-mole fed largely on fresh meat, cooked or raw, drank freely, was lively and playful, followed the hand of its feeder by scent, burrowed for a short distance in loose earth, and, after making a small circle, returned for more food. It employed its flexible snout in a singular manner whilst it was eating, in order to thrust the food into its mouth, doubling it so as to force it directly backwards.

The same author remarks that Sir Charles Mackenzie saw many animals, which he terms 'moles,' on the banks of a small stream near the sources of the Columbia; but as it may be inferred that they were in numbers above ground, Dr. Richardson is inclined to think that they were

*Sewellels*, belonging to the genus *Aplodontia* [MURIDÆ, vol. xv., p. 515], and not Shrew-moles; but the latter did not obtain recent specimens of the Shrew-mole during the expedition to which he was attached, and is unable to say what are the exact limits of its range to the northward. He does not think however that it can exist, at least on the east side of the Rocky Mountains, beyond the fiftieth degree of latitude; because the earth-worm on which the Scalops, like the German mole, principally feeds, is unknown to the Hudson's Bay countries. On the milder Pacific shore, it may, perhaps, he thinks, reach a somewhat higher latitude. He remarks that there are two specimens of the Shrew-mole from the Columbia preserved in the museum of the Hudson's Bay Company, and he states that Mr. David Douglas had kindly furnished him with others which he obtained in the same quarter. Dr. Richardson further observes that the Columbian animal seems to be of larger dimensions, and has a longer tail than the Shrew-moles of the United States, but he had not detected any other peculiarities by which it might be characterised as a distinct species; and he adverts to the fact that authors, probably from their specimens being of different ages, have varied considerably in their descriptions of the dentition of the Scalops, and that several of them have mentioned edentate spaces between the incisors and grinders. In the adult animal from which his description was taken, no such spaces existed.

M. Lesson makes the *Scalops Pennsylvanica* the type of his genus *Talpasorex*, acknowledging however that it only differs from *Scalops* in its dental formula, which he gives thus:—Incisors $\frac{2}{4}$; Canines 0; Molars $\frac{11-11}{6-6}=40$. It will be well for the student to bear in mind, with reference to the genus proposed by M. Lesson, Dr. Richardson's observations on the dentition of Scalops above noticed.

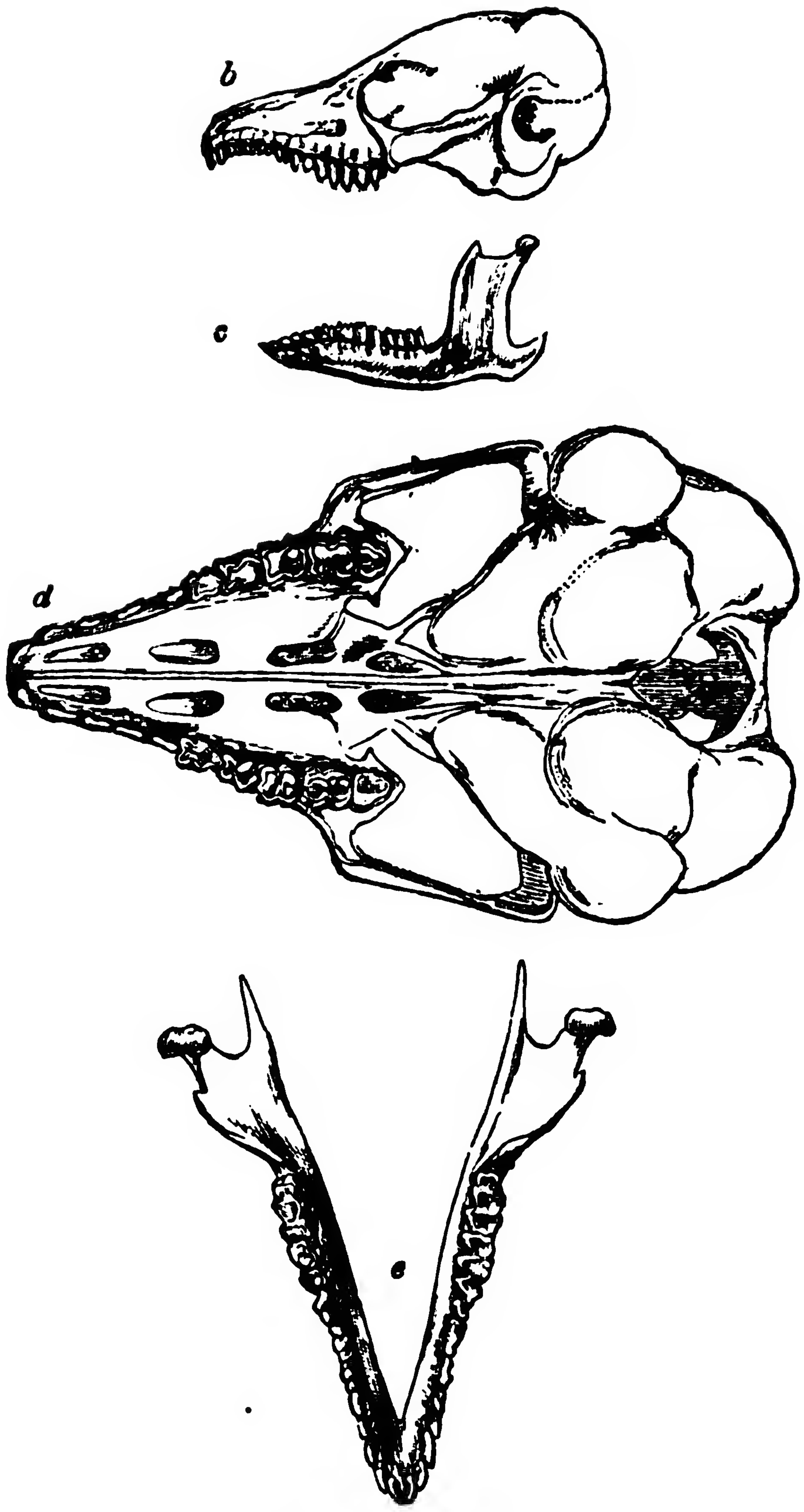
With regard to the question of the existence of true Moles in North America, the following remarks of the last-mentioned accurate and diligent author are also worthy of attention. 'From the great resemblance of the shrew-mole to the common one,' says Dr. Richardson, 'they might be readily mistaken for each other by a common observer; and Bartram and others, who have asserted the existence of a species of the genus *Talpa* in America, are, on this account, supposed, by later writers, to have been mistaken. There are however several true moles in the Museum of the Zoological Society which were brought from America, and which differ from the ordinary European species in being of a smaller size, and in having a shorter and thicker snout. Their fur is brownish-black. I could not learn what district of America they came from.' (*Fauna Boreali-Americana.*)

Scolops aquaticus.]

Macroscelides.

*Generic Character.*—Muzzle narrow, ending anteriorly in a long and subcylindrical proboscis, having nostrils at its apex. Eyes moderate. Ears large and round. Body furry. Tail elongated, scaly, annulated, and furnished scantily with hairs. Feet distinct, plantigrade, and five-toed; the claws falcular. Hind-legs much shorter than the fore-feet.

Dental Formula.—incisors $\frac{2}{2}$; canines $\frac{4-4}{4-4}$; molars $\frac{5-5}{5-5}$ = 40. (Smith.)




**Skull and teeth of Macroscelides Typicus.**

*a*, Upper surface of the skull of *M. Typicus*, nat. size; *b*, lateral parts of the same, nat size; *c*, lower jaw of the same, nat. size; *d*, under surface of the skull of the same, double the nat. size; *e*, lower jaw of the same, double the nat. size. (Smith.)

Example, *Macroscelides typicus.*

*Description.*—Above brown, brightened by an intermixture of tawny; beneath whitish; extremities covered with a very short whitish hair; ears within, scantily furnished with some of a similar colour, without, nearly bare; tail thinly clothed with a stiff short black hair; whiskers near the base of the proboscis, each hair variegated black and white; claws short, black, compressed, and pointed. Length from nostrils to root of tail four inches and three-quarters; length of tail three inches and a quarter.

The colour of both sexes is nearly alike.

*Locality, Habits, &c.*—Inhabits the open country in the interior of South Africa, and is occasionally seen during the day about the roots of bushes or amongst brushwood, from whence, upon being discovered, it instantly retreats to its natural and subterraneous habitation. (*Zool. Journ.*)

Dr. Smith, in his *Illustrations of the Zoology of South Africa*, thus further describes the appearance and habits of *M. typicus* which he had first recorded in the *Zoological Journal* under the name of *M. Typus*. 'The shape, breadth, and shortness of the ears, together with the comparatively dense coating of fur by which both their inner and outer surfaces are covered, enable us readily to distinguish this species from any of the others which have yet been discovered in Southern Africa. It is found inhabiting open arid plains, particularly such as bear a thin coating of brushwood. It lives in burrows under ground, the passage to which is usually for some distance below the surface almost perpendicular; it vacates these during a great portion of the day, and is employed either in seeking its food or basking in the solar rays. To the latter it is very partial, and for the purpose of insuring the greatest *quantum* of heat, it usually sits erect upon its hinder legs, and facing the direction from which the heat proceeds. When disturbed while occupied in either of the ways mentioned, it flies immediately to its subterranean retreat, and its progress is effected with such rapidity, that it is impossible to discover anything either of the form or the real nature of the animal as it advances. On this account I was familiar with the general appearance it presents on such occasions long before I had any idea of its real character. It feeds upon insects. The discovery of this little animal in 1828, rendered the institution of a new group of *Insectivora* necessary. When its characters were indicated in 1829, *M. typicus* was only known; at present the number of described species are seven, six of which belong to Southern Africa and one to Algiers.'

Dr. Smith, in the *Zoological Journal*, places this genus immediately after *Sorex*, and the reader will find most of the species beautifully depicted and accurately described in the *Illustrations of the Zoology of South Africa* above quoted.

This, or one of the species,—but most probably this,—seems to be the Elephant Shrew of Pennant, and thus described: 'S. with a very long, slender, and little nose; the whole animal of a deep brown colour. Inhabits the neighbourhood of the Cape of Good Hope: called the *Elephant*, from its proboscis-like snout: engraven from a drawing by Mr. Paterson.' Pennant further remarks that this animal has been very ill represented by Petiver, in Tab. xxiii. of his *Gazophylacii Naturæ et Artis Decas tertia*, and truly so it is: but Pennant's figure is not much better. Petiver's description is '9. *Mus araneus Capensis maximus*. Taken from a painting of Dr. Sherard's, now consul of Smyrna.'

SOREL. [CANADA.]

SOREL, AGNES. [CHARLES VII. of France.]

SOREX. [SORECIDÆ.]

SORGHUM, a genus of grasses, said to be named from the Oriental name of one of the species, of which *sorgo* is the Italian name. The species have sometimes been referred to Holcus, sometimes to Andropogon, but from their habit and uses they seem well entitled to be considered as a distinct genus, which may be characterized as having the flowers monœcious, panicled; glume coriaceous, cartilaginous, 2-flowered; the upper flower hermaphrodite, the lower palea more or less deeply bifid and awned between the lobes, the upper often wanting. The species form tall grasses with succulent stems, and are found in the tropical parts of Asia, whence they have spread to the warm parts of Europe. *S. vulgare* is the largest of the small cereal grains, and may be considered the representative of the Indian corn (*Zea Mays*) in America, where it is usually called Guinea corn, and in some works the Great or Indian Millet. The different kinds are usually called *joar* in India, where they form principal objects of culture, and one of much more importance than would appear in Europe, as many of the inhabitants live as much upon these small or dry grains as upon rice. The *joar* is the *durra* of some Arab tribes, and the *zurrut* of others; its Indian origin is indicated by the Persian name, *jawurs Hindee*. It is extensively cultivated throughout Asia, and appears to be the *tall corn* of the Chinese. It has been introduced into the south of Europe, where it is chiefly employed for feeding cattle and poultry, but it is also made into cakes. The flour is white and a good deal resembles that of the Indian corn in nature. The species commonly sown in India are *S. vulgare* and *S. bicolor* (*kala-joar*). *S. cernuum* is a distinct species, which forms the principal food of the mountaineers of the Munnipore district. *S. saccharatum* is also cultivated in many parts during the rainy and cold seasons, on land which is too high for rice. The stalks and straw of all are much valued as fodder for cattle, being cut in o small pieces, commonly called *kurbee*.

SO'RIA, a small province of Spain, bounded on the north by the province of Logroño, on the south by that of Siguenza, to the east by Aragon, and to the west by the province of Burgos. The capital, Sória, is situated on the right bank of the river Douro, about 30 miles from its source, in 41° 34′ N. lat. and 2° 24′ W. long. It is supposed to occupy the site of the antient Numantia. It owes its foundation to the Syrian Arabs, who settled in Spain after the conquest of the country by Músa, and gave it the name of Súria, whence Sória. The town is surrounded by a thick and strong wall, built in the year 1290, by one of the kings of Castile, and is commanded by a strong citadel, now in ruins, which is the work of the Moors. The population, according to Minaño, did not exceed 7000 souls in 1832. The chief trade of the inhabitants consists in the breeding of cattle, and a few tan-yards. It contains nine parishes, one of which is collegiate.

SORREL. [RUMEX.]

SORSO. [SARDEGNA.]

SORUS, in botany (from σωρός, 'a heap'), a term applied to the collections of the sporangia or capsules which are found on the edges or the under surface of the fronds of ferns. In most instances, as in the Aspidiaceæ, Aspleniaceæ, Davilliaceæ, &c., the sori are covered with a peculiar projecting portion of the epidermis, which is called the *Indusium*, and forms an important part in the systematic arrangement of these plants. In some instances, as in Adianthum and Ceratopteris, the substance of the leaf has a share in the formation of the indusium. It has been generally admitted that the indusium is the analogue of the bract in the higher plants, but Treviranus maintains that it is an entirely peculiar organ, nor, according to this view, can it be looked upon as a mere extension of the epidermis. In looking for analogies between flowering and flowerless plants, Kölreuter supposed that the indusium represented the stamens. [SPORE.]

The term sorus is sometimes applied to mere collections of spores or granules, as seen in many Algæ, of which *Delesseria alata* and *D. sinuosa* are examples.

SOSI'GENES, an Egyptian astronomer, who was brought to Rome by Julius Cæsar, to superintend the correction of the calendar. He is said to have lived at Rome till the time of Augustus, and to have assisted in the further correction which took place in the reign of that emperor. But beyond this nothing is known of his life, death, or pursuits. For some detail of the correction see YEAR.

SOSPELLO. [NICE.]

SO'STRATUS of CNIDUS. [ALEXANDRIA.]

SOTHIAC PERIOD. The antient Egyptian year consisted only of 365 days, without any intercalation; and was divided into 12 months of 30 days each, with 5 days added at the end. (Herodotus, ii. 4.) The Scholiast on Aratus informs us that the priests were sworn never to alter this year. This oath, we may conjecture, only came into use after the discovery of the fact that a fraction of a day more would have been desirable to make the civil year conform to the sun. As long as 365 days was imagined to be the real year, it is not likely that they would have sworn each other to its observance; but if, after the discovery, a party were formed in favour of an alteration, the attempt to preserve the antient institution by an oath would be almost a matter of course. Again, Diodorus Siculus (i. 50) says, that the Egyptians add five days and a quarter to the 360 days of their 12 months, which statement is generally supposed to refer to a more correct year which had been introduced among the people, while their religious festivals continued to be regulated by the old year. The propriety of this mode of reconciling the two authorities is made probable by the known existence of the Sothiac period (also called the Canicular year, Annus Magnus, &c., derived from Sothis, a name for the star Sirius) mentioned by Geminus, and also by Censorinus and Clement of Alexandria, from older writers. It is obvious that 1461 years of 365 days each, make 1460 years of 365¼ days. This period of 1460 Julian years was the Sothiac period. It is impossible to fix any time at which this period was introduced, or to say whether, during its existence as a recognised cycle, it had time to run its whole career. Had it been a real cycle of experiment, it must be imagined that it would have been found to be wrong, to the extent of requiring an addition to the oath; for 1508 real years is nearer to the time in which a year of 365 days would have its beginning in all the seasons successively, and recommence the same process. It is obvious that such a cycle of recurrence was the intention of the Egyptians in constructing the period: their vague year (*annus vagus*) of 365 days, combined with their nearly fixed festivals, depending upon the heliacal rising of Sirius, made the latter take all consecutive positions among the months of the former, gradually falling later and later. Again, if the Egyptians had really gone through a whole recorded period, it is difficult to see how they would avoid discovering that another cycle would be necessary. In the time of their antient kings the heliacal rising of Sirius would have advanced, by the precession of the equinoxes, about 12 days in one Sothiac period. The beginning of the vague year (365 days) was continually falling back; so that if at the beginning of a period they had noted the day of their vague year on which the equinox fell, and also the day on which Sirius rose heliacally, they would have found that the latter came again to the same day of the vague year fifty years, or thereabouts, before the equinox was similarly restored. This, so far as the star was concerned, would fit their erroneous period very well (1460 instead of 1508); but it is difficult to suppose that astronomers who had discovered the odd quarter of a day which the year requires, should not know within 12 days the time of the equinox. But, on the other hand, those who incline to believe in a very long period of star-gazing, too rude to be called observation, may assert the possibility of a period of 1460 years, or thereabouts, being discovered by noting the period elapsed between successive heliacal risings of Sirius on the same day of the vague year, and the theory of the discovery of the additional quarter of a day must be looked upon as a subsequent (and of course mistaken) mode of explaining the period.

The epoch of commencement of a Sothiac period is not well determined, and only from comparatively modern writers. Censorinus asserts that the consulship of Ulpius and Pontianus (usually placed in A.D. 238) was in the hundredth year of such a period: accordingly B.C. 1322 was the beginning of the preceding period. Clement of Alexandria says that the period began 345 years after the migration of the Israelites from Egypt, a date which differs considerably from that of Censorinus, according to modern chronologers. The point is however of no importance, as no dates were ever recorded in written history by means of Sothiac periods.

SOTIES. [ENGLISH DRAMA, p. 416.]

SOTO, DOMINGO, a learned Spanish ecclesiastic, was born at Segovia, in 1494. His father, who was a gardener, destined him for the same occupation, but seeing him make rapid progress in his studies, he gave him as good an education as his means could afford, and placed him as sacristan to the church of a neighbouring village. Having, whilst there, rendered himself qualified for the study of philosophy, Soto repaired to the university of Alcalá, where he made the acquaintance of a young nobleman named Saavedra, who took him to Paris as one of his suite. Soto pursued his studies there, and received the degree of master of arts. On his return to Spain, in 1519, he taught philosophy, first at Alcalá, and then at Salamanca; and in 1524, entered into the Dominican order. It was about this time that he published his treatise on the Dialectics and Physics of Aristotle, entitled 'Summulæ,' Salamanca, 1525, 4to. So high was his reputation for ecclesiastical learning, that in 1545 the emperor Charles V. sent him as his first theologian to the council of Trent, where he became one of the most active and esteemed members of that assembly. As he spoke frequently, and was consulted on difficult points of canonic law, he was one of the members charged with recording the decisions of the assembly and drawing up its decrees. This peculiar distinction was the more remarkable, as there were above fifty bishops and several eminent theologians of the same order as his in the assembly. Finding that a brother of his own order, named Catharin, dissented from him on several material points, he composed his 'Apologia contra R. Patrem Ambrosium Catharinum, qua ipse de certitudine gratiæ respondet,' which was afterwards published at Antwerp, 1556, fol., and Salam., 1574, fol. On his return from the council Charles V. appointed him his confessor, and offered him the bishopric of Segovia, which he declined. He was soon after chosen by that monarch to arbitrate in a dispute pending between Las Casas and Sepulveda respecting the Indians, which he decided in favour of the former. [SEPULVEDA.] In 1550 Soto left the court and retired to Salamanca, where he died on the 17th of December, 1560, at the age of sixty-six. Besides the above-mentioned works, Soto wrote the following:—'In Dialecticam Aristotelis Commentarii.' Salmanticæ, 1580, fol.; 'In Categorias Aristotelis Commentarii,' Venetiis, 1583, 4to.; 'De Natura et Gratia Libri iii.,' Antwerp, 1550; 'De Justitiâ et Jure,' Antw., 1568. In this last treatise Soto defends the proposition which he had maintained at the council, 'that the residence of bishops is of divine right.' 'De Cavendo Juramentorum Abusu,' Salmanticæ, 1552, and several more, a list of which may be seen in Nicolas. Ant., *Bib. Hisp Nova*, vol. i., p. 332.

SOUBISE, BENJAMIN DE ROHAN, baron of Frontenai, and brother to the famous Duc de Rohan. [ROHAN.] He was born in 1589. Under Maurice of Nassau, in Holland, he learnt the art of war. Soubise was through life a zealous reformer, and figures in all the assemblies of the Huguenots for putting in force the Edict of Nantes. In 1615 he joined the party of the Prince de Condé, but the civil war terminating shortly after, he has little opportunity for exhibiting that audacity and those talents for intrigue which he subsequently displayed in the religious wars which commenced in 1621. His reputation for courage and his talents as a leader induced the assembly of Rochelle to give him the general command in Bretagne, Anjou, and Poitou. Undazzled by the brilliant offers which had seduced so many of the corrupt chiefs to submit to the court, Soubise, with his brother, the Duc de Rohan, remained true to their party. But seeing themselves deserted by their friends and reduced to despair, they resolved on a decisive blow, and proclaimed open war against the king. Louis XIII. marched against them in person, and commenced the siege of Saint Jean d'Angeli. Soubise undertook its defence, and with his usual audacity, when summoned to surrender, he wrote the following reply:—'I am his majesty's very humble servant, but the execution of his commands is not in my power. Benjamin de Rohan.' The siege was vigorously pressed, but it was not till after a month's hard fighting that the place surrendered. On the entrance of the royal army, Soubise, throwing himself on his knees before Louis, vowed inviolable fidelity. 'Serve me better than thou hast done hitherto,' replied the king, and pardoned him.

The 'inviolable fidelity' of Soubise disappeared with the absence of danger, and accordingly we find him very soon after flying to Rochelle, there to form new intrigues. He was not so warmly seconded however as he had anticipated. He soon after collected a few troops and seized Royan; and in the winter of 1622 made himself master of Bas-Poitou, together with the isle of Ré, Perier, and Mons. This success drew 8000 men to his standard, with whom he seized Olonne, and threatened Nantes. Louis again marched to meet him, and routed his army after a short conflict. Soubise escaped to Rochelle, whence he passed over to England to ask for succour, but failing, he went to Germany, and with no better success. The king declared him a rebel, but by the edict of pacification published at Montpellier, October 19, 1622, he was restored to his honours and estates.

Peace tired him, inactivity was abhorrent to him; and restless unless plotting, Soubise soon recommenced intriguing with Spain and England, and, in the beginning of

1625, he again appeared as a traitor; and publishing a manifesto, seized the isle of Ré, with three hundred soldiers and one hundred sailors. Encouraged by this success, he descended on Blavet in Bretagne, where the royal fleet was at that moment; and suddenly attacking one of the largest ships, boarded it, sword in hand. He took the other ships in succession, and then attacked the fort. He was repulsed in his attack on the fort; and after a fruitless siege of three weeks, he set sail for the isle of Ré with fifteen ships. He seized the isle of Oleron, and was thus master of the sea from Nantes to Bordeaux.

His daring had surprised every one; and the Huguenots, who had bitherto regarded these exploits as those of a brigand, now acknowledged him chief of the reform. The king, occupied with the Spanish war, offered him the command of a squadron of ten ships in an expedition against Genoa, as an honourable way of returning to his allegiance. Soubise refused the offer; and naming himself admiral of the Protestant church, persisted in the war. Attacked by the Royalists near Castillon, he regained his ships with a precipitation very unfavourable to his reputation for courage. We may observe that his life exhibited a contrast of audacity and cowardice. He was more reckless than bold, more vehement than courageous. On his return to the isle of Ré, he was met by the royal fleet, augmented by twenty Dutch vessels. As he was still in negociation with the court, he obtained a suspension of arms, and the two admirals exchanged hostages. Without awaiting the result of the negociation, Soubise redemanded his hostages, which were returned by the Dutch admiral, on the condition that the suspension of arms should not terminate till news was received from the court; but Soubise suddenly attacked the fleet, and fired the admiral' ship. The result of this perfidy was the confirmation of Louis in his pacific intentions with regard to the Protestants; but the people of Rochelle, blinded by prosperity, were more exacting in proportion to the concession of the court, and the war continued. On the 15th September, after a sharp conflict, Soubise was beaten by the royal fleet; and quitting his ship, he regained the isle, where the victorious royalists had landed, and attacked them with 3000 men. Here too his army was vanquished, and he saved himself by ignominious flight.

He again came to England. Charles I., interposing on behalf of the French Protestants, obtained for them a new edict of pacification, April 6, 1626. Soubise was created a duke; but he still remained in England, endeavouring to win over the Duke of Buckingham to support the Huguenots, and he succeeded. Louis seriously determining to besiege Rochelle, Soubise prevailed on Buckingham to put himself at the head of a fleet, which Soubise conducted to Rochelle; but the Rochellois refused to admit the English ships into their port, or Soubise within their walls. Soubise returned to England and solicited a second fleet, which, commanded by Denbigh, Buckingham's brother-in-law, was equally unsuccessful. Nothing daunted, he again returned to England; and after pressing Charles for some time, had a third fleet granted, under the command of Buckingham. This fleet was at Plymouth, ready to start; but Buckingham, having quarrelled with Soubise, annoyed him by all sorts of delays. On the 2nd September, 1628, the two had an animated discussion in French on the point, which the officers who were present, not understanding the language, viewed as a quarrel. A few hours after this Buckingham was stabbed by Felton. In the first moment of horror at the murder, the officers accused Soubise and the deputies of the deed, and the infuriated people were about to sacrifice them, when Felton declared himself.

The command of the fleet was then bestowed on the Earl of Lindsey. When they arrived before Rochelle, Lindsey repulsed all Soubise's proposals, and it was found impossible for them to act in concert. Meanwhile Rochelle capitulated; but Soubise, refusing the conditions proposed by Louis, returned to England, where he ceased not to intrigue against nis country His restless career was terminated in 1641, when he died, regretted by few and less respected. (*Biog. Univ.*; Voltaire, *Siècle de Louis XIV.*)

SOUBISE, CHARLES DE ROHAN, born July 16, 1715. He was an inefficient general, but a fortunate courtier; for, befriended by Louis XV., he became maréchal of France, minister of state, and allied to royalty itself. His life was tinged with many licentious and foolish acts, but his bravery and generosity gilded over his faults and vices. He married Mdlle. de Bouillon, daughter of the chamberlain of France. She died soon after the birth of her first child, a daughter, whom he subsequently (1753) married to the Prince de Condé. In 1745 Soubise married the Princess Christina of Hesse-Rheinfels. He served Louis as aide-de-camp in all the campaigns of 1744 to 1748, and is thus alluded to by Voltaire:—

'Maison du roi, marchez, assurez la victoire;
Soubise et Pecquigny vous menent à la gloire.'

His services were rewarded by the appointment of field-marshal in 1748, and in 1751 with the government of Flanders and Hainault. Being defeated by the Prussians at Rosbach, he returned to court, the object of a thousand malicious epigrams. The favourite of Madame Pompadour, he was hated as a favourite by all the other courtiers; but Louis remained firm in his attachment to him, and made him minister of state, with a pension of 50,000 livres.

In 1758 he commanded a new army, burning to efface the disgrace of Rosbach, and defeated the Hessians, Hanoverians, and English, first at Sondershausen, July 13, and next at Sutzelberg, Oct. 10, by which he completed the conquest of the landgraviat of Hesse. When Louis XV. had taken Madame Dubarry as his mistress, and presented her at court, the ladies refused to receive her, or acknowledge her presence, except in the most distant manner Soubise induced the Countess de l'Hôpital, his mistress, to rece ·e her at her house. This delighted Louis, and made Madame Dubarry his friend. Soubise indeed carried his venality so far as to consent to the marriage of his cousin Mdlle. de Toromon with the Vicomte Dubarry, the favourite's nephew; but we must add however, as a set-off to this baseness, that on the death of Louis, Soubise alone of all the courtiers followed the funeral procession, which consisted only of a few valets and pages, and never left the remains of his kind master till he saw them fairly deposited in the tomb. He had resolved to retire from the court, but Louis XVI. touched with his fidelity, requested him to retain his place as minister, which he did. He died on the 4th July, 1787. (*Biographie Universelle*; Voltaire, *Siècle de Louis XIV.*)

SOUFFLOT, JACQUES GERMAIN, was born at Irancy, near Auxerre, in 1713. His parents gave him a good education, but without any intention of bringing him up to the profession to which his own inclination strongly prompted him. Fortunately, instead of attempting to thwart this bias, his father assisted him in pursuing the requisite preparatory studies. At what time he went to Rome, where, through the influence of M. de Saint-Aignant, the ambassador, he was admitted as a pensionary at the French academy, is not precisely known, but he remained there three years, after which he spent several more at Lyon where he commenced the practice of his profession; and besides the Exchange (now converted into the Protestant church), and some other works of less importance, he executed one of the largest public edifices in that city, the Great Hospital, the façade of which is somewhat more than 1000 feet in extent. The distinction he thus acquired caused him to be invited to Paris, where he was admitted into the Royal Academy of Architecture. Within a short time an opportunity presenting itself of revisiting Italy, in company with M. de Marigny (Madame Pompadour's brother) the superintendent of the crown buildings, he availed him self of it, and examined the antiquities of Pæstum in 1750. [PÆSTUM, ARCHITECTURE OF.] In 1754 he was again em ployed at Lyon to erect the Grand Theatre, which was capable of containing 2000 spectators, and was considered to be excellently contrived in every respect, but has since been replaced by another structure.

It having been determined to rebuild the antient and greatly decayed church of St. Généviève, several architects presented designs for the new edifice, among which those by Soufflot obtained the preference; and in 1757 the works commenced, but they proceeded so slowly, that the ceremony of laying the first stone by Louis XV. did not take place till the 6th of September, 1764. [PARIS, page 257.] In this work Soufflot entirely changed the system which had till then prevailed in all the modern churches of Paris; and although he could not attempt to rival the magnitude of St. Peter's at Rome, or St. Paul's, London, his aim seems to have been to produce greatness of effect of a different kind, together with decided difference of character. Avoiding two orders, as in the latter building, and the attached columns and heavy attic of the former, he has employed a single order of insulated columns 60 feet high as a prostyle, occupying the entire width of the façade at that extremity of the cross; and has moreover confined the order to that feature of the building, the entablature alone being continued along the other elevations, which else present little more than unbroken surface of solid wall, a circumstance that gives the whole a degree of severity, not to call it nakedness, that contrasts most strongly with the breaks and multiplicity of parts in the two other buildings. The portico itself is therefore a feature which strikingly distinguishes this from both the Italian and the English church. Like St. Paul's, Soufflot's edifice has a Corinthian peristyle of thirty columns, encircling the tambour of the dome, with the difference that all the columns are insulated, whereas in the other instance eight of them are attached to four *massifs*, or piers. Another marked distinction in regard to the effect of the dome in the exterior composition generally is, that the plan of the building being a Greek cross, it comes in the centre, consequently is not thrown so far back from the front as in the other two instances. In the interior, again, Soufflot's design differs from them still more: it has colonnades, comparatively shallow as to depth, instead of aisles separated from the naves by massive piers and arches; neither has it any windows, except in the tambour of the dome and the arches in the vaultings of the roof, so that the light is admitted entirely from above. In consequence however of settlements and fractures taking place, it was afterwards found necessary to deviate from the original plan, filling up the spaces between the columns at the four angles beneath the dome, so as to convert them into solid piers. These remarks might be greatly extended, but the only one we will add is, that a detailed parallel between this edifice, St. Peter's, and St. Paul's, might be rendered a highly interesting architectural disquisition, especially if illustrated with drawings made to the same scale.

Soufflot did not live to see his great work completed, for he died on the 29th of August, 1781, after which period many repairs in the construction took place, an account of which, and criticisms npon the building, may be found in Wood's 'Letters of an Architect,' vol. i. At the time of the Revolution, the destination of the building was changed, and it was then called the Pantheon, by which name it is still generally spoken of, although now restored to its original purpose, and the dome, &c. decorated with paintings by Gros and others. Among other buildings by Soufflot may be mentioned the Ecole de Droit (1775) in the Place du Panthéon (which last formed part of his plan for a uniform architectural area round the church), the Orangery at the Château de Menars, the sacristry of Notre Dame, and several private hotels.

SOUI-MANGA. [SUN-BIRDS.]

SOULTZ. [RHIN, HAUT.]

SOUND. [ACOUSTICS.]

SOUND-BOARD, or SOUNDING-BOARD, a board placed over a pulpit or other place occupied by a public speaker, to reflect the sound of his voice, and thereby render it more audible. Sounding-boards are usually flat, and placed horizontally over the head of the speaker; but a different form and position, contrived by the Rev. J. Blackburn, of Attercliffe-cum-Darnell, near Sheffield, has been adopted in some cases with great advantage. In the new church erected at that place in 1826, it was found that the speaker's voice was rendered so indistinct and confused as to be scarcely audible, and the common sounding-board was tried, but with very imperfect success. The body of the church is 95 feet long, and 72 feet wide; but the extreme length is increased to 105 feet by an elliptical recess at the east end, 32 feet wide, and 10 feet deep. The extreme height from the floor to the roof is 56 feet, and the roof is groined and vaulted. In the hope of overcoming the difficulty, the pulpit was tried in several different situations; but that finally chosen was in the centre of the church, 15 feet in advance of the altar rails; the floor of the pulpit was about 9 feet above that of the church. All other means having failed, Mr. Blackburn conceived that the object might be attained by the use of a concave parabolic sounding-board, so placed as to intercept and reflect to a distance the sound that would otherwise escape behind the speaker, and echo in the vaulted roof. The experiment succeeded perfectly, and similar sounding-boards have been erected in other places with great advantage. The Rev. W. Farish, Jacksonian professor in the university of Cambridge, had one put up in his church, and states that he could, by its assistance, converse in a low whisper with a person in any part of the building. He recommends that the mouth of the speaker should be a little behind the focus of the reflector. Mr. Blackburn's reflector, or sounding-board, was made of pine-wood, and so ornamented as to have a handsome appearance. 'The surface,' he states, 'is concave, and is generated by half a revolution of one branch of a parabola on its axis.' The axis is inclined forward at an angle of about 10° or 15° to the plane of the floor, so that the sounding-board comes partly over, but chiefly behind the speaker. Models of the pulpit and sounding-board were exhibited to the Royal Society in 1828, and subsequently deposited in the museum of the Society of Arts; and full descriptions have appeared in the 'Philosophical Transactions,' vol. cxviii., p. 361; the 'Transactions' of the Society of Arts, vol. xlviii., p. 192; and in an octavo pamphlet, published in 1829, entitled 'Description of a Parabolic Sounding-Board erected in Attercliffe Church.' Mr. Blackburn concludes his pamphlet by suggesting whether, in erecting a new church, it might not be advisable to give to the east end of the building itself the form of a paraboloidal concave, and to place the pulpit in its focus.

SOUNDINGS, in hydrography, are properly the depths of water in rivers, harbours, along shores, and even in the open seas; but the term is also applied to the nature of the ground at the bottom of the water.

If the operation of taking soundings is to be performed while the vessel is in motion, and the depth of the water is comparatively small, a man who is stationed for the purpose in the main or mizen chains, on the windward side, throws out a mass of lead, which is attached to one end of a line between 20 and 30 fathoms in length. On this line are fixed, at intervals of two or three fathoms, pieces of leather or cloth of different colours; and the mark which is next above the surface of the water when the lead strikes the bottom affords an indication of the depth.

The sounding-lead is usually in the form of a frustum of a cone, and weighs eight or nine pounds. The man takes care to throw it towards the head of the vessel, so that as the latter advances the line may be nearly in a vertical position when he observes the mark. That which is called the deep-sea lead is a mass of metal, weighing from 25 to 30 lbs., and attached to a line of great length, on which at the distance of every ten fathoms are knots expressing the number of times ten fathoms in the depth (thus five knots denote 50 fathoms, &c.): it is used nearly in the same manner as the hand-lead, but generally the motion of the ship is stopped before it is thrown, in order that the line may be as nearly as possible in a vertical position when the depth is observed. The bottom of the lead is covered with a coating of tallow for the purpose of ascertaining, by the sand, shells, or other matter which may adhere to it, the nature of the ground.

When soundings are to be taken in the survey of a coast, a harbour, or the mouth of a river, the surveying ship and its boats are disposed at convenient distances from each other (suppose from two to five miles), so that the lines imagined to join them and any remarkable objects, should there be such, on the shore, may form triangles as nearly as possible equilateral. If the number of boats are not sufficient, the deficiency may be supplied by beacons formed of water-casks. The distances of the boats or beacons from one another and from the ship, when all have been moored, may be ascertained by the velocity of sound, guns being fired for this purpose, or by observing the angle subtended by the known distance from the surface of the water to the top of a mast; but the officers in the ship and boats observe also the angles which lines supposed to join their several stations make with one another, and thus the positions which they occupy may be determined. The boats then row or sail along the directions of the lines joining each other, sounding as they proceed at equal intervals, suppose ten minutes, of time. If it be necessary to sound close to a reef or shore, or within the mouth of a river, the boats move from one remarkable point to another, taking such angles as may be necessary to determine the positions of those points, and sounding as before: thus the outline of the shoal, reef, coast, or river will be determined, as well as the depth of the water. All the soundings must be afterwards reduced to the depths below the surface of the sea at the level of low-water.

In order that the rise and fall of the tide may be ascertained, the ship should remain in its position during twenty-four hours, and at certain intervals of time the depth of the water should be observed. For this purpose the ship is usually provided with a graduated pole about fifty feet long, and having at its lower extremity a heavy mass of lead; this pole, being let fall into the sea, retains a vertical position in consequence of the ballast attached to it, and the graduation at the surface of the water expresses the depth. When this depth exceeds the length of the pole, the sounding-lead must of course be used.

It is sometimes difficult to ascertain the precise moment when the lead strikes the bottom; and to meet this inconvenience an electro-magnetic sounding apparatus has been invented by Mr. Bain, who has contrived also some other recently ingenious machines for rendering available the power of electricity. The line itself is formed of wires, protected from the action of the water; and it is so arranged that the electrical current shall be uninterrupted so long as the ring attached to the weight remains in contact with the ring or hook at the lower end of the line, but shall be broken when, owing to the lead touching the bottom, the contact of the rings is interrupted. The effect thus produced is instantaneously communicated through the wires to an apparatus on deck, where it causes a bell to ring. This invention is exhibited at the Polytechnic Institution, in Regent Street, London.

**SOUSLIK**, the name of certain marmots with cheek-pouches (*Spermophilus*, F. Cuv.).

The European and Asiatic *Souslik*, or *Zizel* (*Mus Citellus*, Linn.), has the face cinereous and a white line over each eye. The teeth are yellow and the whiskers black and long. It is grey-brown above, undulated or spotted with white below.

There appear to be several varieties. One spotted (guttatus); one undulated (the Zizel); and a third of a yellowish uniform brown (*Yevrashka* or *Jevraschka*, the Siberian Marmot). Length a foot: that of the tail to the end of the hairs four inches and a half.

*Geographical Distribution.*—Bohemia, Austria, Hungary; from the banks of the Wolga to India and Persia, through Siberia and Great Tartary to Kamtchatka; some of the intervening isles, such as Kadjak; and even the continent of America itself. (Pennant.)

*Habits, &c.*—This marmot or ground-squirrel (as these *Spermophili* have been termed from their more slender forms) burrows and provides for its winter food by laying up a magazine of corn and nuts. Some inhabit the fields, and their holes have a double entrance: others inhabit granaries, and these are said not to sleep in winter like the field sousliks, but to remain in motion during the cold season. They sit in multitudes near their holes, and only one inhabits each burrow. The females remain separate from the males except during the breeding season, which is in May, and produce from five to eight young ones: these they bring up in their burrows and cover with hay.

The sousliks are very quarrelsome among themselves, and bite very hard. They whistle like the common marmot. They are supposed to be very fond of salt, and have been taken in numbers on board the barges laden with that commodity at Solikamsky, which drop down into the Wolga below Casan The sousliks are said to have an appetite for flesh, and to feed on the young of little birds and the lesser mice, as well as on corn, nuts, &c.

*Utility to Man.*—Pennant says that the Bohemian ladies were wont to make cloaks of the skins of these animals; and adds, 'we see them at this time made use of for linings, and appear very beautiful for that purpose, especially the spotted kind.'

Dr. Richardson, in his *Fauna Boreali Americana*, notices the *American Souslik* ('*Arctomys* (*Spermophilus*) *guttatus Mus Citillus* var. *guttata*, Pallas?, *Spermophilus guttatus*, Temm.?') Dr. Richardson says, 'Mr. Douglas brought a small marmot from the western side of the Rocky Mountains, and several injured specimens of the same species exist in the museum of the Hudson's Bay Company. I can detect no external characters (except that the spots on its fur are more crowded and indistinct) to distinguish it from the *Mus Noricus* of Agricola, or Hungarian Souslik, which I know only from the descriptions and figures given by authors; but a skull of the latter preserved in the College of Surgeons, although of the same size with the American animal, differs from it in having a more arched facial line, and in possessing an uniform degree of curvature from the occiput to the end of the nose. The American Souslik has a convex nose, with the frontal bone depressed between the orbits, as in the *A. Richardsonii*. It resembles the *A. Parryi* very closely in the colours and markings of its fur, though it has not, when recent, one-third of the weight of that animal, and its feet and claws are much smaller, being less than those even of the *A. lateralis*. I have been able to collect no particular information respecting its habits. It seems to be confined to the western declivity of the Rocky Mountains. Buffon mentions that the name of Souslik, given to the *A. guttatus* on the Wolga, is intended to express the great avidity that animal has for salt, which induces it to go on board vessels laden with that commodity, where it is often taken.'

The description of the *Prairie Marmot*, or, as it is often called, the *Prairie Dog* (*Arctomys* (*Spermophilus*?) *Ludovicianus*) will be found under WISTONWISH.

**SOUTH FERRY**, properly and generally called Ferry-port-on-Craig, a small seaport village in the county of Fife situated about 12 miles north-east from Cupar, the county town, and 10 north from St. Andrews. It lies on the margin of the left banks of the Tay, sloping towards the river, and near to its mouth. There is a good and convenient stone pier, where vessels of considerable burthen can discharge at high water, and great numbers not unfrequently come to anchor in the roads, to wait for favourable weather previous to putting out to sea. A passage-boat crosses at every alternate hour to Broughty Ferry, which stands close on the opposite shore, and a trader sails daily to Dundee, whence steam-boats ply regularly to and from Perth, and during the greater part of the year the steam-vessels which ply betwixt Edinburgh and Dundee touch here in landing and taking passengers on board. The salmon fishery, both by coble and stake net, and ship-building, are carried on to a pretty considerable extent. The inhabitants are chiefly employed in weaving and navigation. A line of railway is at present in contemplation through the county as a means of communication betwixt the shores of the Forth and the Tay, crossing the latter river at or near this village, and joining the Dundee and Arbroath railway on the opposite side. In 1831 the population was 1680 (*Communication from Scotland.*)

**SOUTH POLAR COUNTRIES.** The southern hemisphere, as is now well known, contains a much less proportion of land to sea than the northern. But it was formerly supposed that the remote and then unknown parts of the southern hemisphere were occupied by an extensive continent, which surrounded the antarctic pole, and extended to a great distance from it. This imaginary continent, called *Terra Australis Incognita*, makes a conspicuous figure on all maps which are more than a century old. Nothing could be adduced in support of the supposed existence of this continent, except the fact that a coast had been seen in 1599 by Dirk Gerritz, a Dutchman, west of Cape Horn, but in a much higher latitude. His vessel, which belonged to a Dutch fleet commanded by James Mahu, on leaving the straits of Magalhaens for the Pacific, had been separated from the other vessels, and carried by winds and currents as far south as 64°, where he found a lofty coast, which Gerritz compared with that of Norway. He was unable however to determine the position of this newly discovered coast. It is probable that the coast which he saw was that which Biscoe discovered in 1832, and called Graham's Land.

In the middle of the last century, when the spirit of maritime enterprise was active in Great Britain, and the Pacific particularly attracted attention, it was determined to solve the problem of the existence of this Terra Australis, and Cook undertook his second voyage (1772-1775) for the purpose. He found large masses of floating ice, and only in three places succeeded in penetrating beyond the antarctic polar circle. In one place he attained 71° 10′ S. lat., but he was generally unable to go much farther south than 60° S. lat. This was the case between 90° and 150° E. long., within which limits the most extensive and continuous line of coast was discovered two years ago. This line of coast however lies between 4 and 5 degrees south of Cook's track. As Cook had found no land south of 60°, the Terra Australis disappeared from our maps, though he himself thought that there must be land in the vicinity of the pole, being convinced that ice can only be formed in the neighbourhood of land.

Thus the matter rested up to 1819, when the South Shetland Islands were seen by William Smith, on a voyage from Monte Video to Valparaiso. This discovery rekindled the spirit of enterprise in Great Britain and other countries. In 1821 Powell discovered Trinity Land, south of the South Shetlands and the South Orkneys, between 60° 30′ and 61° S. lat., and 44° 30′ and 46° 30′ W. long. Palmer, an American, discovered a coast-line west of Trinity Land, which is called Palmer's Land; and the Russian navigator Bellingshausen discovered Alexander's Land, south-west of Palmer's Land. All these lands are south and west of the South Shetland Islands. In 1823, Weddell tried to find land east of the meridian of these islands. He did not find land, but he succeeded in advancing as far as 74° 15′ S. lat., where he found a sea clear of ice. In 1831 and 1832 Biscoe sailed round the icy masses which enclose the south pole, and added to former discoveries Enderby's Land and Graham's Land. The first lies at a great distance from the countries south of the Shetland Islands, between 49° and 51° E. long.; but Graham's Land is between Alexander's Land and Palmer's Land. Thus a nearly continuous coast-line has been discovered south and west of the South Shetland Islands, extending from 36° to 70° W. long., and comprehending from east to west Trinity Land, Palmer's Land, Graham's Land, and Alexander's Land. In 1833 Kemp sailed towards Enderby's Land, and found certain indications of land to the east of it, though he was prevented by ice from approaching near enough to see it. In 1837 the French government sent some vessels to these parts, under the command of Dumont d'Urville, who explored the coast which Powell named Trinity Land, and changed its name to that of Louis-Philippe's Land. In the following year Balleny directed his course to those parts of the ocean which are south of New Zealand and Australia, and discovered some islands near 165° E. long., which he called Balleny Islands. He also discovered a projecting coast-line near 116° E. long., which was called Sabrina Land. But the largest tract of sea-coast was discovered in 1840. In 1839 the French government and that of the United States of North America sent out expeditions for the purpose of making discoveries in the antarctic seas. The French expedition consisted of two vessels, under the command of Dumont d'Urville, and the American of four vessels commanded by Charles Wilkes. Both directed their course to the seas which the year before had been visited by Balleny. Wilkes found a coast-line in 154° 27′ E. long.; and in continuing his course westward for four weeks, he had either always a coast in sight or unequivocal indications of land being at no great distance. He advanced as far as 97° 30′ E. long., so that, including Sabrina Land, he discovered a coast-line extending over near fifty degrees of longitude. Dumont d'Urville reached the same coast in 140° 41′ E. long., and pursued his course westward to 130° E. long. He called it Adélie Land. It is remarkable that the coast of this Antarctic Continent, for this appellation cannot be denied to it, lies near the polar circle, either to the south or to the north of it, and this is also the case with Enderby's Land and Graham's Land, both of which are traversed by that line. Only the tract of coast south of the South Shetland Islands extends farther north, and approaches to 63° S. lat.

An expedition was fitted out in England for the purpose of making an attempt to reach the south magnetic pole, and placed under the command of Captain James Clarke Ross. He directed his course several degrees east of Balleny Island, and on the first day of this year (1841) passed the antarctic polar circle, near 178° E. long. On the 11th of January he discovered land near 70° 41′ S. lat. and 172° 36′ E. long., and soon found that it was a continuous coast trending southward, and rising in mountain peaks to the height of 9000 to 12,000 feet, and covered with snow. On the 12th of January he effected a landing, and took possession of it in the name of the queen. He continued his course along the shores to 78° 4′ S. lat. In 77° 32′ S. lat. and 167° E. long. he saw a mountain about 12,400 feet above the sea-level, which sent forth abundance of fire and smoke, to which he gave the name of Mount Erebus. East of this volcano he observed an extinct crater of somewhat less elevation, which he called Mount Terror. At 78° 4′ S. lat. his progress to the south was prevented by a barrier which presented a perpendicular face of at least 150 feet, along which he sailed eastward until he attained 191° 23′ in 78° S. lat. The coast-line discovered by Ross is above 600 miles. Adding to these the discoveries of Balleny, Wilkes, and Dumont d'Urville, which comprehend a coast exceeding 1200 miles, we find that within the last two years more than 1800 miles of the coast of the Antarctic Continent have been discovered south of New Zealand and Australia, between 170° and 97° E. long.

The discoverers of these new countries have only in a very few cases been able to effect a landing, the coasts being skirted with a bank of either solid or broken ice, which generally extends from five to ten, and, in some places, even to twenty miles from the shore. The land is elevated, and even mountainous, at no great distance from the shores. Dumont d'Urville estimates the average elevation of the mountains in Adélie Land at about 1500 feet. They are covered with snow, even in February, and might easily be mistaken for ice-bergs, if some rocks did not rise from them, to the perpendicular sides of which the snow cannot adhere. Between the mountain-ridges valleys are observed, but they are filled with snow and ice nearly to the summits of the mountains, and these icy masses, being converted into glaciers, protrude into the sea. In summer enormous pieces are broken off from them, and to this cause are owing the numerous icebergs which render the navigation along these coasts more difficult and dangerous than in the most northern latitudes which have been visited by our whalers. Some portions of the coasts are of volcanic origin, especially those which lie south of the South Shetland Islands. Bellingshausen found an active volcano near 69° S. lat., and there is another on Palmer's Land. These volcanoes seem to be connected with those in the South Shetland Islands. [New South Shetland Islands.] A volcano occurs also on Balleny's Islands, which continually emits smoke, and Mount Erebus and Mount Terror have been noticed above.

No traces of vegetation have been discovered on any part of this coast, nor any terrestrial quadrupeds. The birds were albatrosses, penguins, eaglets, Cape pigeons, king-birds, and nellies. Whales have been observed in several places, especially hump-backed and fin-backed whales; as also several kinds of seals.

(Weddell's *Voyage towards the South Pole*; Biscoe's *Discoveries in the Atlantic Ocean*, in *London Geogr. Journal*, vol. iii.; Wilkes's *Voyage*, in the *Globe* newspaper, 14th Aug., 1840; Dumont d'Urville, *Expédition au Pole Antarctique*; and *Nautical Magazine* for Sept., 1841.)

**SOUTH, ROBERT**, was the son of Mr. South, an eminent London merchant. He was born at Hackney in Middlesex, in 1633. In 1648 he was a king's scholar in the college of Westminster, at which time Dr. Busby was master of the school. He read the Latin prayers in the school on the day of the execution of Charles I., and prayed for his majesty by name; apparently an indication that even then he had embraced those principles of attachment to the established form of government in church and state, of which he was all through his long life a most strenuous and able champion. In 1651 he was admitted a student of Christ Church, Oxford, having been elected at the same time with John Locke. In 1655, in which year he took his degree of Bachelor of Arts, he wrote a copy of Latin verses for the purpose of congratulating Oliver Cromwell on the peace which he had made with the Dutch. Those who have reflected upon South for this compliment to the Protector, need to be informed that the copy of Latin verses was a University exercise of the kind which was then usually imposed on bachelors of arts and undergraduates. He met with some opposition to taking his degree of Master of Arts, in 1657, from Dr. John Owen, who then filled the place of dean of Christ Church, and was, or pretended to be, favourable to the principles of those who were then in power. In 1658 South was ordained by a deprived bishop, and in 1660 he was made University orator, for which he was perhaps partly indebted to his excellent sermon preached before the king's commissioners, entitled the 'Scribe Instructed' (*Matth.*, xiii. 52). After describing the qualifications of a scribe as the result of habitual preparation, by study and exercise, he takes the opportunity of observing on the qualifications of the sectarists then lately in power, and this passage is a good sample of the kind of warfare which he carried on to the end of his life against those who dissented from the ecclesiastical constitution as established by law, and also of his style. The teachers of those days, he says, 'first of all seize upon some text, from whence they *draw* something (which they call doctrine), and well may it be said to be *drawn* from the words, forasmuch as it seldom naturally *flows* or *results* from them. In the next place, being thus provided, they *branch* it into several heads, perhaps twenty or thirty or upwards.

Whereupon, for the prosecution of these, they repair to some trusty concordance, which never *fails* them; and by the help of that they range six or seven scriptures under each head; which scriptures they prosecute one by one: *First* amplifying and enlarging upon one for some considerable time, till they have spoiled it; and then that being done, they pass to another, *which in its turn* suffers accordingly. And these impertinent and unpremeditated enlargements they look upon as the *motions, effects, and breathings of the spirit*, and therefore much beyond those *carnal ordinances of sense and reason*, supported by industry and study; and this they call a *saving way of preaching*, as it must be confessed to be a way to save much labour, and nothing else, that I know of.'

The Chancellor Clarendon made South his domestic chaplain, in consideration of an oration delivered by South as public orator on the occasion of Clarendon being installed chancellor of the university of Oxford. In 1663 he was made a prebendary of Westminster, and took his degree of doctor in divinity; and in 1670 he was made a canon of Christ Church, Oxford.

Charles II. having appointed Lawrence Hyde, son of the Chancellor Clarendon, and afterwards earl of Rochester, as ambassador extraordinary to congratulate John Sobieski on being elected king of Poland, the ambassador took South with him as his chaplain. South had been his tutor, and Hyde was much attached to him. A long letter from South, dated Danzig, Dec. 16th, 1677, to Dr. Edward Pococke, regius professor of Hebrew in Oxford, contains his remarks on Poland: it is printed in the volume of his posthumous works. This letter, from a man of South's observation and ability, is a very curious and valuable historical record. He says that Sobieski spoke Latin with great facility, and was acquainted with French, Italian, German, and Turkish, besides his own language. Altogether the doctor formed a high opinion of Sobieski's abilities. South's remarks on the ecclesiastical state and constitution of Poland are marked by his usual penetration and good sense.

Soon after his return from Poland, South was presented to the rectory of Islip in Oxfordshire by the dean and chapter of Westminster. He rebuilt the chancel of the church, as appears from a Latin inscription ever the entrance; and also the parsonage-house. In 1681 he preached before Charles II., being then one of his majesty's chaplains in ordinary, on these words, 'The lot is cast into the lap, but the disposing of it is of the Lord.' This sermon, which is a good specimen of his vehement invective, contains the following singular passage, which is not much in favour of the doctor's good taste, particularly considering the occasion:—'And who that had beheld such a bankrupt beggarly fellow as Cromwell, first entering the parliament-house with a threadbare torn cloak and greasy hat (perhaps neither of them paid for), could have suspected that in the space of so few years he should, by the murder of one king and the banishment of another, ascend the throne.' On which the king fell into a violent fit of laughter, and turning to Lord Rochester, said, 'Ods fish, your chaplain must be a bishop, therefore put me in mind of him at the next death.' But the chaplain did not preach in order to please those in power, or with a view to promotion in the church. He would not take any preferment either during the reign of Charles or James, or after the revolution of 1688, though he was often pressed to accept the highest dignities in the church.

He strongly disapproved of all James's measures towards the restoration of the Roman Catholic religion, being a most zealous upholder of the Protestant church. But he had also strong opinions of the duty of submission to his lawful prince; and accordingly, when the archbishop of Canterbury and the bishops who signed the invitation to the Prince of Orange to come over, wanted him to do the same, he replied that 'His religion taught him to bear all things; and however it should please God that he should suffer, he would, by the divine assistance, continue to abide by his allegiance, and use no other weapons but his prayers and tears for the recovery of his sovereign from the wicked and unadvised councils wherewith he was entangled.' On the abdication of James and the settlement of the crown on the Prince and Princess of Orange, South at first made some opposition, but ultimately he acknowledged the new government; yet he would accept nothing, though certain persons then in power offered to exert themselves in his behalf on the vacating of several of the sees by the bishops who refused the oath of allegiance to King William and Queen Mary. He declared 'that notwithstanding he himself saw nothing that was contrary to the laws of God and the common practice of all nations to submit to princes in possession of the throne, yet others might have their reasons for a contrary opinion; and he blessed God that he was neither so ambitious, nor in want of preferment, as for the sake of it to build his rise upon the ruins of any one father of the church who, for piety, good morals, and strictness of life, which every one of the deprived bishops were famed for, might be said not to have left their equal.'

South did not like the Act of Toleration, and he vigorously exerted himself with the commissioners appointed by the king in 1689 for a union with dissenting Protestants, in behalf of the Liturgy and forms of prayer, and entreated them to part with none of its ceremonies. He continued to preach against dissent, exposing the insufficiency of the dissenting ministers, and pouring forth upon them his inexhaustible sarcasm, ridicule, and contempt. One of his strongest sermons to this effect was preached in the Abbey Church of Westminster in 1692, on the text, 'Now there are diversities of gifts, but the same spirit' (1 *Cor.*, xii. 4). His controversy with Dr. Sherlock, then dean of St. Paul's, who had written a book entitled 'A Vindication of the Holy and Ever-blessed Trinity,' was carried on with great power of argument, and infinite wit and humour, more indeed than suited the solemnity of the subject. South was admitted to have the better in the discussion. The king at last interposed by his royal authority, by directions addressed to the archbishops and bishops, that no preacher should in his sermon or lecture deliver any other doctrine concerning the Trinity than what was contained in the Holy Scriptures, and was agreeable to the three Creeds and the Thirty-nine Articles of Religion. A ballad, which was much circulated at the time, beginning

> 'A dean and prebendary
> Had once a new vagary,' &c.,

turned the two combatants into ridicule, together with Dr. Burnet, master of the Charter-House, who, about the same time, published his 'Archæologia.'

South lived till the 8th of July, 1716. He was buried in Westminster Abbey near the grave of his old master Busby. Neither children nor wife are mentioned by his biographers. By his will he disposed of a good deal of his property for charitable purposes, having all through life been a most generous giver. The residue, after the legacies and charities were satisfied, he gave to his executrix Mrs. Margaret Hammond, his housekeeper, who had lived with him above five and thirty years. There is a Life of South in a volume of his 'Posthumous Works,' London, 1717, which is the authority for what has been stated. This volume also contains three of his sermons, his will, and his Latin poems and orations delivered in his capacity of public orator in the University of Oxford.

Though South is only known by his sermons, he must be viewed both as a political and a theological writer. He defended by argument, and by his example he enforced, passive obedience and the divine right of kings. He says that the 'absolute subjection' which men yield to princes comes from 'a secret work of the divine power.' He believed the Church of England to be perfect, and the express image of the primitive ordinances. Many of his sermons are directed against the Puritans. 'He dwelt with delight on their meagre mortified faces, their droneing and snuffling whine, their sanctimonious hypocritical demeanor; but in the midst of his pleasantry, he shot some shafts dipped in the bitterest gall, and pointed by the most inveterate hatred. With a proud consciousness of superior learning, and perhaps a pharisaical conceit of superior integrity, with the keenest sarcasm and the most undisguised contempt, he held up to the detestation of mankind these impudent pretenders to the gift of the Spirit.' According as a man's affections are disposed, he will view South as a furious bigot, or as an uncompromising defender of the state and the church as established.

As a writer he is conspicuous for sound practical good sense, for a deep insight into human character, for liveliness of imagination, and exuberant invention, and wit that knew not always the limits of propriety. In perspicuity, copiousness, and force of expression he is almost unrivalled among English writers; and these great qualities fully compensate for the 'forced conceits, unnatural metaphors, absurd similes, and turgid and verbose language which occasionally disfigure his pages.' With all his faults, he was a truly honest man, a firm friend, and a generous benefactor. The sincerity of his principles is shown in the purity of his life, and the vigour of his understanding is stamped on all that he wrote.

(*Sermons preached upon several Occasions*, by Robert South, D.D., third edition, 6 vols. 8vo., 1704; *Retrospective Review*, No. 18.)

SOUTHAM. [WARWICKSHIRE.]

SOUTHAMPTON, a town within Hampshire, though forming a county of itself, situated on a point of land between the river Alre, or Itchen, on the east, and the Test, Teese, or Anton on the west. These rivers here unite to form the æstuary called 'Southampton Water.' Southampton is 70 miles in a direct line south-west of the General Post-office, London, or 79 miles by the London and South-Western Railway; in 50° 54′ N. lat. and 1° 24′ W. long.

The Roman town of Clausentum, though not on the exact site of Southampton, may be regarded as its predecessor. Clausentum was on a point of land formed by the winding of the Itchen, on the left or east bank of that river, about a mile north-east of Southampton, now occupied by Bittern Farm. The present road from Winchester to Southampton, as far as the village of Otterbourn, coincides with the line of the Roman road from Venta Belgarum (Winchester) to Clausentum; at Otterbourn the Southampton road diverges a little to the right, while the Roman road may be traced along the hills running straight onward towards Bittern. (*Ordnance Survey*.) There are at Bittern the traces of a fosse and vallum, which defended the place on the land side; and fragments of Roman bricks and pottery, also urns and coins, have been found in abundance. Within the enclosure is a farmhouse, built partly from the ruins of a castellated mansion formerly belonging to the bishops of Winchester. [HAMPSHIRE.]

The foundation of the present town is ascribed to the Anglo-Saxons. There is reason to believe that the castle was early erected by the Saxons. The town was attacked, but without success, by the Danes, A.D. 837; plundered by them A.D. 980; and again occupied as their winter-quarters A.D. 994. It is said to have been the scene of the memorable rebuke which Canute [CANUTE] administered to his courtiers. In the Saxon Chronicle the town is called Hamtune and Suth-Hamtun; in 'Domesday,' Hantone and Hentune. In the reign of Henry II. it had four churches. Leland and Grose have supposed the Southampton of this period to have been at St. Mary's, a little to the east or north-east of the present town, which they suppose to have been removed to its present site after the sack of Southampton by the French or Genoese fleet, A.D. 1338. [HAMPSHIRE.] But Sir H. C. Englefield (*Walk round Southampton*) has given good reason for doubting the correctness of this opinion. The year after this disaster the defences of the town were repaired and strengthened. Richard II. rebuilt the castle. It was at Southampton that Henry V. embarked in his first invasion of France (A.D. 1415), at which time the Earl of Cambridge, Lord Scrope, and Sir Thomas Grey were executed in the town for conspiring against him. In the war of the Roses a smart skirmish took place between the partizans of the rival houses, in which the Lancastrians were worsted: several of them were executed by order of Edward IV. In A.D. 1512 the marquis of Dorset, who was sent to the support of Ferdinand the Catholic in his war against France, embarked with 10,000 men at Southampton; and in 1522 the earl of Surrey, admiral of England, sailed from this place with a considerable fleet, with which he escorted the emperor Charles V. (who had been visiting Henry VIII.), on his return to his dominions, and afterwards attacked the French coast. Philip II. of Spain landed here A.D. 1554, when he came to marry Queen Mary.

The county of the town comprehends the whole of the point of land between the rivers, and extends along the bank of the Itchen about three miles; its area is 1970 acres; the population, in 1831, was 19,324; in 1841, 26,900, including 800 or 900 persons employed in constructing the docks; it is rapidly increasing. The town is on a gravelly soil, somewhat elevated on the bank of the Anton, which washes it on the west and south sides. The principal street (High Street) runs north and south, and is divided into two parts by an antient 'bar' or gateway belonging to the old town wall, considerable portions of which, with the west gate and south gate, are still standing. That part of the street which is south of the bar was included in the town, and is about half a mile long; the remainder, distinguished as 'High Street above bar,' or 'Above-bar Street,' belonged to the suburbs. The room in the upper part of the gateway forms the town-hall, which is small and ill-constructed. The other streets or lanes lead from the High Street at right angles or are nearly parallel to it. The principal streets are well paved and lighted; but several of those which consist of smaller tenements are not paved or lighted, and are in a very disorderly state. (*Munic. Corpor. Commissioners' Report; Parl. Papers for* 1835.) On the south side of the town is the quay, near which, at the south-western corner of the town, is the pier, a structure of considerable extent and elegance, erected some years since, and called Victoria Pier, after her Majesty, by whom, before her accession, it was opened. At the east end of the quay is a raised walk or causeway along the shore extending about half a mile. On the platform or battery near the quay is a singular gun of the time of Henry VIII. In the more modern part of the town, comprehending Above-bar Street and the adjacent streets, are some handsome ranges of building. The Winchester road is adorned by a fine avenue of elms, after leaving which it passes through an extensive field of open ground, beautifully wooded, called Southampton Common, affording delightful walks, drives, and rides. High Street is a handsome street throughout. The eastern side of the town is occupied by the poorer class of inhabitants; and a new road from the southern part of the town to the Itchen leads to the floating bridge which forms the communication with Fareham, Gosport, and Portsmouth.

Southampton has five parish churches. Holy Rhood church, a large and antient structure, consists of a nave with side aisles and a choir or chancel; it has a tower and spire at the south-west angle, and a colonnade or portico, which occupies the whole front. The church contains several stalls of neat workmanship, a wooden screen of the time of Elizabeth or James I., a neat Gothic font, and some fragments of fine painted glass in the windows. St. Lawrence's church is small, and almost choked up with the surrounding houses. For ecclesiastical purposes this parish is united with that of St. John. All-Saints' church is of Grecian Ionic architecture, and has been much admired; it contains the monuments of Carteret, the circumnavigator, and of Bryan Edwards, the historian of the West Indies. These churches are all in High Street. St. Michael's, the most antient of any in the town, is in the west part of the town, in a square (formerly the fish-market) of which it forms the east side; it has a tower between the nave and chancel; there are several Norman portions and some of later date; the windows are chiefly of perpendicular character. This church has an antient font of Norman character, and the monument of Chancellor Wriothesley. St. Mary's church in the suburbs, east of the town, was rebuilt in the last century on the foundations of the older structure, which yet appear a few feet above ground: its large burial-ground is the principal place of interment for the town. There is a proprietary episcopal chapel (St. Paul's) in All Saints' parish, erected a few years since; the architecture is Gothic, and the 'Clergy List' contains a notice of the chapel of the Holy Trinity and of Jesus' free chapel.

There are several dissenting places of worship, including one each for Independents, Baptists, Quakers, Roman Catholics, and Wesleyan Methodists.

The corporation have, besides the Guildhall, a handsome audit-house, a borough gaol, and a debtors' prison. There are several places of amusement, a theatre, and two sets of assembly-rooms, a racecourse, a subscription reading-room, circulating libraries, billiard-rooms, and bathing-rooms; and a botanic garden. There are scarcely any remains of the antient castle, but a tower has been erected on the site and from the materials of the antient keep.

Southampton was antiently a place of great trade; wool and tin were exported; but it declined very much when the export of wool was prohibited, and at the beginning of the eighteenth century was reduced to a very low ebb. During the eighteenth century it revived; but the improvement, though considerable, was not to be compared with its increase during the present century, in which it has trebled its population. It is much frequented as a watering-place. The harbour, which is secure, affords good anchorage. Ship-building is extensively carried on, though the vessels built are chiefly small; and considerable docks are in course of construction. Timber is imported from the Baltic and from America; coals, of which a great quantity is sent up the country as far as Salisbury, from the north of England; stone from the western counties; and wine and brandy from Spain, Portugal, and France. There is a considerable Irish trade. There are a custom-house and four banking establishments. The port of Southampton extends to Christchurch westward, and nearly to Portsmouth eastward. The customs produced 60,000*l.* in 1830, and 78,000*l.* in 1840. The vessels inwards from foreign ports with cargoes in 1830 were 336, tonnage 31,000; outwards 184, tonnage 15,000: in 1841 (first 11 months), inwards 520, tonnage 83,036; outwards 247, tonnage 50,444. In December, 1841, the mail-packet steam-ships to the West Indies commenced running, of which 14, admeasuring from 1800 to 2000 tons each, are destined for this service. They are expected to lead to a considerable extension of the commerce of Southampton, already the largest packet-port in the kingdom. Passengers to the East embark here, there being a direct communication to India once a fortnight, as well as weekly, by steamers, to Vigo, Oporto, Lisbon, Cadiz, and Gibraltar, and daily to the Isle of Wight, France, and the Channel Islands.

The trade of Southampton is promoted by the Andover Canal, which follows the valley of the Anton, and by the navigation of the Itchen, which extends to Winchester. There are general markets on Tuesday, Thursday, and Saturday; a fish-market every day; and two yearly fairs, at one of which a great number of cattle are sold.

Southampton is a very antient borough: the earliest known charter, which is simply confirmatory, is of Henry II. The borough limits, which are coextensive with the county of the town, include the six parishes of All Saints, Holy Rhood, St. Lawrence, St. John (united for ecclesiastical purposes to St. Lawrence), St. Michael, and St. Mary, and the tithing of Portswood, in South Stoneham parish: it has one sheriff and two coroners, besides numerous other corporate officers. Quarter-sessions are held; a court-leet from time to time by adjournment, and a civil court for mixed and personal actions of unlimited amount. Under the Municipal Corporation Act the borough was divided into five wards, with ten aldermen and thirty councillors. The revenue of the corporation, arising from rents, a proportion of the harbour dues, fines, and other sources, amounts to about 1500*l.* per annum. The borough returns two members to parliament, which privilege it has exercised ever since the time of Edward I.; the number of voters in 1835-36 was 1226, viz. 581 ten-pound householders, 20 burgesses, 540 scot and lot voters, and 85 persons possessing more than one qualification; in 1841-42 the number was 1570, viz. 1301 ten-pound householders, 29 burgesses, 460 scot and lot voters, and 214 persons having more than one qualification. The court of election for the southern division of Hampshire is held at Southampton, which is also a polling-station.

The living of All Saints is a rectory, of the clear yearly value of 400*l.*, with a glebe-house; that of Holy Rhood, a vicarage, of the clear yearly value of 379*l.*; that of St. Lawrence, a rectory, united with the vicarage of St. John, of the joint clear yearly value of 148*l.*; that of St. Michael, a vicarage, of the clear yearly value of 145*l.*; and that of St. Mary, a rectory; all, except the last, which is a peculiar of the bishop of Winchester, are in the archdeaconry as well as in the diocese of Winchester.

There were, in 1841, three infant-schools, with 150 children; an endowed grammar-school, founded by Edward VI.; another endowed school, with 40 scholars (boys), 10 of them on the foundation; three national schools, with about 300 boys and girls; one Royal British school, with 250 boys and 100 girls; the Holy Rhood parochial school, with 20 girls; a school in the workhouse; and an adult school, attached to Holy Rhood church, with from 17 to 20 scholars. The school of the Military Asylum has been removed to Chelsea; its place is occupied by the Surveying and Mapping department of the Ordnance Office, since the late fire in the Tower. There are about 70 private boarding or day schools, and 13 Sunday-schools attached to various places of worship.

There are several ranges of almshouses, a penitentiary or refuge for destitute females, a dispensary, and several other charities. Dr. Isaac Watts was a native of this town, and was educated at the grammar-school.

There is a Mechanics' Institution, which comprises about 300 members, and has a library, reading-room, and museum attached to it. Lectures are delivered every week during the winter. There is also a Literary and Scientific Institution, which has its museum and rooms, where lectures are delivered weekly during the season. An Infirmary has been established, which is conducted by a committee of gentlemen, who are making strenuous efforts to enlarge it. An Harmonic Society, composed of amateurs, is well supported.

(Sir H. C. Englefield's *Walk round Southampton*; *Beauties of England and Wales; Report of Commissioners of Municipal Corporations;* other *Parliamentary Papers; Communication from Southampton.*)

SOUTHAMPTON, COUNTY OF, the name, in legal proceedings, of HAMPSHIRE.

SOUTHCOTT, JOANNA, was born in Devonshire about the year 1750, of humble parents. She was employed, chiefly at Exeter, as a domestic servant, and up to the age of forty or thereabouts seems to have aspired to no higher occupation; but having joined the Methodists, and become acquainted with a man of the name of Sanderson, who laid claim to the spirit of prophecy, the notion of a like pretension was gradually communicated to Joanna. She wrote prophecies, and she dictated prophecies, sometimes in prose and sometimes in rhymed doggrel; her influence extended, and the number of her followers increased; she announced herself as the woman spoken of in the 12th chapter of *Revelation*, and obtained considerable sums by the sale of seals which were to secure the salvation of those who purchased them. Her confidence increased with her reputation, and she challenged the bishop and clergy of Exeter to a public investigation of her miraculous powers, but they treated her challenge with contemptuous neglect, which she and her converts imputed to fear. By degrees Exeter became too narrow a stage for her performances, and she came to London on the invitation and at the expense of Sharp the engraver. [SHARP, WILLIAM.] She was very illiterate, but wrote numerous letters and pamphlets, and her prophecies, nearly unintelligible as they were, had a large sale. In 1803 she published 'A Warning to the whole World, from the sealed Prophecies of Joanna Southcott, and other Communications given since the Writings were opened on the 12th of January, 1803,' Lond., 8vo. In 1804 appeared 'Copies and Parts of Copies of Letters and Communications written from Joanna Southcott, and transmitted by Miss Townley to Mr. W. Sharp in London.' In 1813-14 she published 'The Book of Wonders, in Five Parts,' London, 8vo.; and also, in 1814, 'Prophecies concerning the Birth of the Prince of Peace, extracted from the works of Joanna Southcott,' London, 8vo. Of the Prince of Peace she announced that she was to be delivered on the 19th of October, 1814, at midnight, being then upwards of 60 years of age. There was indeed the external appearance of pregnancy, and in consequence the enthusiasm of her followers, who are said to have amounted at that time to not fewer than 100,000, was greatly excited. An expensive cradle was made, and considerable sums were contributed, in order to have other things prepared in a style worthy of the expected Shiloh. On the night of the 19th of October, a very large number of persons assembled in the street where she lived, to hear the announcement of the looked-for advent; but the hour of midnight passed over, and the crowd were only induced to disperse by being informed that Joanna had fallen into a trance. On the 27th of December, 1814, she died, having a short time previously declared that 'if she was deceived, she was at all events misled by some spirit, either good or evil.' Her body was opened after her decease, and the appearance which had deceived her followers, and perhaps herself, was found to have arisen from dropsy. Dr. Reece, one of the medical men by whom she had been examined, and who had publicly expressed his belief in her pregnancy, published, 'A correct Statement of the Circumstances that attended the last Illness and Death of Mrs. Southcott; by Richard Reece, M.D.,' London, 1815. The number of her followers continued to be very great for many years after her death: they believed that there would be a resurrection of her body, and that she was still to be the mother of the promised Shiloh. There are still (1841) believers in Joanna Southcott.

SOUTHEND. [ESSEX.]

SOUTHERN, THOMAS, an English dramatist, was born at Oxmantown, in the county of Dublin, in 1660. He was admitted student of Trinity College, Dublin, in his seventeenth year, March 13, 1676, and in 1678 entered the Middle Temple, London. Preferring poetry to law, he became a popular writer of plays, the first of which was the 'Persian Prince,' acted in 1682: in the character of the Loyal Brother in this drama, a compliment to the Duke of York was intended, according to the biographer of Southern, in the Life prefixed to his works, 1774. At the time of the Duke of Monmouth's landing, Southern served in the king's army as ensign in Lord Ferrers's regiment, and was afterwards presented with a company by the Duke of Berwick, to whom he had been recommended by Colonel Sarsfield. At the duke's request he wrote the 'Spartan Dame,' which however was not acted till 1721. For the copyright of this play he received 120*l.*, a large sum in those days. After quitting the army, Southern continued to write plays, enjoying great popularity as an author, and living on terms of intimacy with those of his contemporaries most distinguished for wit or rank. Dryden, for whom he finished the play of 'Cleomenes,' and afterwards Pope, were among his friends. Southern died May 26, 1746, at a very advanced age.

In the delineation of character, the conduct of plots, and all the niceties of dramatic art, Southern shows but little skill; he is neither imaginative, as were the elder English dramatists, nor witty in his comic dialogues, like Congreve and others, his contemporaries. But his language is pure, and free from affectation; his verse has a pleasant fluency, and he has been successful in the expression of simple and natural pathos, particularly in the last scenes of the 'Fatal Marriage,' a tragedy which has been much and deservedly admired, and which was popular on the stage in the last century, under the title of 'Isabella.' Some of his plays were published by Tonson, 1721, 12mo.; a complete edition of his works in 1774; they consist of comedies, and of tragedies with an infelicitous mixture of comic scenes. There is a short account of Southern prefixed to this edition, and in the prefaces to the plays are a few particulars of his life, stated by himself. He is wrongly inserted in the 'Athenæ Oxonienses' by Wood. See his Life in that work, ed. Bliss, where will be found a letter from Southern to Dr. Rawlinson, denying that he ever was at Oxford. See also Malone, 'Life of Dryden,' i., 176.

SOUTHGATE. [MIDDLESEX.]

SOUTHWARK, one of the divisions of the metropolis of England, extending along the south bank of the river Thames, opposite the city of London. As this part of the metropolis is included in the general description given elsewhere [LONDON], we have here only to add some particulars of its local history.

The flat, which is bounded on three sides by the Thames, in the bend which it makes between Greenwich and Vauxhall, was originally overflowed by the tide, and formed a large marsh extending to the foot of the eminences which skirt the fourth (*i.e.* the south) side. It is probable that this space was banked in by the Romans so as to secure it from being overflowed; and Roman remains which have been dug up in St. George's Fields and in other places in Southwark or its neighbourhood, indicate that they had a settlement of some kind there. As Ptolemy says that London was in the territory of the Cantii (Κάντιοι), it has been inferred that it was on the south side of the Thames; but this opinion has been very generally rejected, as contrary to all the evidence. It is probable that on the site of Southwark there was a suburb of London, with which it communicated by a ferry near the site of the old bridge. At this ferry the great road Watling Street crossed the Thames.

In the early part of the Saxon times there is no notice of any town or other place on this spot; but a tradition of Bartholomew Linsted, or Fowle, last prior of St. Mary Overie, preserved by Stow (*Survey of London*, book i., c. xiii.), notices that the profits of the ferry were devoted by the owner, 'a maiden named Mary,' to the foundation and endowment of a nunnery, or 'house of sisters,' afterwards converted into a college of priests, by whom a bridge of timber was built, which with the aid of the citizens was afterwards converted into one of stone. If this tradition is entitled to credit (which Maitland denies, *Hist. of London*, book i., c. vii.), it would carry back the time of the foundation of the monastery of St. Mary Overie to a much earlier period than any existing historical notice of Southwark: and however doubtful the claim of the priests to the honour of building the bridge may be, we think the tradition may be taken as fair evidence of the early foundation of a religious house, and of its endowment with the profits of the then existing ferry. In A.D. 993, Anlaf, king of Norway, sailed up the river as far as Stane (Staines) (*Saxon Chron.*), from which it has been inferred that there was no bridge between London and Southwark; but this inference is hardly authorised by subsequent events. In A.D. 994 there was a bridge which obstructed the flight of Sweyn's forces when he attacked London, and was repulsed by the citizens. (Willielm. Malmesb., *De Gestis Regum Anglor.*, lib. ii.; and *Sax. Chron.*) In A.D. 1016, when Canute attacked London, the bridge formed an obstacle to the advance of his fleet, and in order to avoid it he dug a trench on the south side, by which he dragged his ships to the west side of the bridge. (*Sax. Chron.*) In the account of these transactions there is no mention of Southwark; yet there must have been some defence for the south end of the bridge; and in A.D. 1023, we read in the *Saxon Chronicle* that 'on the sixth day before the ides of June, the illustrious king (Cnut, or Canute), and the archbishop (Egelnoth of Canterbury), and the diocesan bishops, and the earls, and very many others, both clergy and laity, carried by ship his holy corpse (*i.e.* the body of Aelfeah, or Alphege, saint and martyr) over the Thames to Suthgeweorke, or Southwark, on its way to Canterbury. This is, we believe, the earliest distinct mention of the place. In A.D. 1052, Godwin, then in rebellion against Edward the Confessor, came with his fleet to Southwark, and passing the bridge without opposition, proceeded to attack the king's navy which lay at Westminster; but hostilities were averted by the offer of peace. At this time, Southwark had a harbour for ships (St. Saviour's dock?) and a monastery or church (St. Mary Overie?), both belonging to the king. Southwark was burned by William the Conqueror, when the citizens of London, after the battle of Hastings, closed their gates against him. In 'Domesday' the name appears under the form Sudwerche.

The wooden bridge which connected Southwark with London was burned in a fire which consumed great part of the city (A.D. 1136). It was however repaired in a few years afterwards; and in A.D. 1163 still more thoroughly restored. It is probable that the charge of these repairs led to the erection of a more stable fabric of stone (A.D. 1176-1209), which remained till within the last few years. The old timber bridge appears to have been opposite Botolph Wharf, midway between the Custom-House and the present bridge: the former stone bridge was between the timber bridge and the present one, at the foot of Fish-Street Hill. In order to the erection of the stone bridge, a new channel was cut for the stream, so as to lay the natural bed of the river nearly dry. It appears that the bridge was not at first wholly occupied with houses, for in A.D. 1395 there was a tournament held on it. Stow infers from this that there were then no houses at all on the bridge, but such an inference is by no means necessary. In A.D. 1471 there were houses, several being burned by the Bastard of Fauconbridge. There appears to have been from the first a drawbridge, so as to allow the passage of vessels above bridge: also a chapel on the east side; and two towers for defence, one at the south end of the bridge, and the other at the north end of the drawbridge. The bridge underwent many alterations and sustained many injuries before its final removal. The most remarkable alterations were the removal of the drawbridge and the clearing away of the houses and other buildings: the last alteration took place A.D. 1756. The bridge itself was taken down in 1831, after the opening of the present London Bridge.

In A.D. 1213 Southwark was nearly destroyed by fire; and the flames having communicated to the northern end of the bridge, a number of the inhabitants of London, who had come to assist in putting out the fire, were destroyed by it or drowned in their attempts to escape: about 3000 are said to have perished. In A.D. 1327 Southwark was, by charter of Edward III., in the first year of his reign, given to the city, great inconvenience having been found to arise from its affording a refuge to offenders of various kinds. The city was to pay to the Exchequer a yearly sum of 10*l.* as fee-farm rent. Though in this grant it is called a 'village,' it must have been of considerable size; for it had four parish churches—St. Mary's, a chapel of the great conventual church of St. Mary Over-the-Rie (or water); St. Margaret's, where the town-hall now stands; St. Olave's; and St. George's; besides the priory and church of St. Mary Over-the-Rie (or Overy), for the canons of St. Augustin; the hospital of St. Thomas; two prisons, the King's Bench and the Marshalsea; and the houses of several prelates, nobles, or abbots. Near it were the villages of Rotherhithe or Redriffe; Bermondsey, with its Cluniac priory (afterwards an abbey); and Walworth; and the market-town of Lambeth, the residence of the primate, and in the parish of which, at Kennington, was a royal palace.

In A.D. 1381 the insurgent populace, under Wat Tyler, took possession of Southwark, broke open the prisons and released the prisoners, and destroyed the 'stews' or brothels on Bankside, which were farmed of the city. They then, by threats of burning Southwark, obliged the lord mayor of London to admit them into the city, where they committed great excesses. In Cade's insurrection (A.D. 1450), Southwark was again occupied by the rebels, who, by intimidation, forced their way into the city. Twenty years afterwards (A.D. 1471), Southwark was seized by the Bastard of Fauconbridge. He attempted to storm the bridge, but was repulsed with great slaughter. In A.D. 1554 Southwark was occupied by Sir Thomas Wyatt, who was joined by the townsmen; but he could not gain admission into London. It appears from these events that Southwark was destitute of fortifications.

In the time of Elizabeth, Southwark appears to have consisted of a line of street extending from the bridge nearly to where is now the King's Bench, formerly called Long Southwark; Kent Street, then the high road to Dover, and of which only the part near St. George's Church was lined with houses; a line of street, including Tooley (*i.e.* St. Olave's) Street, extending from the bridge foot to Rotherhithe Church; another line of street, running westward by Bankside to where the Blackfriars Road now stands; and Bermondsey Street, branching off from Tooley Street to Bermondsey church. Except near St. Mary Overy's (now St. Saviour's) Church, there were scarcely any back or cross streets. Near Bankside were the bishop of Winchester's palace, the Globe theatre, the 'stews,' before spoken of (which were however suppressed at the Reformation), and two bear-gardens for baiting bulls and bears. The villages of Lambeth, Kennington, Newington, and Walworth were then separated by open fields.

In the civil war of Charles I., Southwark was included within the circuit of the fortifications erected by order of parliament. Towards the close of the seventeenth century it had considerably extended. The houses on the east side of Blackman Street extended to Newington and Walworth, which were thus united to the metropolis; but St. George's Fields, on the opposite side, still remained open. Back streets had been formed on each side of the High Street as far as St. George's Church. In the early part of the following century the buildings extended along the river bank to Lambeth; and Rotherhithe Street was continued to and even beyond Cuckold's Point, where the river bends to the southward. Later still, the opening of Blackfriars Bridge led to the formation of Great Surrey Street; and towards the close of the century St. George's Fields were enclosed and laid out in new streets. Since the commencement of the present century, Lambeth Marsh, which formerly separated Southwark from Lambeth, has been covered with new streets and buildings; and in every direction Southwark has spread, till it has united with the surrounding villages, from Greenwich to Battersea, and combined them into one large town, forming the southern division of the metropolis, and having a population of 300,000, of which town Southwark may be regarded as the nucleus.

Since its annexation to the city, its ecclesiastical divisions have become more numerous. The two parishes of St. Mary and St. Margaret have indeed been united into one, of which the fine old priory church of St. Mary Overie, better known as St. Saviour's, is the parish church; but the parish of Christ Church has been formed from this united one of St. Saviour; and within the last year or two, a new district church, St. Peter's, in Park Street, Bankside, in the same parish (St. Saviour's), has been completed. St. John's, Horslydown, has been formed out of St. Olave's, and St. Thomas's Hospital church has become parochial. That part of St. Saviour's parish of which Christ Church parish was formed, appears not to have been included in the grant to the city of London, which probably comprehended only the king's manor of Southwark, from which that of Christ Church (antiently the manor of Paris Garden) was distinct. Another portion of St. Saviour's parish, 'the Clink Liberty,' belongs to the bishop of Winchester, who appoints a steward and bailiff, and appears never to have been granted to the city.

The grant of Edward III. appears only to have conveyed to the city the lordship of the manor: this jurisdiction was augmented by new privileges in subsequent reigns; and in the reign of Edward VI., Southwark was by letters patent incorporated with the city, and constituted the ward of Bridge Without. Certain lands were excepted from this arrangement, as Southwark Mansion and Park, belonging to the king. The ward appears never to have been represented in the Common Council, nor do the inhabitants now elect their alderman. The senior alderman of London is always alderman of this ward, and on his death the next in seniority succeeds. He has no ward duties to perform. In the article LONDON [vol. xiv., p. 117] this is said, but not accurately, to be the case with the alderman of 'Bridge' Ward. There is a Bridge Ward Within, which is properly a part of the city; and Bridge Ward Without, which comprehends Southwark. The alderman of Bridge Ward *Within* has the same duties as any other alderman. The city of London appoints a high-bailiff and steward for Southwark, but the county magistrates for Surrey exercise jurisdiction in several matters: it is also in the district of the metropolitan police.

Southwark is a parliamentary borough, and has sent two representatives to parliament uninterruptedly from 23 Edward I. It is by Londoners colloquially termed 'The Borough.' By the Boundary Act, the Clink Liberty, and the parishes of Christ Church, Bermondsey, and Rotherhithe, have been added to it for parliamentary purposes. The number of voters on the register in 1835-6 was 5388; in 1839-40, 5047, viz. 4096 ten-pound householders, and 951 scot and lot voters.

The borough as thus enlarged comprehends an important manufacturing and commercial district. Along the waterside there are numerous wharfs, and various establishments which are necessary for the construction, equipage, and freight of vessels. A considerable hat-manufacture is carried on in St. Saviour's parish and in Bermondsey, in which latter there are a number of tanners and curriers. Southwark is the chief place of business of those connected with the hop-trade; the largest porter brewery in London, and indeed in the world (Messrs. Barclay and Co.'s), and a very extensive vinegar-yard (Messrs. Potts'), are included within it.

(Stow's *London;* Manning's *Surrey; Parliamentary Papers;* &c.)

SOUTHWELL. [NOTTINGHAMSHIRE.]

SOUTHWELL, ROBERT, descended from an antient family in Norfolk, was born in 1560. He was educated on the Continent, and in 1578 entered the Society of Jesuits at Rome. In 1585 he was appointed prefect of the English Jesuits' College in that city, and was soon afterwards sent to England as a missionary. He resided chiefly with Anne, countess of Arundel, who was imprisoned in the Tower of London, and died there. Southwell was apprehended in July, 1592, and was strictly examined by Queen Elizabeth's agents as to a supposed plot against the queen's government. No disclosures could be obtained from him, and he was committed to the Tower, where, in the course of three years, he was ten times subjected to the torture. At length he admitted that he was a Jesuit, and that he came to England for the purpose of making proselytes to the Roman Catholic faith. By an act passed in 1585 (27 Eliz., c. 2) an Englishman who was a Jesuit and refused to take the oath of supremacy was declared to be guilty of treason. It was probably under this act that, on the 20th of February, 1595, he was brought to trial in the Court of King's Bench. Our authorities however do not state what was the precise charge against him, but he was found guilty, was condemned to death, and on the following day was executed at Tyburn. His demeanour was firm, he declared that he was proud to profess himself a Jesuit, and thanked God that he had been called upon to suffer martyrdom. In the 'Gentleman's Magazine,' vol. 67, there is a notice of his life, with a copious list of his works. His writings, which are both in prose and verse, were once very popular among the Roman Catholics. He writes rather elegant English for the age in which he lived, but the matter will hardly repay the trouble of perusal, at least to Protestants.

Southwell's principal works are the following:—'A Consolation to Catholics imprisoned on account of Religion,' and a 'Supplication to Queen Elizabeth,' London, 1593; 'St. Peter's Complaint; with other Poems,' 1593; 'Mæoniæ; or Certain excellent Poems and Spirituall Hymns,' 1595, 4to., 1600, 4to., 1620, 1630, 1634, 12mo.; 'The Triumph over Death,' 1595, 1596; 'A Short Rule of Good Life,' 8vo.; 'Mary Magdalen's Funeral Tears,' 1609; 'Epistle of Comfort to those Catholics who lie under Restraint,' 1605, 8vo.; 'Peter's Complaint,' Mary Magdalen's Tears,' and the 'Triumph over Death,' were printed together in 8vo., London, 1620.

SOUTHWELL, NATHANIEL, became a Jesuit in 1624, and twenty-four years afterwards was made secretary to the general of the Order, which office he held during seventeen years. He died at Rome in 1676, in which year he published his continuation of the Jesuits' *Library*, 'Bibliotheca Scriptorum Societatis Jesu, Opus inchoatum à R.P. Petro Ribadeneira, et productum ad Annum 1609; continuatum à Philippo Alegambe ad Annum 1643; recognitum et productum ad Annum 1675, à Nathanaelo Sotwello,' Rome, 1676, folio. Southwell's continuation is considered inferior to that of Alegambe. The work was afterwards continued by Oudin, who commenced his task in 1733, and performed it to the general satisfaction of the Society.

SOUTHWOLD. [SUFFOLK.]

SOUZA, MANUEL FARIA E, was born at Souto in Portugal, 1590, of a noble and antient family. He manifested great precocity, and when nine years old was sent to the university of Braga, where he distinguished himself. In 1605 he was taken as secretary by one of his powerful relations, and then commenced his diplomatic education. In 1618 he married and went to Madrid; but though well recommended, his rough manner hindered his advancement at court. In 1632 he was sent on an embassy, under the Marquis Castel Rodrigo, to Rome, where his learning attracted the attention of Urban VIII. and the men of letters at the pontifical court. Having some quarrel with the marquis, he quitted him and returned to Spain; but he was arrested at Barcelona by order of the marquis, and was only released by the powerful intercession of some friends. He then renounced politics, and devoted himself exclusively to literature. Such was his activity, that he himself states that he daily wrote forty-eight pages, each page containing thirty lines; and he possessed such rhetorical facility, that in one day he could compose a hundred addresses of congratulation and condolence, all different from each other. (Bouterwek, *Hist. of Port. Lit.*, 278.) He obtained a small pension from Philip IV. and the cross of chevalier; but to his pen he trusted for subsistence. He died in 1649, at Madrid. His manners were very eccentric, and his dress the same; neither the entreaties of his wife nor of his friends could prevail on him to cut off the immense beard which disfigured him. He was proud, independent, and vehement, but affectionate and amiable.

As a poet, Souza ranks high in Portugal, though most of his works are written in Spanish; but his works are little relished by foreigners, nor have they been translated. His talents were vitiated by the bad taste of the age. He was but a reflex of the extravagancies and conceits of Lope de Vega, Marino, and Gongora. Prodigious facility and fertility of images and rhymes he certainly displays, but they are of themselves vices when not corrected by a refined judgment. Most of his ideas are intolerably fantastic, as where he speaks of the 'ten lucid arrows of crystal which were darted from his Albania's eyes, which produced a rubious effect on his pain, though the cause was crystalline:'

> Flechando de sus manos peregrinas,
> De cristal diez luzientes passadores,
> De rubi fue el efeto en mis dolores
> Si do Albania las causas cristalinas.'

And yet he sometimes hits a very fanciful image, as where he says of his mistress's eyes, 'Love has written my fate in the beauty of those eyes, which are as large as my pain and dark as my destiny:'

> 'Ojos, en cuya hermosura
> Cifrò mi suerte el Amor,
> Grandes como mi dolor,
> Negros como mi ventura.'

But when we add that he wrote six hundred sonnets, besides eclogues, and all in this strained fanciful style, it may be conceived how tedious his works become.

As a critic he has been long revered as an oracle, 'de ser venerado por Oraculo,' says Machado; but an inspection of his treatises on the sonnet and on poetry will show the worthlessness of them. They are curious evidences of what a nation will consent to as regards criticism. Souza also published a 'Commentary on the Lusiad,' which is interesting for the same cause as his treatises, and which Bouterwek thinks 'a production more calculated to obscure than illustrate the original.' Souza's works are:—1, 'Discursos Morales y Politicos,' Madrid, 1623; 2, 'Commentarios sobre la Lusiada,' 1639; 3, 'Defensa por los Commentarios sobre la Lusiada,' 1640; 4, 'Rimas varias de Luis de Camoes, commentados por Manuel de Faria y Souza,' Lisbon, 1685; 5, 'Epitome de las Historias Portuguesas,' 1626; 6, 'Europea Portugesa,' 1666; 7, 'Imperio de la China, y Cultura Evangelica por los Religiosos de la Compañia de Jesus,' 1643; 8, 'Fuente de Aganipe, varias Rimas,' 1646. (Bouterwek, *Hist. of Port. Lit.*; Heyse, *Grundriss einer Gesch. der Port. Lit.*; *Biog. Universelle*; Sismondi, *Lit. du Midi*.)

SOUZA, JEAN DE, born at Damascus in Syria, 1730, of Roman Catholic parents. He came to Lisbon with some French Capuchins in 1750, and was there protected by the house of Saldanha. Gaspar Saldanha presented him to the Marquis of Pombal, who appointed him as interpreter and secretary to the embassy which Joseph I. sent in 1773 to the emperor of Marocco. He was often employed in such negociations, and always acquitted himself with credit. The queen having founded a chair for the Arabic language in the University, she named Souza professor, and he composed for it the Grammar which is still in use. He was made correspondent of the Royal Academy of Sciences, and retiring to the convent of Jesus, died there January 29th, 1812. (*Biographie Universelle*.)

SOUZA-BOTELHO, DOM JOSE-MARIA, born at Oporto, 9th March, 1758. His father was governor-general of the province of St. Paul in Brazil. Souza was educated at the university of Coimbra, and in 1778 he entered the army, where he served till 1791. He was then nominated ambassador-plenipotentiary to Sweden. From Stockholm he passed in 1795 to Copenhagen in the same capacity. His father's death recalled him in 1799 to Lisbon. He was next sent on a mission to England, but the object of his mission was frustrated by the French not admitting him to the congress at Amiens in order to look after the interests of Portugal. On the general peace in 1802, Souza went to France as plenipotentiary, and stayed there till 1805, where he had every possible exercise for his diplomatic ingenuity. It was a perilous position; and, disgusted with public affairs, he resolved to confine his attention to literature, for which he had always manifested a strong disposition. Camoens, the pride of Portugal, had ever been his favourite author, and he resolved on producing an edition of his works which should be a lasting monument. He spared neither time, trouble, nor expense. He corresponded with all the learned, and after twelve years' labour he had the satisfaction of completing it in 1818. He prefixed a dedication to the king of Portugal, a mass of curious bibliographical researches, and a critique on Camoens, where in his editorial enthusiasm he extols Camoens over all modern poets, and even implies that he equals Homer and Virgil. He formed the project of writing a History of Portugal, but his declining health only allowed him to finish some fragments of it. He died in 1819. (*Biographie des Contemporains*; Heyse, *Grundriss*, &c.; *Biog. Univ.*)

SOVEREIGN. [MONEY.]

SOVEREIGNTY. *Supranus* is a low Latin word, formed from *supra*, like *subtranus*, another low Latin word, formed from *subtra*. (Ducange *in vv.*) These words however, though they do not belong to classical Latinity, are formed according to the same analogy as the classical word *supernus* from *super*. From *supranus* have been derived the Italian *soprano* or *sovrano*, and the French *souverain*, from the latter of which has been borrowed the English word *sovereign*. In the old English writers the word is correctly spelt *soverain* or *soverein* (Richardson *in v.*); the received orthography seems to be founded on the erroneous supposition that the last syllable of the word is connected with *reign*, *regnum*. Milton spells the word *sovran*, deriving it from the Italian; but it passed into our language from the French.

Having explained the etymology of the word *sovereign*, and its derivative, *sovereignty*, we proceed to consider the meaning of the term sovereignty as it is understood by political and juridical writers.

In every society, not being in a state of nature or a state of anarchy [ANARCHY], some person or persons must possess the supreme or *sovereign* power.

The marks by which the possession of the sovereign power may be distinguished are mainly two, the one positive and the other negative; viz.:

1. A habit of obedience to some determinate person or persons, by the community which he or they affect to govern.

2. The absence of a habit of obedience, on the part of the same person or persons, to any person or government.

Whenever these two marks meet in any person or body of persons, such person or body possesses the sovereign power; on the other hand, if either of the two marks be wanting, the person or body is not sovereign. For example, the local government of Jamaica or Sydney, being in the habit of obeying the English parliament, is not a sovereign or supreme government; whereas the government of Tuscany, or the States of the Church, although it may occasionally defer to the wishes of Austria, is not in a habit of obedience to that or any other state, and therefore is a sovereign government. Again, a body of persons calling themselves a government, but unable through their weakness to secure the habitual obedience of the people, are not sovereign, and would not be recognised as a sovereign government by foreign states.

Inasmuch as it is impossible to fix the precise moment at which a habit of obedience to a foreign government ceases, it is difficult for foreign states to determine when they will recognise the sovereignty of a territory, once dependent, which has achieved its independence.

The sovereign powers include all the powers which can be exercised by a government. They include the legislative power, the executive power, the power of making *privilegia* [LAW; LEGISLATION], the power of declaring peace and war, the power of concluding treaties with foreign states, and the power of instituting inquiries.

The sovereign power is unlimited by any legal check or control. The securities for its beneficial exercise are derived exclusively from the balance of interests and the influence of public opinion.

Sovereign or supreme governments are divided into MONARCHIES and REPUBLICS; and REPUBLICS are divided into ARISTOCRACIES and DEMOCRACIES.

It is commonly, but erroneously, thought that the sovereignty resides in every person who bears the name of *king;* in other words, that every king is a monarch. Accordingly those kingdoms in which the king is not strictly a monarch are called 'limited monarchies;' and the king is supposed to be a sovereign whose power is checked or controlled by certain popular bodies; whereas, in truth, the sovereignty is divided between the king and the popular body, and the former does not possess the entire sovereignty. This subject is further explained in MONARCHY and ROYALTY.

A sovereign government may cease to exist as such by becoming a subordinate government (as was, for example, the case with the governments of the islands of the Ægean, conquered by Athens, and the governments of the states which became Roman provinces), or by its dissolution, in consequence of a successful rebellion of its own subjects, or any other cause.

The subject of sovereignty will be found best explained in Mr. Austin's 'Province of Jurisprudence determined.' The received doctrines upon the subject will likewise be found in the treatises on international law. The *Leviathan* of Hobbes contains a very correct view of the nature of sovereignty, which has been often misunderstood and misrepresented by later writers.

SOW-THISTLE. [SONCHUS.]

SOWING AND SOWING-MACHINES. The sowing of the seed has always been looked upon as one of the most important operations of husbandry. Much of the success of the future crops depends on the time and the mode in which the seed is committed to the earth. After the land has been well prepared by judicious tillage and manuring, many accidents and circumstances may disappoint the hope of the farmer, and the crop may be scanty or fail altogether. The weather and the seasons are not under his control, and he must submit to the dispensations of Providence with pious resignation; but much also depends on his own judgment and skill. If he selects the best seeds chooses the proper season for sowing them, and has them carefully distributed and properly covered with earth, as their nature requires for the most perfect germination, and thus also protects them from the voracity of birds or insects, he will have a much greater prospect of success, under all circumstances, than if he were careless or negligent.

The most common mode of sowing the seed is by scattering it as evenly as possible over the ploughed surface, as it lies in ridges from the plough. The harrows follow, and crumbling down the ridges, cover the seed which has fallen in the hollows between them. It requires an experienced sower to scatter the exact quantity over a given surface, without crowding the seed in one spot, and allowing too great intervals in another. Hence the farmer who does not himself sow the seed, invariably chooses the most experienced and skilful labourer to perform this work. Notwithstanding every care and attention on the part of the farmer or master, the labourer will often relax and become careless, and the result appears only when it is too late to remedy it. This has given rise to the various attempts which have been made to invent machines for sowing the seed, such as should insure perfect regularity. Of some of these we will now give a short account.

One of the simplest of these machines consisted in a hollow cylinder, with one or more rows of holes in a line parallel to the axis. These holes can be stopped in part if required. The seed is put into the cylinder, the length of which is equal to the width of the land, or stitch, which it is desired to sow at a time. By shaking this when held horizontally and at right angles to the path of the sower, the seed is scattered with considerable regularity: one inconvenience of this instrument is that it requires to be filled frequently, and that much still depends on the attention of the operator. Accordingly it was very soon laid by. The idea however was followed up and improved upon in the *sowing-barrow*, an instrument still extensively used for sowing grass-seeds. It consists of a wooden trough placed on the frame of a light wheelbarrow. An iron spindle, furnished with circular brushes at regular intervals, runs the whole length of the trough, and is turned by means of simple machinery connected with the wheel. Opposite each brush is a brass plate, with holes of different sizes, which can be partly closed by means of a circular slide. According to the size of the seed to be sown and the quantity to be scattered, the holes are opened or shut. The seed is put into the trough, which has a cover or lid; and by merely wheeling the barrow in a straight line, a breadth is sown equal to the length of the trough, usually 12 or 15 feet. But this machine cannot conveniently be used in windy weather, which disperses the seeds irregularly; and it is very little superior to sowing by the hand, except in the case of small seeds, which cannot so well be spread evenly by the hand.

The drill husbandry has suggested other more complicated machines, of which some account will be found in the article DRILL. The principle of these is to deliver the seed by means of funnels, each corresponding to a small furrow made by a coulter placed immediately before the funnel; and some of these machines perform the work very regularly and satisfactorily. As the inequalities of the ground require that the coulters should move up or down, to allow for these inequalities, the seed cannot be accurately deposited at a given depth; and some improvement in the mode of drilling is yet desirable, and has in some measure been effected. The patent lever-drill in common use is very imperfect in its work, and the remedy lies in the greater attention to the preparation of the surface. When this is effected, the levers may be set aside, and a much simpler drill, such as was used at first, may replace it. The object is to make furrows of equal depth in which to deposit the seed, and to cover this uniformly. The land must consequently be more carefully prepared by repeated harrowing and rolling, till the surface resembles the seed-beds in a garden. A simple drill, which makes equidistant furrows at a given depth, in which the seed drops regularly, will then do better work than a more complicated machine; but if still greater accuracy and perfection are desired, the dibble must be had recourse to. No one will deny that seed deposited by means of a dibble is distributed more equally and covered with a more equal depth of soil than by any other means, and that there is a great economy of seed in this mode of sowing; but the slowness of the operation, and the number of hands it would require to dibble all the seed on a large farm, have prevented its being very generally adopted. [ARABLE LAND.] Many attempts have been made to invent machines to imitate the work done by hand in dibbling, and hitherto with no marked success, owing chiefly to the difficulty of clearing the dibbles from the adhering soil, and making a clean hole, and also of letting the seed fall exactly in the dibble-holes. Several patents have lately been taken out for dibbling-machines, of which we shall only notice three. The first machine consists of large hollow disks, armed at the circumference with blunt projections or knobs, which make a depression in the surface as the disk revolves: these knobs are hollow, and open by one half sliding upwards as the knob leaves the depression it has made. The seed which has been deposited in the hollow knob falls into the hole. This machine is said to do its work well, and was exhibited at the meeting of the Royal Agricultural Society at Liverpool, in 1841.

The next is Bradshaw's patent, which is not so generally known, having only been tried by the inventor and his friends. Here the dibbles are moved up and down by means of a crank or excentric circle, and are twisted in the ground by means of a projection from the shank of the dibble, which is connected with the frame of the machine; and when the dibble is moved by the crank, the rod is twisted by the difference in the motion of the crank and the machine. The seed is delivered by means of a cylinder with cavities in its surface, which revolves very near the ground, the seed being kept in these cavities by a leather belt, which only lets them out at the lowest part.

The last, of which the specification was only enrolled the 25th Nov., 1841, and is somewhat on the same principle, was invented by the Rev. W. L. Rham, of Winkfield, Berkshire. This machine, which was exhibited at the meeting of the Royal Agricultural Society of England at Liverpool, in 1841, is thus noticed by the judges of the implements appointed by that Society:—

'The Rev. W. L. Rham, of Winkfield, Berkshire, exhibited an implement, the principal object of which is to extend and improve the system of drilling and dibbling wheat, beans, &c. It is chiefly in its latter capacity, as a dibbler of seed and manure, that we shall attempt to give a slight description of it. The operative part of the machine is suspended upon an iron carriage having four wheels, the two hinder ones being fast upon their axle and turning with it. On this axle is a spur-wheel, giving motion to a pinion on an intermediary axle, which carries a wheel geared into a second pinion fixed on its axis, having six cranks arranged spirally. The velocity given to the axis is such that the cranks make one revolution for every six inches of the circumference of the hind wheels, or whatever is the distance desired between dibble-holes. The radius of each crank is such that this distance shall be equal to the circumference described by one revolution. Thus the space described by every crank coincides with that passed over in the same time by the hind wheels; and as the cranks turn, during the half of a revolution, in an opposite direction to that of the wheels, the result of this compound motion is a pause or rest of short duration, at the point where the crank in its rotation commences to retrograde from the line of progress of the machine, *i.e.* at the lowest point, and when the dibbles are in the ground. The crank raises the dibbles up and down by means of connecting rods and levers, which double the vertical without increasing the horizontal motion; and in order that the point, when in the ground, may be perfectly stationary, it is made the centre of motion while the machine progresses; and to enable it to retain that position for a sufficient length of time for the purpose of leaving a hole truly vertical, the dibbles move between checks in the rod which connects it with the crank, and which has a spring to restore it quickly to its proper place as it rises out of the ground. During therefore the entire time occupied in its piercing the hole and being withdrawn from the soil, the dibble retains its perpendicularity.

'By an ingenious and simple contrivance, a slow rotatory motion about its own axis is given to the dibble, by which means its point may be said to *bore* into the ground, thus assisting in the formation of the hole; and by the same action the dibble is cleared of any adhering soil, and the hole left firm and clear.

'The seed-valve consists of a cylinder, with a cavity in it of dimensions sufficient to hold one or more seeds. This cylinder is *tumbled* over, and the seed discharged into a recipient of the shape of a quadrant, from which it is *pushed out*, when the cylinder returns to its first position and takes in a fresh supply. As this motion is sudden, the seed is surely delivered, even when rather damp: when the cylinder is delivering, the quadrant is receiving, and *vice versâ*. The delivery of manure is effected by a similar apparatus only of a larger size, the valves being furnished with brushes or other means to remove the superfluity.

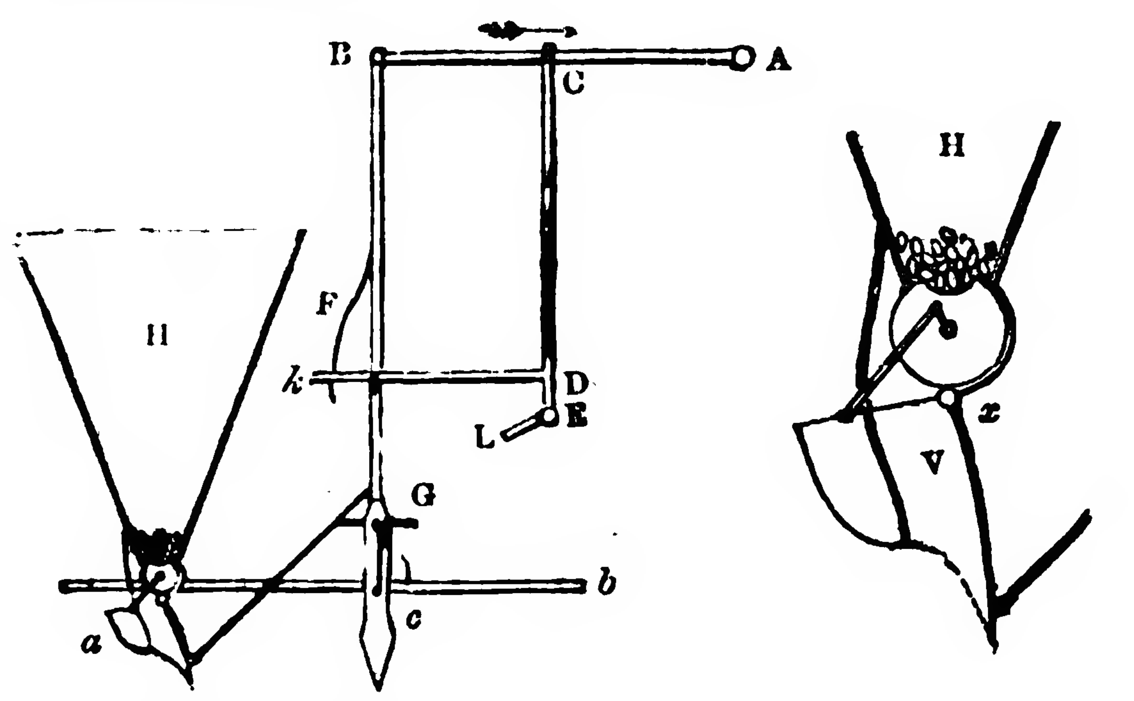
'The valves are connected with the dibbles in such a manner as to deposit the manure and seed in the hole last formed, whilst the dibbles are stationary in the advancing one. The dibbles bore their holes in shallow drills made by the pressure and sliding action of an iron shoe shaped like a boat, and forming a smooth furrow.

'The whole of the machinery is supported by an iron frame, one end of which rests on trunnions attached to a projecting part of the back of the carriage. It is suspended at the other end by a cross shaft carrying two pinions, working in arcs of circles fixed on the frame, so that it can be raised or depressed at pleasure, or elevated clear of the ground by one turn of a winch. At the same time, the pinion connecting the machinery with the hind wheels is put out of gear, and the whole can be moved about on the carriage. The implement is steered in a manner somewhat similar to Lord Western's drill.

'The object of the Rev. gentleman in contriving this original and singularly ingenious implement has been to imitate the more minute and certain manipulations of the gardener; and so to adapt his machinery to the drilling and dibbling of seed upon land previously laid flat and well prepared, that every field, however extensive, should present the neatness and regularity of a highly-finished garden.

'The distinguishing peculiarities of this remarkable piece of mechanism are the arrangements for the dibbles to *bore* holes, causing them to be perpendicular and truly cylindrical, and the apparatus for giving certainty to the valves in receiving and delivering the manure.'

In order to render the above highly commendatory report of the judges more intelligible to those who have not seen this implement, we will add a slight diagram to explain the most essential parts.




ACB is a lever, whose fulcrum is at A; BG the rod of the dibble M, which turns on it by means of a socket; CDE is the rod which communicates the motion to the lever ACB, by means of the crank LE moved by the machinery. KD is a rod connecting the crank with the rod of the dibble and having a slit or cheeks in which this rod moves. F is the spring which keeps the rod in its place when the dibble is out of the ground. *a b* is an iron plate with a slit or cheeks to keep the dibble from swerving from the line of the furrow made by the shoe. *c* is a pin projecting upwards from this plate and bent at its upper end. This pin meets one of four arms projecting horizontally from the shank of the dibble whenever it descends into the ground: and as it proceeds with the carriage while the dibble is at rest, it gives this a motion round its rod to the extent of a quarter of a circle. When the rod rises, it clears the arms from the pin, which, at the next descent, meets with another arm; and thus a complete revolution is effected in four descents of the dibble

The valve consists of a cylinder *d* with a cavity sufficient to contain the required number of seeds to be deposited in each hole, a brush *e* to remove any superfluous seeds, and a recipient *v* in the form of a quadrant, in which they drop when the cylinder is suddenly turned half round on its axis. This is effected by a small crank fixed to the axis, and connected by a rod *r* with the quadrant *v*. The quadrant itself moves ¼ round its centre *x* by means of a rod *q* which connects it with the dibble, or with the crank, when the dibble is not used; and the seed is dropped into the dibble-hole or the furrow when the quadrant is pushed back in its place. A rake and roller are attached to the implement to complete the operation.

This may give some idea of this new machine, and if it answer the expectations of the inventor, it will cause a great saving in the seed and labour of sowing, while it will deposit the seed much more regularly, and at an equal depth.

The stimulus which has been given to improvements in the implements and operations of husbandry by the establishment of the Royal Agricultural Society of England, will greatly increase the number of useful inventions by which all the common operations will be simplified, and the labour of the hands will be performed by machinery, wherever there is a deficiency of labourers or a great demand for them in more profitable mechanical employments, and where machinery, which works automatically and with certainty, becomes superior to manual dexterity.

SOY. [SOJA.]

SOYA, or SOWA, an umbelliferous plant cultivated in India. It is the *Anethum Sowa* of Roxburgh, of which the aromatic seed is much used by the natives in cookery, as well as for medicinal purposes; the green parts also are cut down, and sold in the bazars, as the plant is used as a vegetable both by Mussulmans and Hindus. The seeds are the *shubit* of Avicenna, which is usually translated Anethum; by the Arabs it seems to have been considered the Anethum (ἄνηθον) of Dioscorides.

SOYMI'DA, a genus of plants of the natural family of Meliaceæ, named by Adr. Jussieu from the Telinga name of the tree, which was referred to Swietenia, and called *S. febrifuga* by Dr. Roxburgh. This is a large forest-tree, a native of the mountainous parts of the Rajahmundry Circars, and likewise of the jungly parts in general of the central parts of India. The genus is characterised by calyx 5-leaved, imbricate. Petals 5, shortly clawed. Stamen tube cup-shaped; 10-lobed, each lobe bi-dentate at the apex. Anthers 10, included within the tube and lodged between the teeth of the lobes. Ovary 5-celled, seated on a broad disk. Ovules numerous, pendulous from the centre of the cells. Style short, stigma peltate, 5-cornered. Capsule woody, 5-celled, 5-valved. Seeds winged. The only species known attains a height of 80 feet, with abruptly pinnate leaves. The inflorescence a large diffuse and terminal panicle.

This tree, which is called *rohuna* in Hindustan, is particularly noted on account of its bark. This is of a dull red colour, of a fibrous nature, and astringent, and has been much employed in India for the cure of intermittent fevers. It was first introduced to public notice by Dr. Roxburgh in India, and by Dr. Duncan in this country, and is no doubt suited to the milder class of agues, but probably is not to be depended on in the more severe affections of this nature.

SOYU'TI, a philosopher, called by Wüstenfeld ('Geschichte der Arabischen Aerzte und Naturforscher,' 8vo., Göttingen, 1840, p. 156) Abul-Fadhl Abd el-Rahman Ben Abu Bekr Ben Mohammed Jelál ed-Din el-Soyuti, or Osyuti, was born on the 1st of Rajeb, A.H. 849 (2 October, A.D. 1445) at Cairo. He received a good education, so that in his fifteenth year he entered the academy, where he heard the most distinguished teachers, and at the same time began to give instruction himself in some departments. He was most deeply versed in the exposition of the Korán, the criticism of traditions, jurisprudence, and the syntax of the Arabic grammar. His studies embraced almost all the sciences; but he himself confesses that his knowledge of medicine was very slight and superficial, and to attempt to solve a mathematical problem seemed to him as if he were obliged to carry a mountain: notwithstanding this, he composed some works on medical subjects. He was so voluminous a writer, that the number of his writings is said to have amounted to 560; of these however some are said to have consisted of a single sheet, many were nothing more than a pamphlet, and others were only extracts and compilations from larger works. His extensive learning is duly acknowledged by his contemporaries, but at the same time he is justly reproached for being too much taken up with himself, and thinking himself equally raised above the scholars of his own time and his predecessors. Although on this account he had few friends, he succeeded in being appointed professor at the Academia Sheichunia, A.H. 872 (A.D. 1467) as his father had been before him; and besides other appointments, he afterwards received also the professorship at the Academia Bibarsia.* However, he was deprived of the latter appointment A.H. 906 (A.D. 1500), and when it was offered him again, A.H. 909 (A.D. 1503), he refused it. He died on the 18th Jomada I., A.H. 911 (17th Sept., A.D. 1505). The following list of such of his works as relate to medicine, or have been published, is given by Wüstenfeld: 1, 'Codex Animalium,' an extract out of Demiri's *Historia Animalium*, with a sketch of the medical uses to be obtained from animals, and an appendix; printed in Latin, with the title *De Proprietatibus et Virtutibus Medicis Animalium*, ed. Abraham Ecchellensis, Paris, 1647; and again, with remarks by John Eliot, London, 1649, or Leyden, 1699; 2, 'Inscriptio Codicis de Nominibus Animalium,' a continuation of the former; 3, 'Tractatus de Febre ejusque Speciebus;' 4, 'Revelatio Nubis de Praestantia Febris;' 5, 'Hortus Mundus de Puritate à Menstruis;' 6, 'Via Plana et Locus Adaequationis Irriguus, de Dictis, Factisque Mohammedis ad Medicinam Spectantibus;' 7, 'Liber Classium Virorum qui Korani et Traditionum Cognitione excelluerunt, Auctore Abu Abdalla Dahabio, in Epitomen coegit et continuavit Anonymus, e Cod. Goth.,' ed. H. F. Wüstenfeld, Gottingae, 1833; the *Anonymous* author is Soyuti; 8, 'Conversatio Pulchra de Historia Misrae et Cahirae; Fragmenta quaedam Auctore Gelal-eddino Sojuthensi e Cod. Upsal. excerp. Car. Joh. Tornberg,' Upsaliae, 1834; 9, 'Sojutii Liber de Interpretibus Korani,' ed. Alb. Meursinge, Lugdun. Batav., 1839. Wüstenfeld considers that the work translated by Reynolds, with the title 'History of the Temple of Jerusalem,' by Jalál Addin al-Siuti, Lond., 1836, 8vo., is not to be attributed to the subject of the present article.

SOZO'MENUS, HERMIAS, called, by some, of Salamis in Cyprus, otherwise named Salamanes Hermias Sozomenus, or Hermias, son of Sozomenus, a church historian of the fifth century, was born in Palestine, probably at Gaza. He was educated in a monastery, and, after studying law at Berytus, went to Constantinople, where he practised as an advocate, and also wrote in Greek his 'Church History,' which consists of 9 books, and embraces a period of 117 years, from 323 to 439 A.D. He is superior to his contemporary Socrates in his style, which is modelled upon that of Xenophon; but in other respects there is such a close resemblance between the works, that Sozomen, who was the younger of the two, is supposed to have seen the work of Socrates, and to have used it without acknowledgment. He sometimes mentions facts that are not in Socrates, but these are generally of little importance, and relate chiefly to the hermits and monks, of whom he expresses unbounded admiration. He is deficient in judgment, and makes many chronological errors. His ninth book relates chiefly to political history. Sozomen lived in the reign of Theodosius II., to whom he dedicates his History. He had previously written an epitome of church history from the ascension of Christ to the defeat of Licinius, which is not now extant.

The history of Sozomen is printed with all the editions of Socrates.

(Valesius, *De Vit. et Script. Socratis et Sozomeni*; Lardner's *Credibility*; Schoell's *Geschichte der Griechischen Litteratur*, vol. iii., p. 317.)

SPAA is a town in the province (formerly the bishopric) of Liege, in the kingdom of Belgium. It is situated in 50° 30′ N. lat. and 5° 50′ E. long., on the banks of a rivulet, 25 miles from Aix-la-Chapelle. It is in a deep valley, with pastures and corn-fields in the immediate vicinity, but surrounded at no great distance with steep richly wooded mountains, which exhibit a great variety of wild and romantic scenery. Though a small town, with fewer than 4000 inhabitants, it is celebrated throughout Europe for its medicinal springs, which were known to the Romans. They issue from the ground in more than four hundred places, but there are only six of any importance, of which the four principal are called Pouhon, Geronstère, Sauvenière, and Tonnelet; the two others are Watroz and Groesbeck. The Pouhon springs from the hill to the north of Spaa, but is conducted to the middle of the town, where it is made to issue from a fountain. The three others are at some distance from the town; the Geronstère is about a mile and a half distant. Peter the Great derived

* This is doubtless the same as that called *Daheriyah* by Makrizi, who says that it was built in the street *Bein-al-kasrein* ('between the two palaces') by Malek-al-Daher Bibars of the first or Tartar dynasty of Mamluke Sultans.

great benefit from the waters of this spring in 1717, of which his physician left a written certificate, which is carefully preserved. The Tonnelet is three-quarters of a mile and the Sauvenière half a league from Spaa. Here are the cold baths, which are called *plongeons*. The strongest of these springs is the Pouhon, and the only one the water of which is exported, which is to the amount of 150,000 bottles in a year. The waters are all chalybeate. They are diuretic and exhilarating, more cooling than common water, and they also more effectually allay thirst. They are chiefly recommended in cases of relaxation of the bowels, and likewise in obstruction of the liver and other disorders. The town consists of four straight and wide streets, crossing each other at right angles, in the form of a cross. The inhabitants derive their chief support from the great influx of visitors who come to take the benefit of the waters during the season, which commences with the warm weather, and continues about four months. The company, chiefly composed of great numbers of persons of rank and property from England, France, the Netherlands, and Germany, is superior to the ordinary description of visitors at such watering-places, mingled but occasionally, it is true, with adventurers, who seek to derive a harvest from gambling, which is too often resorted to as a resource against ennui. There are however other means provided for the entertainment of the company, such as the public breakfast in the Vauxhall, one of the finest buildings of the kind on the Continent, the assembly-house, and the beautiful public walks which connect the four springs. Two of these walks are called La Prairie (or La Promenade) de Quatre Heures, and the other La Prairie (or La Promenade) de Sept Heures, those being the hours at which they are usually frequented. There is likewise a theatre. The adjacent country abounds in game. It must be added that the accommodations both at the hotels and in private lodgings are generally good. The inhabitants manufacture elegant painted and varnished articles, such as work-boxes, writing-desks, teaboards, &c., for which there is a considerable demand, especially during the season. (Hassel; Stein; Hörschelmann; Cannabich.)

SPACE AND TIME. (Mathematics.) We do not here propose to enter into any discussion of the doctrines of metaphysicians upon the idea of space, or whether it is innate or acquired. Space and time are essential to thought, and are, come by the notions how we may, necessary attendants on our own consciousness of existence. It is possible for imagination to picture the annihilation of all things, itself included, or to fancy that it can form such a picture, which is the same thing; but what then would remain (in the thoughts)? Infinitely extended empty space, lasting through infinitely extended time. Existence of space and successions of existence we may defy the speculator to deprive himself of for one moment. The greatest proof we have of our ignorance of the Creator of all things is the absolute impossibility which we find of making the necessity of his existence as real a conception of our minds as that of space or time. The most religious man will read with pleasure a work on natural theology tending to prove that there must be a God; but who would bear ten pages of a serious attempt to demonstate the existence of space and time?

In these ideas we have the foundation of the mathematical sciences; for from space follows form, which is the conception of the manner in which one part of space is separated from the rest, and from the investigation of forms arises geometry. Again, time is only apprehended by succession of events or ideas, and succession or repetition gives the notion of *numbering*. And though *collection* is sometimes stated to be the leading idea in *number*, which may be the fact, yet it may be asserted that number in the last sense is not the object of arithmetic, except as furnishing the subject of numbering. The leading phrases of arithmetic suggest the idea of time, and are derived from it. How often is 2 contained in 12? Six times. The 2 presented to the thoughts at six different times is the mode in which the collection of 12 is counted by twos.

From both space and time we get the notion of direction, but in very different manners. The extremities of a portion of space give the idea of a point of space, a fundamental notion of an indivisible index of commencement or termination. The extremities of time give the notion of points of time, or indivisible portions of duration. No point of space contains any space; no point of time lasts any time. If we choose a point of space or a point of time, we can in our thoughts set out from the former in an infinite number of different ways; from the latter, in only two. This is the law of thought, upon which it is useless to speculate: but it is followed by important consequences. As long as algebra, the science of reasoning by symbols, was founded only on notions of arithmetic or succession, its ideas were not competent to furnish explanation to all the results of its mechanical processes. As soon as the same rules were transferred to ideas of space, or made to spring from geometrical explanations, the mysteries of that science gradually vanished.

From space and time also we get the idea of infinity, a subject which has been already treated [INFINITE]; but only in such a point of view, as would meet the objections of those who cannot reason clearly on absolute infinity. That space and time are unbounded, is the simple consequence of their being necessary to our notion of the existence of anything: we speak of our conceptions of them. For if it could be imagined that *space ceased* at a certain boundary, it would be as easy to make it cease in our own neighbourhood; and if duration could be imagined to have an end, it would not be difficult to place ourselves in thought within five minutes of that end. The denial of the possibility of our approaching the boundary of space or time in our thoughts, is the same thing as the denial of the existence of such a boundary; and the notion of infinity becomes a relief from the incongruity of the attempt to conceive existence stripped of its essential conditions. But it might be asked, why not, as to space at least, consider real existing extension, not as the object of our thoughts, but as it would exist if we were not alive to think? Is it, or is it not, physically possible to go on for ever in space? If a person could provide himself with an unlimited supply of motive-power, air, heat, food, &c., must we, or must we not, say that there is anything to hinder his travelling to all eternity? For ourselves, we should say there is clearly nothing to hinder; but of course we cannot appeal to experiment, and it may be only the impossibility of destroying our own conception of space which dictates an answer as to that external reality which, let metaphysicians say what they please, can always be established by a wave of the hand. We should have supposed that, mysterious as the connection may be between the external world and our impressions of it, the possibility of really infinite external space would be admitted by any one, unless he held the metaphysical system of BERKELEY, which denies the necessity of any external substratum of our conceptions, and substitutes the direct agency of the Creator; and we should have thought it impossible to maintain the necessary finitude of *matter*, without also maintaining the same of real external space. Nevertheless, to show how differently these subjects strike different persons, we quote the following from a recent dissertation of an eminent writer: 'Every *real, existing, material* body must enjoy that indefeasible attribute of body, viz. *definite place*. Now place is defined by *direction* and *distance* from a fixed point. Every body therefore which does exist, exists at a certain definite distance from us, and at no other, either more or less. The distance of every individual body in the universe from us is therefore necessarily admitted to be finite.' Now it will hardly be denied that the space which a body fills is as real and existent as the body itself, and this whether so occupied or not. Leave out the word *material* in the above, and for 'body' read 'part of space,' and the argument remains as good as before, ending with a denial of the infinity of space. Every *assignable* body is at a finite distance from us; but this is a truism contained in the meaning of the word assignable. But who is therefore to deny the following? Name any distance, however great; matter exists at still greater distances.

If we estimate the reality of a conception by its necessity, which is what we do when we settle the pre-eminence of space and time among our ideas, then it is certain that the conception of infinity is as real as that of space or time, being essentially united with them. Many mathematicians try to deny this, and substitute various modes of speaking to avoid the introduction of the idea. It is true that the notion of infinite is one which it is difficult to use without falling into error; a very good reason for avoiding it until the understanding has been well practised in mathematical deduction, but none for denying its existence. Why say that the notion of infinity arises from our not being able to assign a limit, when we know that we feel something more positive; when we are as certain as we are of any right to use the words *can* and *cannot*, that there *cannot be* a limit to either space or time? Those who examine the views of different writers on the first principles of science, see a great variety of modes of expression on this point, but a uniform practical use of nothing more than the *denial of finitude*, accompanied by the mere expression of *incapacity to attain infinity;* resolutely coupled, in many cases, with a determination not to allow any words capable of expressing the *absolute notion of infinity* which actually is before the thoughts. Now it should be the object of elementary writing, while guarding the avenues to error which branch in all directions from an improper use of the word infinite, to acknowledge the existence of the idea, and to make a gradual preparation for its correct and legitimate use. Both infinitely small and infinitely great ought to become terms which may be employed without fear; and the student who has been trained to the natural and healthy use of all his notions, will in the end succeed better than the one who has had some of them tied up from the beginning because they are somewhat difficult to use at first.

As soon as an attempt is made to fetter one branch of thought, the effect is sure to be immediately felt in others. The infinite divisibility of space is a truth of the same sort as its infinite extension. *Matter* may not be divisible without end, and the truths of modern chemistry would seem to show that there are ultimate particles inseparable by chemical, and still less by mechanical, means. But there is a solvent which every one has it in his power to apply to space; it is the intuitive conviction that every portion of it, however small, except that ultimate notion which is called a point, is divisible into parts, which are themselves divisible into parts; a process which may be continued without end. Now a person who trifles with the notion of infinite extension, and persuades himself that he has not the idea, will probably end by denying infinite diminution: and as motion, however small it may be, requires the succession of positions answering to an unlimited separation of the time of motion into parts, the next step will be to deny the infinite divisibility of time, and the possibility of motion, as commonly conceived. Change of place will be imagined to be physically impossible, if it be asserted that between the first and last positions there have been an infinite number of others: and the mind will be driven, in order to avoid the notion of infinity, into a sort of opinion that motion is a very large (but finite) number of annihilations and re-creations; annihilation in one spot, and re-creation a little farther on, without anything intermediate. This is no imaginary case; and it seems to us that when this theory of motion is once attained, nature has taken a very proper revenge for the attempt to smother her conceptions.

The errors which arise from the improper use of the notion of infinite lie mostly in the idea that all that is proved of finite space or time must necessarily be true of the infinite. We pass over the error that all infinites must be equal, as being that of the merest beginner; there are enough remaining to claim great caution. The process adopted in the article INFINITE is perhaps the best way of habituating the young mind to the rigorous attainment of results; provided only that the understanding is duly apprised that such a course of proceeding is not pursued because there is not infinity, but because there is, and because the notion, though inevitable, is not easily used. The road need not be carried over any unsafe foundation, but that is no reason why the quicksand and the marsh should be left out of the map.

SPACES, in Music, the intervals between the five lines forming the staff. [STAFF.]

SPA'DA, LIONELLO, a distinguished painter, both in fresco and in oil, of the early part of the seventeenth century, and one of the best colourists of the Bolognese school. He was born in Bologna, of very poor parents of the labouring class, in 1576. He was employed whilst a boy as a colour-grinder by the Caracci; but through an observing mind and an ambitious disposition, he was led himself to attempt design, and incited to an endeavour to emulate the great works by which he was surrounded. He at first copied in the school of the Caracci, but afterwards became the scholar of Baglione, and contracted a friendship with his fellow-scholar Dentone. From Dentone Spada learnt perspective, and most probably acquired that correct taste and true feeling for chiaroscuro for which his works are conspicuous, and which prevented him from being carried away by the hard contrasts of Caravaggio, when he adopted the style of that master.

Stung by a contemptuous remark of Guido's upon a picture that he had painted, Spada determined to avenge himself by opposing a bold and natural style to the delicate and ideal style of Guido. He accordingly went to Rome and became the scholar of Caravaggio, who then, as the rival of Cesari, was at the height of his reputation. Spada accompanied Caravaggio to Malta, and returned to and established himself at Bologna, master of a new style much after the manner of Caravaggio; as bold as Caravaggio's, but less vulgar, and softer and more harmonious. His design is natural, though not choice; his chiaroscuro powerful and rich; his colouring brilliant and true, though rather red in the shadows; but this may be the effect of time, for Malvasia appears to have considered him unsurpassed as a colourist.

Spada's works were much admired by Tiarini, with whom he painted in competition several times; but some of his rivals in Bologna contemptuously styled him 'La Scimia,' or the ape of Caravaggio. He however soon earned the reputation of being one of the best painters of his time, and he received several orders for great works in Reggio, Modena, Parma, and other neighbouring cities; and in consequence of the successful execution of these works, Spada was appointed his court painter by Ranuccio, duke of Parma; his fortune now equalled his reputation, and he spent the remainder of his life, which was however not a long one, at the court of Ranuccio. He appears to have been of a very humorous and satirical disposition (many specimens of his humour are recorded by Malvasia), and presuming upon the great esteem and friendship of the duke for him, he made himself much disliked by the courtiers and nobles of Parma; and upon the sudden death of Ranuccio by apoplexy, Spada found himself deserted. This appears to have had a great effect upon his mind, and although in the prime of life, he shortly followed the duke to the grave. He died in 1622, in the 46th year of his age.

Spada superintended the decorations of the celebrated, and at that time unrivalled, theatre of Parma. The generality of his compositions are half-figures, of the natural size, after the manner of Caravaggio and Guercino. Holy Families by Spada are not rare in the galleries of Bologna and Lombardy; the Execution of John the Baptist was also a favourite subject of his. His masterpiece is generally considered to be the great picture of San Domenico burning the proscribed books of the heretics, in the church of that saint at Bologna. The following works also gained him great reputation:—The Miracle of St. Benedict, at the monastery of S. Michele in Bosco; a picture which so pleased Sacchi when he saw it, that he took a sketch of it; Susannah at the Bath, and the Return of the Prodigal Son, at Modena; a Madonna, at Reggio; and a St. Jerome, and a Martyrdom of a Saint, at Parma; the two last pictures are painted more in the style of the Caracci than any of his earlier works. Spada wrote verses, some specimens of which have been preserved by Malvasia. He left several scholars, and has had some imitators; Pietro Desani of Bologna, and Orazio Talami and Sebastiano Vercellesi of Reggio, were the most distinguished. (Malvasia, *Felsina Pittrice;* Lanzi.)

SPADIX, a form of the inflorescence of plants, in which the flowers are closely arranged around a thick fleshy axis, and the whole surrounded by a large leaf or bract called a spathe. The flowers of the *Arum maculatum*, cuckoo-pint, or wake-robin, are arranged in this manner. In this plant the central fleshy axis or rachis is much extended beyond the point on which the flowers are situated, forming a soft club-shaped mass, which is variously coloured. This is an instance of the same kind of development as occurs in the production of the spine at the growing point of the branch, only in the one it is soft and blunt, in the other it is hard and sharp-pointed. This form of inflorescence is seen in all the plants belonging to the natural orders Araceæ and Acoraceæ. This term is also applied to the collection of female flowers of the *Zea Mays*, common maize, and to the inflorescence of Palms.

SPAGNOLETTO. [RIBERA.]

SPAHIS (or rather *Sipáhis*, from the Persian *sipah*, meaning a cavalry soldier), are a body of Turkish cavalry organized by Amurath I. (Múrad), who was also the founder of the Janissaries. Their number varied according to circumstances, but amounted sometimes to 20,000. They enjoyed many privileges in common with the Janissaries. Their pay was twelve aspers a day, unless employed on special service, when they received a higher pay. They were composed of two classes; the *spahaoglari*, who had red, and the *silkhadár*, who had yellow banners. Those who held fiefs from the sultan were called *Timari-siphâhis*. Their usual arms were a sabre, a lance, a jereed or dart about two feet long, which they hurled with great dexterity and strength, and a second sabre, or rather broadsword, attached to the saddle. Some of them had also a carabine and one or two pistols. At one time they were the most formidable body of cavalry in the Turkish army; but being an undisciplined and unruly militia, they were, together with the Janissaries, dissolved by the last sultan Mahmud.

SPAIN (*España*), a country in Europe, occupying the greater part of that peninsula which is divided from France by the mountain-range of the Pyrenees, from which circumstance it is sometimes called the Pyrenean Peninsula, or briefly the Peninsula. It is situated between 36° and 43° 46′ N. lat., and 2° 15′ E. long. and 9° 10′ W. long. The most northern point is Cape Ortegal (43° 46′ N. lat.), and the most southern Tarifa (36° 2′). From its most north-western point, Cape Finisterre, to the most eastern, Cape Creus, is a distance of nearly 600 miles; from Tarifa to Fuentarabia, near the boundary of France, on the Bay of Biscay, nearly 540 miles; and from Cape Ortegal to Cape de Gata, the most south-eastern promontory, about 556 miles. The area of Spain is stated by some authors to be nearly 190,000 square miles; but most probably it does not much exceed 185,000 square miles, being larger than that of the British Islands by about one-half their extent, and not quite one-tenth smaller than that of France.

Spain is washed on the east by the Mediterranean, and on the south by the narrow sea which connects the Mediterranean with the Atlantic and terminates on the west in the Strait of Gibraltar, and partly by the Atlantic. On the west it is bounded by Portugal, and on the north-west by the Atlantic. On the north is the Bay of Biscay and France. Spain is divided from France by the mountain-range of the Pyrenees, whose highest portion, constituting the watershed between the rivers which run south and north, forms the boundary between these two countries, with the exception of the Vale of Arran, which contains the sources of the Garonne, and belongs to Spain, though situated on the northern declivity of the mountain-chain. Towards the Bay of Biscay, where the Pyrenees sink down into hills, a chain of heights which separates the basins of the rivers Niêve and Bidasoa is a boundary, but for a few miles from the sea the boundary is formed by the course of the last-mentioned river. Spain bounds Portugal on the north and on the east. Along the northern line the boundary between Spain and Portugal is not marked by any natural object, except that the river Minho separates both countries for about 30 miles from its mouth. The western boundary of Spain towards Portugal is generally more distinctly marked. North of 41° N. lat it is formed by the south-south-western course of the river Duero. Between the Duero and the Tajo, the two countries are separated by the rivers Turones and Erjas, of which the former joins the Duero, and the second the Tajo; and by the mountains in which these rivers rise, which belong to the Sierra de Gata. The Tajo runs along the boundary for 30 miles as far west as the mouth of the river Sever. The lower course of the Sever, and farther south a range of heights, separate Spain from Portugal between the Tajo and Guadiana. The Guadiana runs along the boundary-line for nearly 30 miles to 38° 30′ N. lat., but farther south, as far as 37° 55′, the dividing-line traverses some ridges and valleys. Near 37° 55′ N. lat. the river Chanza, an affluent of the Guadiana, begins to separate the two countries, and continues to be the boundary to its confluence with the Guadiana, which then separates Andalusia from Algarve.

*Coast.*—The coast-line of Spain, without taking into account the numerous small inlets, is 1370 miles, of which 602 are washed by the Atlantic and 768 by the Mediterranean. The coast between the boundary of France and the mouth of the river Minho is 478 miles, and that between the Guadiana and the Punta de Europa, the most southern point of the tongue of land on which Gibraltar stands, is 124 miles.

The northern coast of Spain, from the boundary of France to the Punta de los Cairos (7° 15′ W. long.), runs nearly in a continuous line, without any considerable break, if we except the æstuary of the river Nervion and the bay of Santander, neither of which is a spacious harbour. All the other indentations, which are rather numerous, are only narrow inlets of no great length, which are used by small coasters. These inlets go by the name of *rias*, as they generally constitute the mouths of small rivers. The whole line is rocky, and the rocks nearly always approach the sea, where they form a mural line varying in height between 30 and 300 feet. But with the exception of one or two places, the coast is free from rocks and islands, and the water is deep up to the shore. The coast farther west, between Punta de los Cairos and Cape Ortegal, preserves the same character, except that the inlets which occur along this short distance are wider, and the headlands project farther. From Cape Ortegal to Cape Finisterre, and thence to the mouth of the Minho, the coast is less elevated, though it is rocky, and the rocks come up to the beach. It is also very broken, and several headlands advance some miles into the sea, and some of the inlets enter several miles into the land, and form spacious harbours. The most remarkable is the Bay of Betanzos, which divides into three inlets, which form the harbours of Ferrol, Betanzos, and La Coruña. South of Cape Finisterre are four rather large bays, called Ria de Muros y. Noya, Ria de Arosa, Ria de Pontevedra, and Ria de Vigo, all of which are deep and have good anchorage. Along this line of coast there occur several small rocky islands.

The coast-line of the Atlantic, between the mouth of the Guadiana and the Punta de Europa, is of a different character. From the hills on which the town of Ayamonte is built, at the mouth of the Guadiana, a low shore begins and extends eastward to the harbour of Huelva, which is formed by the æstuary of the rivers Odiel and Tinto. The coast-line is well defined, but skirted by low and sandy islands. Between the harbour of Huelva and the mouth of the river Guadalquivir the coast is extremely low, swampy, and sandy. Even small vessels cannot approach the beach. South of the mouth of the Guadalquivir the shores are again well defined, though low and occasionally swampy. Approaching Cape Trafalgar, at Torre de Roche, the coast begins to rise, and a moderately high shore runs along the northern side of the Strait of Gibraltar, and into the Bay of Algeciras to the town of that name. The remainder of the bay has a low and sandy shore, with the exception of the rock on which Gibraltar stands.

The coast of the Mediterranean from Punta de Europa to Cabo de Palos is in general elevated and rocky. The western portion, between the Strait and the mouth of the river Guadalfeo near Motril, does not rise to a great height, and occasionally sinks down nearly to the level of the sea. East of Motril the coast is generally very high, sometimes several hundred feet, and there is no flat along the sea. The road, which runs not far from the shore, passes from one mountain to another, and descends only in a few places, where the mouths of the small rivers occur. This elevated coast extends to Cabo de Gata, and north of it to the town of Moxacar. From Moxacar to Cabo de Palos the rocks along the coast are of moderate elevation, and in a few places interrupted by flats. This extensive line of rocky coast has no indentations, and no harbour which vessels of moderate size can enter, with the exception of the excellent harbour of Cartagena and the harbour of Malaga; the latter is partly artificial. The open bay of Almeria, between Punta de Elena and Cabo de Gata, has good anchorage, but it is too much exposed to southern, south-eastern, and south-western winds, and to the violent gales which sometimes blow from the mountains that surround the bay.

At Cabo de Palos a low and sandy coast begins, which extends as far north as Cabo de Santa Pola, a short distance south of Alicante. It has no harbours even for small vessels or large boats, though it is intersected by several creeks, which in some places form small lagoons. Near Cabo de Palos is the large lagoon of Encañizada de Murcia, which is very shallow. From Cabo de Santa Pola to Villajoyosa the coast-line is generally low, but rocky, and in some places the ridges, which traverse the adjacent country, terminate on the sea with steep hills of small extent and moderate elevation. From Villajoyosa to Denia the coast is almost without exception rocky and high, but does not rise to a great elevation. Between Cabo de Palos and Denia there is no harbour, except that of Alicante.

From Denia to the mouth of the Ebro the coast is low and sandy. North of Castellon de la Plana a few low ridges terminate on the sea, forming a moderately high shore. This coast line has no harbours even for vessels of moderate size; and Grao, the port of Valencia, is only a bad roadstead. Along this low coast there are many small lagoons, called *albuferas*. The largest is Albufera de Valencia, noted for the great quantity of salt which is made on its banks. South of the mouth of the Ebro is the Puerto de los Alfaques, which can only be entered by vessels not drawing more than 15 feet.

From the mouth of the Ebro to the boundary of France the coast is alternately high and low, and both the low and the high shores generally continue for many miles. The coast however does not rise to a great elevation, except at Cape Creus, and thence to the boundary-line. In this part there occur several harbours for small vessels; and two are deep enough for large ships, Barcelona and Rosas. The Gulf of Rosas is an excellent harbour, but is very little used, as the neighbouring country is only partially cultivated. The small harbour of Salou, which is the port of Reus, is only fit for small vessels.

*Surface and Natural Divisions.*—Spain presents greater and more marked differences in the form of its surface than any other country of Europe of equal extent. The interior is an elevated table-land, whose surface is from 2000 to 3000 feet above the sea-level. Though situated at the western extremity of Europe, and near the sea, which surrounds that part of the world, its elevation is higher than that of any other table-land of Europe. The elevated plains which surround the northern base of the Alps are only between 1000 and 1300 feet above the sea-level, and are about 700 feet lower than the lowest part of the table-land of Castile, as that of Spain is called. The table-land comprehends nearly the whole country which lies between 38° and 43° N. lat., and extends from near 1° to near 8° W. long. It does not advance to the sea, but on the north and west it is divided from the Bay of Biscay and the Atlantic by a comparatively narrow tract of mountainous country. Nor does it extend to the base of the Pyrenees, being separated from them by the basin of the river Ebro. Between the table-land and the Mediterranean there is also a lower country, which in some parts is hilly and even mountainous, and in others extends in wide plains. South of the table-land is the basin of the river Guadalquivir, by which the table-land is separated from another more elevated and more mountainous region, that of the Sierra Nevada, which extends over the southern part of Spain along the Mediterranean and the Strait of Gibraltar. Thus Spain contains six great natural divisions—the Table-land, the Northern and Western Maritime region, the Basin of the Ebro, the Eastern Declivity, the Basin of the Guadalquivir, and the Mountain Region of the Sierra Nevada.

I. The *Table-land* comprehends the eastern districts of Galicia, the whole of the kingdom of Leon, that of Old Castile, with the exception of about one-fourth of its area which lies in the basin of the Ebro and along the Bay of Biscay, the whole of New Castile and Estremadura, the south-western districts of Aragon, and the northern districts of Murcia. According to a rough estimate it extends over a surface of about 92,000 square miles, or over nearly one-half of the area of Spain.

The table-land is nearly surrounded by mountains. Along its northern edge rise with a steep ascent the mountains of Asturias, which in elevation nearly rival the Pyrenees, but occupy a smaller extent of country. That part of the Montes de Asturias which is at the source of the Ebro is called Sierra de Sejos, and attains an elevation of 5700 feet above the sea. Farther west the elevation increases. The Sierra d'Alba, situated where the boundaries of Old Castile, Leon, and Asturias meet, rises to 6960 feet, and the Sierra de Pajares, farther west, to 8628 feet. At the mountain-knot which occurs near the sources of the river Sil (near 6° 20′ W. long.) the chain attains its highest elevation, one of the summits, the Sierra de Peñaranda, rising to 11,000 feet, and far above the snow-line. This mountain is only about 600 feet lower than the Pico de Mulhaçen, the highest summit of the Sierra Nevada, and only 300 feet lower than the Pico de Neton, the highest summit of the Pyrenees. West of this large mountain-mass the chain lowers, but apparently not much, for the Sierra de Peñamarela, which lies near 7° W. long., is 9450 feet above the sea-level. So far the direction of the chain is from east to west, or nearly so, but in this part of the range the highest edge of the mountains runs south-west, but soon turns north, enclosing a narrow glen, in which the river Navia descends to the Bay of Biscay. For about 40 miles the range runs northward, until it approaches the Bay of Biscay within about 12 miles, when it again turns westward, and after having run about 20 miles in that direction, turns southward, dividing the basin of the upper Minho from the lower country which lies to the west of it. The elevation of this chain is not known, but from the cold climate of the upper valley of the Minho, it may be inferred to be 6000 feet above the sea-level. Near the town of Orense the mountain-chain terminates, or rather, there is a depression through which the Minho flows; for on the east of the river rises another ridge, the Sierra de S. Mamed, which runs east-south-east, and soon attains a considerable elevation, 7710 feet above the sea-level. This chain continues east-south-east until it approaches the Duero, where it begins to form the boundary between Spain and Portugal. At this point it is connected with the Serra de Roboreda, which lies within Portugal, and extends, parallel to the course of the Duero, to the point where the river turns to the west.

The high grounds which divide the table-land from the basin of the Ebro cannot be considered as a mountain-ridge in all their extent. Towards the western extremity of the river-basin, between the Sierra de Sejos and the great road which leads from France to Madrid, no mountain-range divides it from the table-land. East of the road and of the town of Burgos rises the Sierra de Oca, which attains the elevation of 4980 feet, or about 2000 feet above the adjacent parts of the table-land. It extends from west-north-west to east-south-east, and is followed by the Sierra de Cameros, whose highest summit, the Pico de Urbion, is 7200 feet above the sea-level. Contiguous to it, and in the same direction, is the Sierra de Moncayo, which rises to 9600 feet at its eastern termination near 2° W. long. From this point the edge of the table-land is less marked. It runs to the river Xalon, which it crosses near Calatayud, and afterwards in a south-eastern direction along the high grounds which form the right bank of the river Xiloca, which gradually rise into mountains near the town of Montalban, whence the mountain-chain continues to the boundary between Aragon and Valencia, where the Sierra de Peñagolosa attains 6000 feet. From this summit the edge of the table-land runs southward along the elevated ridge which extends east of the river Turia or Guadalaviar. It crosses this river north of Requena, and afterwards the river Xucar below its confluence with the Cabriel, and then continues southward, leaving the town of Almansa to the west, to the vicinity of Villena. South of the Xucar the edge of the table-land is not marked by a continuous ridge, though some isolated mountains occur along it. Near Villena is the Sierra del Carache, which runs first south-west, and afterwards north-west, to the neighbourhood of Albacete (39° N. lat. and 1° 55′ W. long.). The Sierra del Carache seems to rise only a little above the table-land, but it presents a considerable ascent from the deep valley of the Segura, and that of the Mundo, a tributary of the Segura.

Along the southern border of the table-land extends that range, or rather mountain region, which is called Sierra Morena. It begins on the east, a short distance west of Albacete, with two ridges which run south-west, including the narrow valley of the river Guadarmena, and are called Sierra de Alcaraz. From the western of these ridges the mountain region extends westward to the boundary of Portugal. It consists of a great number of short ridges, running south-west towards the east, and south-east towards the west. These ridges, which enclose very narrow valleys, are connected by other ridges, lying frequently along their northern extremity or close to the extremity of the table-land, but sometimes also in the middle of the mountain region. Towards the east the Sierra Morena does not occupy more than 30 or 40 miles in width; but in proceeding westward it grows wider, and near the boundary of Portugal it is about 80 miles across. Some of the ridges advance a considerable distance into the basin of the Guadalquivir. At its western extremity one of its branches extends southward along the river Chanza and the lower course of the Guadiana, terminating near the sea in the hill on which the town of Ayamonte is built. North-east of that place is a summit called Monte Gordo, which is 2235 feet above the sea. This is the only summit of the Sierra Morena whose elevation has been determined by actual measurement. The difficulty which is encountered in traversing these mountains, and which is chiefly if not entirely to be attributed to their breadth and the steepness of the ridges, led to the opinion that the general level must be at least 6000 feet above the sea-level; but this supposition is not consistent with what we know of the climate, as few parts are covered with snow more than three months.

Other mountain-ranges occur on the table-land itself. One of them constitutes a continuous range, traversing the plain in all its extent from east to west. It begins on the east near the high summit of the Sierra de Moncayo, and runs, under the name of Sierra de Deza, south-west until it approaches 44° N. lat., when it turns to the west north of the town of Siguenza. In this direction it continues to the place where it is crossed by the road leading from France to Madrid. The mountain-pass through which this road runs is 4950 feet above the sea, and this may be considered as the mean elevation of the Somasierra, as the range here is called. From this pass the range runs south-west, and is called the Sierra de Guadarama. The mean elevation of this part of the range does not seem greater than that of the Somasierra, as the mountain-pass from Madrid to Segovia, in its highest point, is only 4657 feet above the sea; but not far from it stands the Sierra de Peñalara, whose summit attains 7756 feet. The continuation of the Sierra de Guadarama is called Sierra de Avila, the branches of which enclose the small plain on which the town of Avila is built, 3485 feet above the sea. West of Avila the range makes a bend to the south, encircling the upper course of the river Tormes, an affluent of the Duero. At the southern extremity of this bend the range attains the greatest elevation, the Sierra de Gredos rising to 10,548 feet, and considerably above the snow-line. After the range has resumed its south-western direction it is called Sierra de Gata, and enters Portugal, where it again attains a considerable elevaton in the Sierra d'Estrella, and continues to the shores of the Atlantic Ocean, where it terminates with the Cabo da Roca, west of Lisbon. The table land is divided by the mountain-range just mentioned into two parts, which do not differ much in extent. That portion which lies north of it is called the table-land of Old Castile and Leon, and contains about 44,000 square miles. The other part south of the range is called the table-land of New Castile and Estremadura, and contains about 48,000 square miles.

*Table-land of Old Castile and Leon.*—The north-western corner of this region is a mountainous country, which extends over the eastern districts of Galicia. The mountain-range, which separates it from the plain to the east of it, is connected on the north with the mountain-knot of the Sierra de Peñaranda, and on the south joins the Sierra de Segundera, which is part of the Sierra de S. Mamed. This range is called, at least in its greatest extent, Sierra de los Cilleros. Its mean elevation probably does not much fall short of 6000 feet. The country between the Sierra de los Cilleros and the southern prolongation of the Montes de Asturias comprehends the valleys of the rivers Minho and Sil before their confluence. It is a very elevated country. The winters are cold, and the frost usually lasts for three months, sometimes without interruption. These facts lead to the conclusion that the higher districts of the valleys are not less than 4000 feet, and the lower at least 3000 feet above the sea-level. The valleys are, with a few exceptions, rather narrow; but the hills, which are contiguous to the level grounds, have generally a gentle slope, so that they admit of cultivation to a considerable distance up the declivities. They do not rise so high as the mountains which enclose this region. Those parts of the hills which cannot be cultivated are used as pasture-grounds for cattle, sheep, and goats. But many large tracts are covered with forests, and the dockyards of Ferrol are chiefly provided with timber from these mountains. The valleys are not adapted to the cultivation of maize, but wheat, barley, and flax succeed well. Chesnut and walnut trees are very numerous. This region contains about 7600 square miles, and is nearly equal to Wales in extent.

The remainder of the table-land of Old Castile and Leon is a plain which extends over the greater part of these two kingdoms, and contains about 36,400 square miles. The eastern portion of the plain, between the Sierra de Moncayo on the north and the Sierras of Deza and Somasierra or the south, is probably not less than 3000 feet above the sea-level. The surface is rather hilly, and the soil partly stony and partly sandy; its fertility rather indifferent, and large tracts are quite unfit for cultivation. Farther west, where the plain is crossed by the road leading from Burgos to Madrid, the level sinks down to about 2500 feet above the sea; Burgos, which is on a hill, being 2873 feet. On the north of the river Duero the plain is nearly a level, here and there interspersed with small groups of low detached hills. The country is not fertile. The lower tracts are entirely destitute of trees, and generally even of bushes. The hills are partly overgrown with light thin woods and numerous low bushes. The woods consist almost exclusively of evergreen oaks and a kind of cistus. On the hills there are small miserable villages at a great distance from one another; they are surrounded by a few vineyards and cornfields. Farther west, along the road which connects Segovia with Valladolid and Valladolid with Palencia, the soil improves and cultivation increases. The level of the plain does not seem to be lower, but the rivers, having descended deeper, have excavated beds from 2 to 4 miles wide, which are from 100 to 200 feet below the general level, which is as flat as a table, and covered with heath, nor is the view intercepted by any tree. These elevated flats are without cultivation, and only used as pasture-ground for goats and sheep. But the valleys which extend along the beds of the rivers possess a considerable degree of fertility, and produce all kinds of grain; and the slopes of the higher grounds are well stocked with trees and vines. The soil consists of a mixture of clay and sand. Towards the boundary-line of Portugal the higher grounds which divide the valleys along the rivers are not quite level, but extend in gently sloping plains. These plains are likewise destitute of trees; but the soil, being more retentive of moisture, is more fertile; and even the higher grounds are here sown with wheat, rye, barley, and Indian corn. This part of the plain is rather thickly inhabited, and villages occur at short distances from one another.

*The Table-land of New Castile and Estremadura* comprehends these two kingdoms, with the south-western districts of Aragon and the northern part of Murcia. The surface is much more diversified by hills and mountains than that of the northern plain. The mountain-chains are of considerable extent, but they do not form continuous ranges, being interrupted by several depressions, which sink nearly to the level of the country. In the eastern districts of the table-land is the Sierra Molina, which begins north-west of the town of that name, and south of the confluence of the Xiloca with the Xalon, in 41° N. lat. and 1° 30′ W. long. It does not appear to be connected with the Sierra de Deza by a mountain-ridge, but only by high ground. The Sierra de Molina runs southward, and does not rise much more than 1000 feet above the general level of the country in the northern parts. The road from Molina to Teruel rises on the Sierra de Menara to 4333 feet above the sea-level. Farther south it rises still somewhat higher. Where the rivers Tajo and Turia originate, it is from 4500 to 4600 feet high, and at this place it sends off a branch, the Sierra de Albaracin, which runs south-east between the Turia on the east and the Xucar on the west, and extends to the edge of the table-land, near the town of Requena. This ridge rises to a great height, but its elevation has not been determined. From the sources of the Tajo the Sierra de Molina runs south-west, but near 40° S. lat., west of the town of Cuença, it turns again to the south, and soon subsides into hills, which are slightly elevated above the level of the country. The Sierra de Molina is of very inconsiderable width, but it constitutes the watershed between the rivers which fall into the Mediterranean and those that run to the Atlantic.

West of Cuença a ridge of low mountains branches off from the Sierra de Molina, and runs westward, dividing the upper branches of the Tajo from those of the Guadiana. It terminates probably near Tarrancon, east of Aranjuez. In our maps this range is continued south-west, and afterwards west to the Sierra de Toledo, but this appears to be incorrect. The two great roads from Madrid to Manzanares and from Toledo to Ciudad Real traverse this tract, but travellers who have gone over it do not mention having passed or even seen a range of mountains, though they speak of having crossed some broken ground rising into hills. No mountain-range therefore exists between these two roads or in their vicinity; and the watershed between the Tajo and Guadiana is only formed by high ground broken into steep hills. The Sierra de Toledo seems to rise west of 4° W. long., and to extend to 5° W. long., running east and west; but we are very imperfectly acquainted with this ridge. It does not appear to occupy a great width, nor so rise more than 1000 feet above the plain. It is not traversed by any road. Near 5° W. long. it sinks down to the level of the plain, but another range rises out of it, called the Sierra de Guadalupe, which extends westward to the boundary of Portugal, and enters that kingdom, where it is called Sierra de Portalegre. The Sierra del Guadalupe resembles the Sierra Morena more than the mountains of Toledo. It consists of a number of narrow steep ridges, whose general direction is north-east or north-west, and they are sometimes connected by other ridges running east and west, but frequently unconnected, and separated by flats. These flats or valleys are commonly much wider than in the Sierra Morena, and hence this mountain-tract does not oppose so many obstacles to travelling. The width of this region is considerable, as it fills nearly the whole tract between the rivers Tajo and Guadiana, west of 5° W. long. None of the summits attain a great elevation above the level of the country.

The eastern portion of the table-land of New Castile and Estremadura, comprehending the province of Cuença, the northern districts of Murcia, and the adjacent countries, is the highest part of the table-land, and about 3000 feet above the level of the sea. The surface is very uneven, with the exception of the higher ground between the river-basins, which in some places extends in plains, and in others is diversified by numerous hills or low ridges. A very small portion of this region, which lies in the valleys along the rivers, and in some depressions of the plain, is under cultivation; the remainder has rather a sterile and very dry soil, and is either quite useless or only used as sheep-walks, sheep constituting the principal wealth of the inhabitants. In some places wheat is cultivated, and in others there are tracts planted with vines and olive-trees. Saffron is rather extensively grown. Fruit-trees are abundant in the lower tracts. The higher grounds are quite destitute of wood, and covered with heath and odoriferous plants, on which numerous bees feed. Wax and honey are sent to other parts of Spain, and also wool of an inferior quality.

The central region of the table-land is between 3° and 5° W. long. It consists of two plains, the Plain of Madrid and Toledo, which lies north of the mountains of Toledo, and the high broken ground which forms the watershed between the rivers Tajo and Guadiana; and the Plain of La Mancha, which lies to the south. These two plains are about 2000 feet above the sea-level. According to Bauza, Madrid is 2222 feet and Toledo 1868 feet above it. In the plain of La Mancha the town of Val de Peñas is 2119, and that of Villaria 1947 feet above the sea-level. The productive powers and the surface of these two plains are nearly the same. The country consists of extensive levels, intersected by short ridges of low hills and rocks. It is destitute of trees, except some groves of evergreen oak, which are found near the hills, and plantations of olive-trees and vines near the villages. The villages are large and well built, but at great distances from one another. The level tracts between them produce wheat, but as part of these tracts are at a great distance from the villages, in which alone the farms are situated, a large portion of them is badly cultivated, and some tracts are partly overgrown with broom and the flax-leaved daphne (Daphne Gnidium). The crops however are tolerably good. The best cultivated and richest part of the plain is that which lies along the southern base of the Sierra de Guadarama, where the soil is a rich clay, and the country presents a succession of vineyards, olive-plantations, and excellent pastures, with numerous corn-fields. The farmers of this tract are more wealthy than those of other districts in Spain.

The western portion of the table-land of New Castile and Estremadura comprehends the country from 5° W. long. to the boundary of Portugal, or the province of Estremadura. This country has a very mountainous surface. The ridges of the Sierra de Guadalupe cover nearly all the country between the Tajo and the Guadiana. North of the Tajo several offsets of the Sierra de Gata traverse the country in a south-western direction. South of the Guadiana several branches of the Sierra Morena advance within a short distance of the river. Plains of some extent occur only along the banks of the principal rivers. They are small on the banks of the Tajo, but rather extensive on those of the Guadiana. The general level of the country is lower than in the plains farther east, as we may infer from the circumstance that snow and frost are not common in the Sierra de Guadalupe, in which the merino sheep pass the winter without the least injury in the open air. The productive powers of this region differ greatly in different parts. In the districts north of the Tajo there are wide valleys, containing much level ground, between the ridges of the Sierra de Gata; they have a rich soil, are well cultivated, and yield good crops. The hilly tract between the Tajo and Guadiana is nearly a desert. The summits of the ridges are bare; their slopes are clothed with forests of the evergreen oak, but the lower parts are destitute even of bushes. They are never cultivated, but preserved as the pasture-grounds of the merino sheep in winter. The cultivated spots are only found in the narrower valleys, and they are few and of small extent, even in the level country on the banks of the Guadiana, between Merida and Badajoz. To the south of the Guadiana the country improves. At no great distance from the river are plantations of olive-trees, which increase in number as we proceed up the valleys of the Sierra Morena. Some level tracts of considerable extent and great fertility are enclosed by the ridges, as at Llerena, Zafra, and Jerez.

Rain is comparatively scarce on the table-land of Spain. It is stated that the annual quantity on an average does not amount to more than 10 inches, which is partly to be ascribed to the elevation of the more level part of the table-land, and partly to the circumstance that it is in most parts bounded by mountains which rise considerably above the general level of the plain, and prevent the moisture from reaching the flat country. The rain generally falls in the winter, and only a few showers occur in other seasons. The least quantity of rain falls in the mountain region of the Sierra de Guadalupe, and on the high plains of Cuença and Murcia, where sometimes eight or nine months pass without a drop falling. To this scarcity of rain the want of cultivation is chiefly to be attributed which is observed in the two last-mentioned regions. In summer excessive heat, and in winter a great degree of cold, are experienced. Though Madrid is 10° south of London, the mean annual temperature of the winter at Madrid is 43·7°, or only 4° higher than at London. But during every winter a degree of cold is experienced for some days which is very rare in London. In 1830 the thermometer sunk to 9·5° Fahr., and a great quantity of snow fell. Every year for several nights the thermometer falls several degrees below 32° and the rivers are covered with ice, though it generally disappears in the day. The mean temperature of the three summer months is 76·2°, or 15° higher than in London. But during the south-eastern wind, which is called the *solano*, the thermometer frequently rises to 90° and even 100°. With the exception of the injurious effects of such changes in the temperature, the climate of the table-land is very healthy.

II. The *Maritime* region of the Atlantic and Bay of Biscay surrounds the table-land on the north-west and north, and contains the western districts of Galicia, the province of Asturias, and the northern portion of Old Castile. That portion which lies south of Cape Ortegal is hardly more than 40 miles in width, and is traversed by numerous ridges, which have usually gentle slopes, so as to admit of cultivation to a considerable distance from their base. Their summits are crowned with forests. The lower country, which about Santiago de Compostella stretches out in extensive plains, is tolerably fertile and well cultivated. The farmers live in single farms dispersed over the country. The climate is wet. Besides the cultivation of the common kinds of grain, great attention is paid to vines and fruit-trees, among which the chesnut plantations occupy large tracts, and the chesnuts furnish the ordinary food of the poorer classes. The heat of the summer is moderate, and the winters far from being severe, except when the *gallegos*, or north winds, blow, but they are not of long duration.

The country between Cape Ortegal and Cape Ajo is of a different character. The Montañas de Asturias, which descend southward to the plain of Old Castile and Leon with a very rapid slope, decline towards the north in long ridges, which grow lower as they approach the Bay of Biscay. In the vicinity of the principal range these lateral ridges are too steep and too high to be cultivated, and are only used as pasture-ground for cattle and goats: a considerable part of them is covered with forests. Towards the sea the ridges are lower and their declivities less steep, and here cultivation has ascended to some distance from their base. The valleys which lie between these ridges are narrow and elevated near the great chain, but they grow wider towards the sea. They have a tolerably fertile soil, and are well cultivated. Wheat, barley, and maize are grown. Great quantities of cider are annually made and exported. Chesnut-trees are so common, that the chesnuts not only supply the lower classes with food, but also are exported to a great extent. The climate does not differ much from that of the western maritime tract, being also very wet, but the cold is greater, though the *gallegos*, or northern winds, are not experienced in the same degree as in Galicia.

III. *The Basin of the River Ebro* occupies a part of Old Castile, the province of Alava, the kingdom of Navarre, the greater part of Aragon, and a considerable portion of Catalonia. The northern boundary, from the sources of the river Segre on the east to those of the Arga on the west, is formed by the high chain of the Pyrenees. [PYRENEES.] West of the sources of the Arga river a chain of mountains begins, which runs westward until it meets, near the sources of the Ebro, the Sierra de Sejos, or the eastern portion of the Montañas de Asturias. This range, which is called Sierra de Aralar, is about 120 miles in length. It is much less elevated than the two great mountain-systems which it connects. The mean elevation probably does not exceed 3000 feet above the sea-level. The highest summits which have been determined are Mount Adi, which is 4766 feet high, and Mount Arza, which is 4268 feet high, both in Guipuzcoa.

The higher portion of the basin of the Ebro is considerably lower than the plain of Old Castile, which joins it on the south. Espinosa de los Monteros, a small town not far from the source of the river, is 2478 feet above the sea, and 400 feet lower than the town of Burgos; and Miranda, through which town the road from Biscay to Burgos runs, is only 1514 feet above the sea-level. Thus this part of the basin of the Ebro forms a considerable depression between the two adjacent countries. The interior of the basin, in this part, is nearly a plain, which extends north to Vittoria and south to Nagera, and is here and there intersected by detached groups of limestone hills. It has a tolerably fertile soil, and produces good crops of corn. Farther east many offsets branch off from the Sierra de Aralar and the Pyrenees, and west of the river Aragon these ridges cover at least three-fourths of the country north of the Ebro. Near the principal ridges they constitute extensive mountain-masses, which are separated by narrow valleys. The masses themselves are unfit for cultivation, but are used as pasture-grounds, and a great part of them is covered with forests containing many fine timber-trees. The valleys are cultivated, but they are not distinguished by fertility. About 12 miles from the river the mountain masses decrease in size and elevation, and soon sink down to hills, which extend to the banks of the river. Their slopes are partly cultivated, and as the soil is fertile, this tract yield good crops of maize, wheat, and other grain; there are also numerous plantations of vines, olive-trees, and chesnut-trees. Hemp and flax are extensively grown. Grain, oil, and wine are exported to a considerable amount.

East of the river Aragon, more than half of the country north of the Ebro is covered with the branches of the Pyrenees. Near 2° E. long. a range detaches itself from that chain, which runs first south-west and afterwards south, and again south-west until it terminates on the banks of the Ebro about 30′ E. long. This range is called in its southern portion Sierra de Llena, and may be considered as the eastern boundary-line of the basin of the Ebro, as nearly all the rivers which originate on its eastern declivity descend to the south-east and enter the Mediterranean. Between the sources of the rivers Aragon and Segre (that is, between 1° W. long. and 2° E. long.) is the highest portion of the Pyrenean mountains, containing the lofty summits and extensive mountain masses of the Pic du Midi, of Mount Perdido, and the Peña de Maladeta. In this part the northern declivity is extremely steep. But towards the south the range slopes down in a long inclined plain, which terminates about 40 miles from the highest part of the range, north of 42° N. lat. The rocks of which these mountain masses are composed are mostly bare of trees, and have only a scanty vegetation, but they serve as sheep-walks. The irregularly inclined plain is furrowed by deep and narrow valleys. Near the great chain these valleys are almost unfit for cultivation, on account of the severity of the climate; but farther down narrow tracts occur which are cultivated with the grains of Northern Europe and with flax. As the mountains terminate north of 42° N. lat., a considerable tract of country extends between them and the banks of the Ebro. This tract is partly cultivable and partly a desert. The desert is not far from the banks of the river, and extends from the vicinity of Zaragoza on the west, to near Mequinenza on the east, a distance of more than 50 miles in a straight line. It is about 10 or 12 miles in width, and formed by a swell of the ground, which in its highest part may rise 1500 feet above the level of the Ebro. The surface is a succession of slight ascents and descents, and the soil is extremely arid. This tract is called the Sierra de Alcubierre, or the Desert of Fraga, being traversed by the road which leads from Fraga on the Cinca to Zaragoza. It is nearly uninhabited, and almost a useless waste. A cultivated country surrounds it on all sides, though the soil is in general of indifferent quality, and the crops far from being abundant. But the extensive tract which extends at the base of the mountains, from Barbastro on the Cinca to Balaguer on the Segre, and thence eastward to Cervera at the foot of the Sierra de Llena, is an exception. On the south it terminates on the banks of the Ebro between the mouth of the Segre and the southern extremity of the Sierra de Llena. This tract, called the plain of Lerida, is distinguished by fertility. The surface is often undulating and sometimes hilly, especially towards the Sierra de Llena, but the soil being rich, cultivation is general, and the waste lands are of small extent. It produces good crops of maize, wheat, rye, barley, oats, leguminous vegetables, fruit, wine, and oil.

The countries within the basin of the Ebro south of the river contain a much larger proportion of arable land, and are much more populous than those on the north of the river. That part of it which extends between Logroño and the mouth of the Xalon, from the banks of the river southward to the base of the Sierra de Cameros, is probably the most fertile tract in the interior of Spain. West of Calahorra the surface is in general hilly, and the fertility not so great as east of that town, where the district of Rioja and Bureva is almost a plain, which is annually covered with the most abundant crops. In approaching the mouth of the Xalon, the surface of the country is again intersected by hills, and the fertility decreases.

Near the mouth of the river Aragon, and at no great distance from the banks of the Ebro, commences a ridge of high lands, which at first runs south-south-west to the point where the Xiloca falls into the Xalon. Here it attains an elevation of probably more than 2000 feet above the sea, and forms the edge of the table-land from the mouth of the Xiloca as far as the summit of the Peñagolosa. From the last-mentioned height a tolerably elevated range runs eastward until it approaches the Mediterranean within about fifteen miles, when it turns northward, and extending parallel to the sea, terminates on the banks of the Ebro opposite the extremity of the Sierra de Llena. This ridge, which is about six or eight miles across, attains a mean elevation of between 1500 and 2000 feet; and the most elevated summit, Mount Malasima, rises to 2504 feet. The range itself bears the name of Sierra Monsia. The country surrounded by the ridge just mentioned has nearly the form of a semicircle, of which the Ebro forms the diameter, and may be called the plain of Ixa, from the town of that name which is situated in the middle of its northern edge. The surface is generally hilly or undulating, and it contains a much greater portion of arable land than the countries north of the river, but the soil is of moderate fertility and badly cultivated. The average elevation of this plain above the sea-level is probably not more than 300 feet.

The country which extends between the Sierra de Llena and the Mediterranean, and the lower course of the Ebro, may be considered an appendage of the basin of the Ebro. With few exceptions, the surface is very hilly, and in some parts even mountainous, as in the vicinity of Vique. The ridges of hills which traverse it run partly parallel to the Sierra de Llena, and partly in an opposite direction towards the Mediterranean; the fertility is various. Some districts are very fertile and well cultivated, as the valley of the river Fluvia, not far from the boundary of France, which is called El Apurdan; and the fine plain in which the town of Reus is situated, and which is fifteen miles long and six wide. In general the valleys and depressions are rather fertile and well cultivated; but there are also extensive tracts which have a very stony and sterile soil, as the country between Vique, Gerona, and Hostalrich, and Mount Lazamos, which extends from the plain of Reus to the mouth of the Ebro, and whose sandy soil is covered with a forest of stunted furs. Cultivation has attained a high degree of improvement in this tract, and the water of the numerous perennial rivers is used for irrigating the cultivated grounds. Among the mountains of this region, the Montserrat rises in terraces to the elevation of more than 4000 feet, and the hill of salt near Cardona, which is above two miles in circuit, to nearly 600 feet. Great quantities of salt are annually taken from it.

The countries included in the basin of the Ebro differ greatly in climate, the valleys within the Pyrenees being so cold that the common kinds of grain do not succeed, while along the sea-shore and towards the mouth of the river most of the fruits of Southern Europe attain perfection. In general it may be observed that the part of the basin which is north of the river, with the exception of the tracts immediately situated on the shores of the Mediterranean, has more severe winters and colder summers than the great table-land, whilst the countries south of the river have a mild winter, and a much more temperate summer. The mean annual quantity of rain is between 20 and 26 inches, but it is much more in the elevated valleys of the Pyrenees. In the interior the climate is healthy, but not so on the coast. Barcelona has occasionally suffered from the yellow fever.

IV. The *Eastern Declivity* extends from the mouth of the Ebro to Cabo de Palos, and contains four regions, which differ in their natural features and productive powers. The most northern extends from the Ebro to Murviedro. Along the sea-shore there is a narrow strip of level ground, hardly more than two or three miles wide, which in a few places is interrupted by low hills. It is generally fertile, and in some places highly fertile. The hills which lie at the back of it, and the valleys between them, are also tolerably fertile and well cultivated, but where the country approaches the high table-land of Cuença, the soil is dry and less productive.

South of this hilly country is the plain of Valencia, which extends on the sea-shore from Murviedro to Gandia, a distance of more than 40 miles, and in its widest part, at the back of the town of Valencia, it extends about twenty miles inland. It is abundantly irrigated, and the whole is under cultivation. It is no less noted for the great variety of its fruits, and rich crops of rice, wheat, and other grain, than for the mildness of the climate, which never experiences frost, but yet is not considered healthy.

The country which lies south of the plain of Valencia, and extends along the sea-shore from Gandia to the vicinity of Alicante and Elche, is extremely broken. It may be considered the most eastern offset of the great table-land, for its central districts are at a great elevation above the sea-level, as may be inferred from the severe cold which is experienced in the winter months, and from the circumstance that the most elevated of its ridges, the Sierra de Peñaquila, south of Alcoy, is covered for some months of the year with snow, which is collected and sent to the lower countries lying south and north of it. The valleys are usually narrow, and the level tracts between the mountains of small extent, and their fertility not much above mediocrity; but as this tract has become the seat of an extensive manufacturing industry, all the arable land is cultivated with the greatest industry, and the crops of maize and corn are tolerably abundant.

South of this mountainous region the eastern declivity extends much farther inland. On the west it reaches to the Sierra de Cazorla and the Sierra de Segura, two ridges of considerable elevation, situated near 3° W. long., and on the south it extends to the Sierra de Aguaderas (37° 20′ N. lat.). The western portion of this region (west of 2° W. long.) is almost entirely filled up with mountains which rise to between 4000 and 5000 feet above the sea-level. It is probable that the general elevation of the valleys is not less than 2000 feet, and that this tract unites the great table-land with the mountain region of the Sierra Nevada. The long narrow valleys are not fertile, and they are badly cultivated. East of 2° W. long. the mountains recede and leave wide valleys between them, of which the northern, or that of the river Segura, is distinguished by great fertility, and the southern, or that of the river Sangonara, may also be called fertile. Both are covered with corn-fields and plantations of fruit-trees. These valleys do not extend beyond 1° 25′ W. long., where they pass into two plains separated by a low ridge, which runs north-east, and terminates near the mouth of the river Segura. The northern is called the plain of Orihuela, and the soil is of the finest quality. Though its products are less various than those of the plain of Valencia, no tract of Spain yields such abundant crops of wheat. The southern plain, which is called the plain of Murcia, is divided from the sea, which is to the south of it, by another low but rather steep ridge, which terminates at Cabo de Palos. The soil is less fertile, and impregnated with salt, which renders it fit for the cultivation of the various plants from which barilla is obtained, which forms an important article of export from Spain. This region, more than any other part of Spain, is subject to earthquakes, and it suffered much from them in 1829. This region also suffers from want of moisture; sometimes it does not rain all the year round, but the rivers always yield a plentiful supply of water for irrigation.

V. The *Basin of the River Guadalquivir* lies between the great table-land and the mountain region of the Sierra Nevada. On the north is the Sierra Morena, and on the east the Sierra de Segura and that of Cazorla. The mountains which constitute the southern boundary-line run along 37° 35′ N. lat., east of 4° 30′ W. long., but west of that meridian they decline to the south-west and terminate on the Atlantic in Cape Trafalgar. The lower level of this country is about 1500 feet below the high countries which lie north and south of it. The source of the river Guadalquivir, which is at the base of the Sierra de Cazorla, and three miles south of the town of that name, is only 526 feet above the sea-level. Such a difference in the level of the country must of course be attended by a corresponding difference in vegetation and productions. [ANDALUSIA, vol. i., p. 512.] But the basin of the Guadalquivir is not a complete level: it varies greatly in aspect and productions. The most eastern portion, or that which is east of 4° W. long., is traversed in the northern and also in the southern districts by several ridges which branch off from the Sierra Morena and the Montes de Granada, and these offsets, with the intervening valleys, occupy about two-thirds of the surface. The ridges are not high, and the valleys are open and wide, and rather fertile and well cultivated. The country between the extremities of the mountains, occupying the central districts, is generally an undulating plain interspersed with a few hills. It is of considerable fertility and well cultivated, and produces much wine, oil, and all kinds of grain.

The central part of the basin is only mountainous to the north of the Guadalquivir, where several ridges of the Sierra Morena approach to the banks of the river. The valleys between them are very narrow and difficult of access. They contain very little arable land, and are badly cultivated. The slopes can only be used as sheep-walks, and the grass in general is scanty. Many of them are covered with thin forests of stunted evergreen oaks, and many are quite bare. The level tracts along the river are generally from 100 to 200 feet above it; they are very fertile and well cultivated, especially in the neighbourhood of Cordova. The tracts south of the river can hardly be called hilly, except in a few places; the surface is diversified by long and broad swells, which usually rise with a gentle slope, and have only steep sides where they approach the Montes de Granada. Some of these swells are dry, and of very indifferent fertility, and generally covered with pine-trees, but most of them are planted with olive-trees or vines. The broad level depressions between the swells are tolerably fertile, and usually well cultivated. This region extends to 5° W. long.

The lower basin of the Guadalquivir extends from 5° W. long. to the Atlantic. That portion which lies north and west of the river contains two regions, which differ in their natural features. The northern, or that which is north of the road from Sevilla to the town of Ayamonte, at the mouth of the Guadiana, is hilly, and in its northern districts even mountainous. Though the ranges occupy a considerable portion of it, the valleys between the offsets of the Sierra Morena are much wider than farther east, and contain large tracts of arable land, but the soil is not so fertile as that of the valleys north of the range. It is tolerably well cultivated. South of the road between Sevilla and Ayamonte the country is almost a useless waste: it is a dead level, and hardly elevated above the sea. Though the supply of rain is far from being abundant, the whole region, for want of sufficient draining, is converted into a swamp, which is covered with low bushes. It is only along the road, where it is somewhat higher and drier, that a portion of it is cultivated: the remainder is uninhabited, except by fishermen and persons occupied in making salt from sea-water. South of the Guadalquivir is a plain, which is traversed, in the vicinity of the river, by a few low broad swells, but in approaching the mountain region of the Sierra Nevada and the banks of the river Guadalete it rises into hills. The northern and eastern districts have generally a good clayey soil, and as they are also well watered by numerous small rivers that are used for irrigation, agriculture is in a good condition, and the crops of grain are plentiful. The plantations of olive-trees, vines, and fruit-trees, among which the oranges of Sevilla are noted, occupy large tracts. The southern district, which extends from the small town of Utrera to Xerez de la Frontera, is a desert nearly without inhabitants and without cultivation, though the soil, which is clayey, apparently possesses a considerable degree of fertility. But the most southern corner, which surrounds the bay of Cadiz, is famous for its vineyards and large plantations of olive-trees. The sugar-cane is cultivated, and the cochineal insect is now reared.

VI. The Mountain region of the *Sierra Nevada* extends over the most southern part of Spain, lying along the sea which divides Spain from Africa, and along the Strait of Gibraltar. Its northern boundary on the east is marked by elevated ranges, extending east and west near 37° 25′ N. lat. The most eastern is called Sierra de Aguaderas, then follows the Sierra de Estancias, and farther west the Montes de Granada, which reach to the towns of Cabra and Lucena, near 4° 30′ W. long. From this point to the Atlantic near Cape Trafalgar, or rather Torre de Roche, the boundary runs south-west, and is not formed by a distinct ridge, but by a mountainous tract consisting of the offsets of the Sierra de Cabras and Sierra de Ronda. This mountain-system covers nearly 12,000 square miles, and contains two regions, a more elevated one to the east of 4° 20′ W. long., and a lower one west of that line.

The centre of the more elevated region is occupied by the Sierra Nevada, a lofty range of mountains running east and west, and about 10 miles wide. The highest part lies between 3° and 4° W. long., nearly the whole of which is covered with snow all the year round. On the 15th August, 1804, the lowest line of snow on these mountains was 9064 feet above the sea-level, but many of the summits rise to a much greater elevation. The highest is the Pico de Mulhaçen, which is the highest mountain in Spain, and attains 11,666 feet above the sea-level; west of it stands the Pico de Veleta, which rises to 11,387 feet. But there are many other summits which are nearly as elevated, as the Cerro de los Machos, Cerro de la Caldera, and the Cerro de Fachos Altos. In advancing east of 3° and west of 4° W. long., the chain grows lower, and none of the summits attain the snow-line. Between 2° 40′ and 3° 10′ W. long. is a mountain-knot from which several ridges branch off: it lies between the towns of Baza on the east and Guadix on the west, and is called the Sierra de Baza. From its southern edge the Sierra de Gador issues, and running southward terminates on the sea-shore between Punta de Santa Elena and the Castello de Guardias Vejas, with high rocks. This chain rises, at no great distance from the sea, to 7130 feet. Two other chains issue from the eastern side of the mountain-knot of Baza. The southern chain runs east, and is called Sierra de Bucares: it is of considerable elevation, as the eastern extremity, the Sierra de Maria, about two miles from Vera, is 6274 feet above the sea-level. A branch of the Sierra de Bucares, called the Sierra de Ujamilla, or Aljamilla, runs southward, and occupies with its extensive masses the whole space between the Gulf of Almeria and the small plain that surrounds Vera. It does not appear to rise so high as the Sierra de Bucares. The northern chain issuing from the Sierra de Baza also runs eastward, and bears first the name of Sierra de Estancias, and where it approaches the Mediterranean, that of Aguaderas. No part probably rises above 3000 feet. The few valleys of this mountain region are very small, and enclosed by steep declivities. The arable tracts are of inferior quality, and the whole appears to be a very desolate country. But this part of Spain is rarely visited by travellers, and a great portion of it is almost entirely unknown.

South of the Sierra Nevada are the Alpujarras, a name which properly indicates a range of mountains that runs parallel to the great chain and the shores of the sea, nearly half-way between them. They extend from the Sierra de Gador, which is considered a part of them, westward to the river Guadalfeo, where it runs southward. This chain is of a moderate elevation, probably nowhere more than 5000 feet above the sea-level, an elevation which is attained by the Cerro de Murtas. These mountains are characterized by a rich vegetation which clothes their northern declivity. This declivity descends by gentle slopes to the broad valleys which lie between the Alpujarras and the Sierra Nevada. The fine pastures on the mountain slopes and the fertility of the valleys are partly to be attributed to the great quantity of rain, which amounts annually to between 25 and 30 inches. This is owing to the Sierra Nevada, as the southern slope of the Alpujarras is nearly bare of trees and vegetation, and almost uninhabited, except in the valleys formed by the rivers, which intersect the range, and flow to the sea.

The river Guadalfeo is considered the western boundary of the Alpujarras, but the range of mountains continues westward. It is there called Sierra de Jolucar, and is of moderate elevation (2632 feet above the sea-level); but at some distance from the river, where it takes the name of Sierra de Lujar, it rises to 6218 feet; and farther west, in the Sierra de Tejada, it attains the height of 7671 feet. This part of the mountain region is similar in fertility to the Alpujarras, and some geographers consider it a part of that region. But the mountains do not generally advance close to the sea: they slope towards it with a long and gentle declivity, and a narrow, level, though not a low tract intervenes between the base of the declivities and the sea-shore. On this level tract and the slopes of the mountains are those extensive vineyards which supply the wine that is exported from Malaga. This is also the only tract in Europe where sugar is raised to any extent and as an object of rural economy. Much cotton is also grown, and among the trees two or three kinds of palms are found. It is the hottest country in Europe.

Along the northern base of the Sierra Nevada extends the plain of Granada, which is famed for its natural richness and picturesque beauties, and its relics of the Moorish times. [ALHAMBRA; GRANADA.] North of the plain are the southern slopes of the Montes de Granada. On the east this range is connected with the mountain-knot of Baza, and runs westward nearly parallel to the Sierra Nevada. It may extend about 50 miles in length, and is about 10 miles across. It does not rise with a steep ascent, like the Sierra Nevada, but slopes gently to the south and north. These slopes are usually either covered with plantations of olive-trees and vines, or cultivated with grain, though the range rises to a considerable elevation. The town of Alcalá la Real, situated near its western extremity, is 2805 feet above the sea; but the mountains rise much higher to the north-east of Granada, where the Sierra Elvira, or de los Infantes, exceeds 5000 feet. East of the town of Granada, the Xenil river, which divides the declivities of the Sierra Nevada from those of the Montes de Granada, flows in a valley of moderate width, but tolerably well cultivated. Near the town the valley widens to a plain, which extends on both sides of the river as far as Loja, a distance of nearly 20 miles in a straight line, and varies in breadth from eight to ten miles. The whole is covered with fields and gardens, intermixed with houses and villages. In no part of Europe is irrigation better understood. Every kind of grain yields abundant crops. On the slopes of the Sierra Nevada there are excellent pastures.

The mountain region which begins west of the plain of Granada and the Sierra Nevada, extends south-west, occupying the whole of the tract between the Mediterranean and the river Guadalete, which falls into the bay of Cadiz. It terminates on the west between Torre de Roche and Tarifa. Nearly in the middle of it runs an elevated tract about ten miles wide, which however is not immediately connected with the Sierra Nevada, but rather with the Sierra Tejada. East of 5° W. long. it is called Sierra de Cabras; but farther west it takes the shape of two parallel ridges, of which the western is called Sierra de Ronda, and the eastern Sierra de Tolox. The high mountains terminate in the vicinity of Medina Sidonia. The mountains do not attain a great elevation. The Sierra de Cabras may rise to between 4000 and 5000 feet above the sea-level; but farther west it sinks lower, and near Medina Sidonia it hardly exceeds 2000 feet. But the surface of the whole tract is extremely broken, like the Sierra Morena. Steep ridges and high peaks lie close together, and are divided rather by ravines than by valleys. Travellers find it very difficult to cross this tract. On the north-west and south this mountain region is surrounded by a hilly country, which in many places has a very broken surface, but also contains a considerable number of wide valleys and extensive plains. The hills, which are numerous, with few exceptions do not rise more than a thousand feet above the sea; and nearly the whole of the country, where not cultivated, is covered with forests. A great part of it is used as pasture-ground, but other parts are generally cultivated. The soil is moderately fertile Along the Mediterranean, between Malaga and Marbella, are extensive vineyards, plantations of sugar and cotton, date-trees, and other fruit-trees in great abundance.

The region of the Sierra Nevada enjoys the advantages resulting from abundant rains more than any other part of Spain, not even the northern and western coasts of the northern provinces excepted. The annual quantity of rain varies between 25 and 30 inches, being greater near the elevated ridges, and less plentiful near the sea. This, united to the powerful effects of a southern sun, renders it fit for the production of a great number of fruits and plants which do not succeed in any other part of Spain.

*Rivers.*—Spain is drained by a great number of rivers, and some of them run for several hundred miles; but only a very few are navigable for small boats, and that only towards their mouths. Travellers generally attribute this to want of energy in the government or in the nation; but the rivers have only a very small quantity of water. This is mainly to be ascribed to the small amount of rain which falls on the table-land and the adjacent tracts, in which almost all the rivers rise; and this small quantity is very soon evaporated, as the highest parts of the interior are destitute of trees. Though the number of mountain-ranges is very great, most of them are only for a few months of the year covered with a thin layer of snow, which dissolves very rapidly. It is remarkable that those rivers which are navigable become so only at places where they are joined by tributaries which originate in such mountains as rise above the snow-line. The Ebro becomes navigable at Tudela, after having been joined by the Aragon, which originates with numerous branches in the snow-covered mountains which surround the Pic du Midi. The Tagus is not navigable even for small boats above Alcantara, which town lies near the boundary of Portugal, and where it is joined by the Alagon, which river is supplied during the whole year with water from the snow-covered summit of the Sierra de Gredos. The Guadalquivir can only be navigated by small boats from the town of Palma downwards, for at that place it receives the Xenil, which derives the great supply of water that it brings down from the Sierra Nevada. We do not precisely know where the Duero begins to be navigated, but probably this takes place at the confluence with the Ezla, which originates in the Montañas de Asturias, and derives one of its branches from the high summit of the Peña de Peñaranda. But though the rivers of Spain are nearly useless for the transport of its productions, they are of great importance for fertilising the ground by irrigation. This practice is nearly general in all the countries which extend along the Mediterranean, and in the basin of the Guadalquivir. It cannot be introduced on the table-land, as the rivers which water it generally run in so deep a bed, and so much below the general surface of the country, that their waters cannot be made available for that purpose. In the northern and north-western maritime countries the rains are sufficiently abundant for the growth of corn without such artificial means.

The largest rivers are noticed under their proper heads. [DOURO; EBRO; TAGUS.] We shall here briefly mention a few others.

The Miño, or, as it is called by the Portuguese, Minho, rises with numerous branches in the north-eastern districts of Galicia, where the Montañas de Asturias form nearly a circle, whose circumference is open towards the south. All the waters collected on the inner edge of this circular range unite and form the Miño. Where the river issues from the circle, below the town of Lugo, it has scoped its way through an elevated rocky ridge. It continues to run in a southern direction to Orense, where it again runs between high ridges, after having been joined by the Sil, which in its upper course drains a similar circular region, and also in the middle of its course traverses a narrow cleft between high mountains. Below Orense the Miño runs mostly south-west, and from Melgaço to its mouth it constitutes the boundary-line between Spain and Portugal. The mouth is between Guardia in Spain and Caminha in Portugal. Its course in a straight line is about 115 miles, and along the windings 160 miles. Though abundantly supplied with water, this river is not navigable within Spain, on account of its great rapidity. It is however navigated from Salvatierra to its mouth.

The Guadiana rises with numerous branches on the table-land of Cuença, between 2° and 3° W. long. and 39° and 40° N. lat. That branch which is called Guadiana originates near 39° N. lat., in a series of small lakes called Lagunas de Ruydera; and after having run a few miles, it disappears underground, and it continues to run underground for more than twelve miles: it issues from the earth as a strong stream between Villarta and Daymiel. The place where the river re-appears is called Los Ojos de Guadiana (the eyes of the Guadiana). Soon after it is joined by a large tributary, the Giguela, which runs nearly 100 miles, and drains an extensive country. It then runs for more than 120 miles westward through the plains of La Mancha, without being joined by any considerable affluent. East of 6° W. long. it is joined by the Zujar, which descends from the Sierra Morena, and runs more than 100 miles, but has very little water. Continuing westward without receiving any considerable tributary, it begins to form the boundary between Portugal and Spain near Badajoz; and after running about 30 miles along the boundary in a south-south-western direction, it enters Portugal, where it runs in a very narrow valley near the town of Serpa, separating the western offsets of the Sierra Morena from the Sierra de Caldarañ, and forms a cataract, called El Salto del Lobo (the leap of the wolf). Afterwards it turns to the east of south, and from the confluence of the river Chanza to its mouth it again runs along the boundary between Spain and Portugal. Its course exceeds 450 miles; but it has little water, and can only be ascended by flat-bottomed small river-barges to Mertola in Portugal, not much more than 30 miles from its mouth.

The Guadalquivir originates in the Sierra de Cazorla, east of 3° W. long., and near 37° 50′ N. lat.; and after a course of about 30 miles, mostly west, it is met by the Guadiana Menor, which drains the country enclosed by the mountain-knot of Baza, and runs south, west, and north, nearly 100 miles, before it joins the Guadalquivir. The Guadalquivir, after running 30 miles more to the west, is joined from the north by the Guadarmena, which originates on the table-land of Cuença; and, after leaving it, flows south-west in a narrow valley of the Sierra Morena. It flows nearly 150 miles before it joins the Guadalquivir. Below the confluence of the Guadarmena, the Guadalquivir receives only the waters of one considerable affluent, the Xenil or Genil, which brings down the waters from the Sierra Nevada, and runs first west and afterwards north-west. Though its course does not exceed 100 miles, at its confluence with the Guadalquivir it is the larger river, and brings to it such a volume of water, that from this place the Guadalquivir becomes navigable for river-boats. At the town of Sevilla the Guadalquivir changes its south-western course into a nearly southern course; and here the banks, which up to this point were rather high, sink down almost to the level of the river. In the low plain through which it flows it divides into several branches, which enclose two large islands, Isla Menor and Isla Mayor, which are very low and swampy: though fertile, they are nearly uninhabited. Below Isla Mayor, where the river runs in one channel, it forms a small æstuary, which is connected with the sea at S. Lucar de Borrameda. The whole course of the Guadalquivir falls short of 300 miles; but if the Guadarmena is considered as the principal branch, it runs nearly 100 miles more. Sloops may ascend the river to the town of Sevilla.

Among the rivers which fall into the Mediterranean besides the Ebro, the Segura, Xucar, and Guadalaviar require notice. The Segura originates in the Sierra de Segura north of the source of the Guadalquivir, and in its upper course, which nearly forms a semicircle running north, north-east, east, and south, it flows in a narrow valley between high mountains. Afterwards it runs east in the Vale of Murcia, and becomes navigable at that town for river barges, though a great volume of water is drawn from it to irrigate the extensive plain of Orihuela; where it enters that plain it is joined from the south by the Sangonera, which originates on the eastern declivity of the mountain-knot of Baza, and brings down a considerable volume of water. This river runs above 200 miles.

The Xucar rises on the elevated plain of Cuença, at the place where the Sierra de Molina is connected with the Sierra de Albaraçin, and it runs for more than 100 miles, mostly south, in a broad and moderately fertile valley, without receiving any tributary. It then gradually turns to the east, and after descending from the table-land near its confluence with the Cabriel, it flows in a wide and fertile valley until it enters the plain of Valencia about 12 miles from its mouth. It probably would be navigable for the last 30 or 40 miles from its mouth, if the waters were less abundantly applied to the irrigation of the adjacent country. Its course considerably exceeds 200 miles.

The Guadalaviar or Turia rises on the north-eastern edge of the table-land, in the mountain-ridge which runs from Montalban to the Peñagolosa. After having run about 30 miles to the town of Teruel, its surface is still 2887 feet above the sea-level. Its general course is to the south, but after passing 40° N. lat. it gradually declines to the south-east, and the course is nearly east where it enters the plain of Valencia, which is abundantly irrigated by its waters. After flowing more than 20 miles in the plain, it falls into the Mediterranean near Grao, where there is a bad roadstead. Its whole course is about 150 miles.

*Productions.*—The most common kinds of grain which are cultivated in Spain are wheat, maize, barley, and rice. The largest quantity of wheat is cultivated in Catalonia and in the western portion of the plain of Old Castile and Leon. Rice is only grown in the countries along the Mediterranean, from the boundary of France to Cabo de Palos. Frequently the produce of the crops is not sufficient for home consumption, and grain is imported. Other objects of agriculture are hemp and flax, especially in the basin of the Ebro, and madder and saffron on the table-land of Cuença. In the southern districts the sugar-cane and cotton are cultivated, and the aloe for the thread which is obtained from it. The most common vegetables are onions, pumpkins, cucumbers, melons, water-melons, potatoes, beans, and peas. Many fruit-trees are cultivated, as almonds, figs, pomegranates, lemons, oranges, pistachia nuts, carobas, dates in the southern districts, walnuts, hazel-nuts, and especially chesnut-trees, which in some of the northern districts cover large tracts. Olive-trees occur in all parts, except the northern mountain tracts, and the vineyards are extensive, except on the most elevated regions. Several of the Spanish wines are considerable articles of commerce, as Xeres (Sherry), Malaga, Alicante, Malvasia, Tinto, and Val de Peñas. Brandy and raisins also are articles of export. Among the wild trees are the sweet-acorn oak (*Quercus ballota*), the cork-tree (*Quercus suber*), the kermes oak (*Quercus coccifera*), and the sumach-tree. On the Montañas de Asturias and Aralar, and also on the western offsets of the Pyrenees, there are large forests of fine timber-trees. The plant from which the barilla is obtained grows partly wild and is partly cultivated in the plain of Murcia and some adjacent districts. The liquorice-plant is abundant in the vicinity of Sevilla and near the mouth of the Ebro, and the prepared juice is sent to all parts of Europe. The esparto is used for making ropes, mats, baskets, &c. On the naked rocks of the Montañas of Asturias, lichen Islandicus and orchil are collected. The caper-bush grows wild in the countries along the Mediterranean, in which also manna is collected.

Among the domestic animals the sheep and horses are distinguished. The sheep are noted for their fine wool, which forms an important article of export. They pass the summer on the Sierras de Guadarama, Avila, and Gata, and the winter in the low mountains of Estremadura which lie between the Tajo and Guadiana. Their number amounts to five or six millions. Sheep are also numerous in other parts, but they have generally a coarse wool. The horses of Spain, and especially those of Andalusia, are noted for their beauty; but during the French occupation (1808-1814), nearly all the fine breeds were sent to France, and they are now rare. Cattle are only numerous and of large size near the higher mountain-ranges; in other parts they are small. The asses and mules are distinguished by their size and beauty. Pigs are not very numerous. Goats are more numerous than in any country of Europe, especially on the table-land. There are wild cattle in the mountain region of the Sierra Nevada, chamois in the Pyrenees, and porcupines in many places. The mountains also contain wolves, bears, lynxes, wild cats, and martens, the last especially in Biscay. Chameleons are found near Cadiz, and monkeys on the rock of Gibraltar. The flamingo is sometimes seen near Valencia, and there are also eagles. The care of the silkworm, the cochineal insect, and bees are branches of industry. In no country of Europe, except Italy, is so much silk obtained as in the eastern and southern provinces of Spain. The cochineal insect has been reared in the last twenty years in Andalusia, Granada, and Estremadura, and it is said to thrive well. Bees are very abundant, and much honey and wax are obtained. Only a few kinds of fish are met with in the rivers, but the fishery in the Atlantic is important. On the coast of Galicia great numbers of sardines are taken, and along the coast between Cadiz and Gibraltar the tunny and anchovies.

Spain abounds in minerals. Gold and silver are known to exist in several places, but they were neglected whilst Spain was in possession of the American colonies. The Darro, a small affluent of the Xenil, brings down from the Sierra Nevada particles of gold. Silver-ore is extracted from some mines near Guadalcanal, where platinum also has been found. Some copper-mines are worked, but the produce is small. A rich mine of quicksilver is worked near Almaden. Lead is very abundant, especially in the Sierra de Gador, and the annual produce of the lead-mines is 600,000 cwt. Iron-ore is very abundant in the Sierra de Aralar, in the Sierra Nevada, and in the Alpujarras. That of the Sierra de Aralar is of the best quality, and the mines are worked to a considerable extent. There are also tin, calamine, bismuth, cobalt, alum, vitriol, and sulphur. In some parts large quantities of saltpetre are collected. Coal occurs in the Montañas de Asturias and in the Sierra Morena, but it is not much worked. Many kinds of marble are got in Catalonia. Several precious stones are found, as rubies, topazes, amethysts, turquoises, and garnets. Salt is got near Cardona in Catalonia, from the lagune called the Albufera de Valencia, and from the sea-water along the coast between Cape Trafalgar and the boundary of Portugal.

(Miñano, *Diccionario Geogr. Estadist. de España, &c.*; Antillon's *Geografia de España;* Bourgoing's *Tableau de l'Espagne Moderne;* Laborde's *Itinéraire descriptif de l'Espagne;* Swinburne's *Travels through Spain;* Graham's *Travels through Portugal and Spain;* Temple's *Observations on a Journey to Spain and Italy;* Temple's *Second Journey in Spain;* Link's *Reisen durch Frankreich, Spanien, und Portugal;* Fischer's *Gemählde von Valencia.*)

*Political Divisions.*—In former times Spain was divided into fourteen large provinces, some of which were called kingdoms, as Granada, Seville, Jaen, Murcia, Valencia, &c.; others principalities, like Asturias; others counties, like Barcelona, Niebla, &c.; and lastly, others were called provinces, like New and Old Castile, Estremadura, &c. Biscay was termed Señorio. It is now divided into the following forty-nine smaller provinces:—Alava, Albacete, Alicante, Almeria, Avila, Badajoz, Baleares, Barcelona, Burgos, Caceres, Cadiz, Canarias, Castellon de la Plana, Ciudad Real, Cordoba, Coruña, Cuença, Gerona, Granada, Guadalajara, Guipuzcoa, Huelva, Huesca, Jaen, Leon, Lerida, Logroño, Lugo, Madrid, Malaga, Murcia, Navarra, Orense, Oviedo, Palencia, Pontevedra, Salamanca, Santander, Segovia, Sevilla, Soria, Tarragona, Teruel, Toledo, Valencia, Valladolid, Vizcaya, Zamora, Zaragoza.

*Population.*—The present population of Spain is variously estimated: some authors state it only at ten millions; others at twelve; but in the absence of any official documents it is impossible to decide which estimate is nearest the truth. The last census, made in 1803, gave a total of 10,351,000; which cannot have increased much owing to the troubled state of the Peninsula since the commencement of the present century. Don Sebastian Miñano, who, in 1826, published a Geographical and Statistical Dictionary of the Peninsula (*Diccionario Geográfico de España y Portugal*, Mad., 1826-9, art. 'España'), estimates the population of Spain at 13,732,176; which number he says that he has obtained from documents and reports furnished him by the minister of the interior. But as the work of that author abounds in gross inaccuracies, and is well known to have been written under the influence of a faction, and with a view to exaggerate the population and resources of Spain, no faith whatever can be placed in his statements. As a proof of the wilful exaggerations of which that writer has been guilty, we need only point out the fact of his having given Madrid a population of upwards of 200,000; when, by a census taken last year, it has been found to be only 165,000.

*Religion.*—The established religion is the Roman Catholic, and no other is allowed in the Spanish dominions. The crown presents the archbishops and bishops, who are confirmed by the holy see; but the pope, having of late refused to grant bulls of confirmation to the ecclesiastics nominated by the regent, almost all the sees of Spain are now administered ad interim by bishops appointed by the government. The wealth of the church was at one time immense; in 1780 the revenues of the archbishop of Toledo amounted to about half a million sterling. Since the Revolution the clergy have been deprived of the tithes; and, by a law passed in the last Cortes, and which has since obtained the royal sanction, the whole of the estates belonging to the cathedrals are to be sold for the discharge of the national debt, and the clergy are henceforth to be supported by the nation. The monastic orders have also been suppressed; and the convents, and the lands belonging to them, sold; but the convents of nuns have been suffered to remain until the death of the present occupants.

*Education.*—Education is not generally diffused; the lower classes have little or no instruction at all. Until lately education was almost entirely in the hands of the regular clergy, or of the Jesuits, who had colleges in the capital and in the principal cities of the Peninsula; but the suppression of that and the other monastic orders has been in this respect severely felt by the public, as no effectual provision has yet been made by government to supply the place of the schools and colleges formerly kept by them. A society however has lately been formed at Madrid for the establishment of infant-schools, which has already produced some good results, and the example is now being followed by Barcelona, Valencia, and other large cities. The universities, which are nine in number, namely, Salamanca, Valladolid, Santiago, Alcalá, Zaragoza, Huesca, Cervera, Sevilla, and Toledo, are in a most deplorable condition, being attended only by students destined for the church, or those who follow the profession of law or of medicine, for which only academical studies are required. The children of the nobility and rich people are educated in France and other parts of the Continent. There are in the capital various academies and literary societies [MADRID], but their labours of late have been unimportant.

*Colonies.*—The only colonies now remaining to Spain, of her once extensive dominions in America, are the islands of Cuba and Puerto Rico. She possesses the Philippine Islands in Asia, and the fortresses of Ceuta, Melilla, and Peñon de la Gomera, on the northern coast of Africa, which are used as places of transportation for convicts. The islands of Fernando Po and Annabon, on the western coast of Africa, also belong to her.

*Revenue, Trade, &c.*—The public revenue of Spain, including that of her colonies, amounts to about 13,000,000*l.* sterling; but the expenditure for several years has exceeded the revenue by nearly one-half. The public debt amounts to about 40,000,000*l.* sterling, upon which no dividends have been paid for some time. No country of Europe equals Spain in natural commercial advantages, whether we consider its situation or its products. The coasts are extensive, and the ports numerous and commodious; the inhabitants, inured to a warm climate, visit the tropical regions with comparative safety; yet it is far behind any other country in commercial importance. During the seventeenth century most of the Spanish trade with America was carried on in Dutch or English vessels; and, with the exception of wine, wool, and oil, few if any of the productions of the Peninsula found their way to that market. About the close of the last century, under the enlightened administration of Count Florida Blanca, Spanish commerce revived, and several manufactures were established throughout the country. These however were all destroyed during the Peninsular war, and the subsequent separation of the American colonies from the mother country has completely annihilated the maritime trade of Spain. At present Catalonia is almost the only province of Spain where manufacturing is carried on to any extent, but notwithstanding the enormous duties imposed for their protection, few products of Catalonian industry can enter into competition with the corresponding articles of foreign manufacture; and the most scandalous contraband trade is carried on through Gibraltar, Portugal, and on the coast of the Mediterranean, to the great detriment of the revenue. Were the Spaniards to devote their attention to agriculture, and to establish speedy means of communication between their provinces, by making roads or digging canals, it would prove a greater source of prosperity to their country than the attempt to establish manufactures. The chief exports of Spain consist of wines—of which 4,130,755 gallons were shipped, in 1840, to England alone—dried fruits, corn, oil, wool, quicksilver, lead, and some iron. The silk of Valencia, which is equal to that of Italy, is bought by the French manufacturers.

*Government and Constitution.*—The government of Spain during the middle ages was absolute, though, from the peculiar position of the country, and the earlier development of popular rights—the Cortes held at Burgos, in 1169, having preceded by nearly a century the celebrated Leicester parliament—the power of the king was more virtually restricted than in any other country of Europe. Ferdinand the Catholic aimed the first blow at Spanish liberty, by avoiding, as much as possible, the convocation of the Cortes. His successor, Charles V., completed the ruin of the Cortez, by entirely disregarding their petitions and defeating the citizens who rose in arms to support the cause of national liberty. Spain continued to be ruled despotically by the kings of the houses of Austria and Bourbon until the French invasion in 1808, when the deputies of the several provinces assembled at Cadiz, and framed a new constitution, which was sworn to and promulgated in 1812. At the close of the war however, Ferdinand, who had recovered his liberty, refused to give it his sanction, and he re-established the old forms of government; but being compelled soon after (1820) by a military insurrection, at the head of which was General Riego, to swear to the constitution of 1812, it again became the law of the land, until it was a second time put down with the assistance of a French army.

On the death of Ferdinand (1832), his widow, Queen Christina, wishing to conciliate the liberal party, gave the nation a new charter (Estatuto Real), and re-established the antient Cortes of the kingdom, with some slight modifications, one of which was the appointment of two chambers, that of the 'Procuradores,' or Deputies, and that of the 'Proceres,' or Peers. This last was composed of all the grandees of Spain, who were declared peers by right of birth, as well as of a certain number of noblemen, high functionaries, bishops, &c., whom the crown reserved to itself the right of creating peers for life. The king alone had the power of convoking, suspending, and dissolving the Cortes: the only occasion which rendered their convocation imperative was the demise of the crown or the occurrence of any arduous affair which the government might consider so important as to require that they should be consulted. In the event of a dissolution another parliament was to be convoked before the lapse of the year. The Cortes had not the power of deliberating on any matter which had not been expressly submitted to them; but they had the right of petition. The concession of these and other political rights not having satisfied the demands of the Liberal party, several attempts were afterwards made to re-establish the Constitution of 1812, though the more enlightened part of the nation had long acknowledged its impracticablity. At last, in 1836, the revision of the Constitution was intrusted to the Chambers by the government; and after a lengthy discussion, which lasted the whole of the session, the new constitution of the Spanish kingdom was sworn to by the queen-regent, in June, 1837. This differs materially from the old one of 1812. Instead of only one chamber, as before, two were instituted—that of the *Diputados* and that of the *Senadores*—the members of which are invested with equal powers, but all bills relating to taxation are to be presented in the first instance to the Lower Chamber. Instead of the indirect election, the direct system is adopted. Both chambers are elected by the people, the crown having the privilege of choosing one out of every three senators presented by the electors of the provinces. By the Constitution of 1812, the Cortes met annually on a fixed day without being summoned by the king; and the session lasted till another fixed day, two-thirds of the members having the power of adding a month to the session. The *veto* of the crown moreover was only suspensive in the enactment of laws; but in the present constitution it is absolute. Much of the democratic tendency of the former has been done away with, and it has in most points been assimilated to the constitution of other representative states of Europe. It has however not been extended to the colonies.

*Laws.*—During the period of Roman domination Spain was governed by Roman law. The Northmen introduced the Visigothic code, antiently called Forum Judicum, and *Fuero Juzgo* by the Spaniards. It was first promulgated by Euric (A.D. 466-83), and greatly improved or augmented by his successors, its principal groundwork being the Breviarium, or body of law selected from the Theodosian Code, the Institutions of Gaius, and other sources, by command of Alaric II., king of the Visigoths. Alfonso VI. caused it to be translated into Castilian. Besides this written or statute law, the Visigoths and their successors had their peculiar customs, which might be termed their common or unwritten law, and which, together with the *Fueros*, or immunities granted to the settlers in towns or districts conquered from the Mohammedans, formed the body of national law. The progressive improvement of society in the thirteenth century having rendered most of the provisions of the *Fuero Juzgo* impracticable, Alfonso 'el Sabio' substituted for it the code of *Las Siete Partidas*, so called from the seven parts into which it is divided. It is a compilation from the code of Justinian, the Visigothic and unwritten law, the local *fueros*, the decretals of the councils, &c., and may be considered the most valuable monument of legislation during the middle ages. It is still the basis of the Spanish common law; for although more recent compilations exist (*Novisima Recopilacion*), they are chiefly founded on it; and cases which cannot be decided either by them or the local fueros, must be decided by the *Partidas*. A commission appointed by the Cortes for the purpose of making a civil and criminal code for the Spanish kingdom, has been sitting for some time, but the result of their labours has not yet been made known.

*Army and Navy.*—Before the breaking out of the civil war, the standing army of Spain amounted to 60,000 men, besides a reserve of *Milicias Provinciales*, which consisted of 30,000 men. These forces were considerably increased in 1832, and, at the close of the war amounted to upwards of 300,000 men, including in this number several regiments of national guards, who performed the same service as the troops of the line. Since the peace this number has been greatly reduced; the royal guard has been abolished, and its regiments have been incorporated with the rest of the army. The navy is in the most deplorable condition, two ships of the line and half a dozen frigates, with a few smaller vessels, being all that remains to Spain of her once magnificent fleet.

*History.*—The history of the Peninsula may be divided into four periods: 1, Spain before the invasion of the Arabs; 2, Spain divided into kingdoms; 3, Spain under the kings of the house of Austria; 4, Spain under the house of Bourbon.

*First Period. Spain before the invasion of the Arabs.*—The history of the Peninsula, previous to the settlements of the Carthaginians, is unknown. The earliest inhabitants mentioned by the Greek and Roman historians were the Iberi. The Iberi were disturbed in their possessions by the Celtae, who invaded the Peninsula from Gaul, or, as others would have it (Masdeu, *Hist. crit. de España*, vol. ii., p. 116, *et seq.*), from Africa, and subsequently settled in the northern districts. In many places however, but chiefly in the central districts of the Peninsula, the two races seem to have been amalgamated, and to have formed only one nation, known as the Celtiberians. [CELTIBERI.] The rich corn-lands, the mines, and seaports of the Peninsula, attracted the attention of the early Phœnician navigators. The time when the Phœnicians first had commercial intercourse with the inhabitants of the southern coast of Spain is not ascertained; but it was doubtless before the foundation of either Rome or Carthage. For some time their settlements, of which Ghadir (now Cadiz) was the principal, were limited to the coasts of Bætica, whence they supplied the natives with the products of Asia, in exchange for the gold, silver, iron, and other valuable productions of the Peninsula. But as they became better acquainted with the country, they penetrated into the interior, where they founded the city of Kartabah (now Cordova), and explored the mountainous districts of Navarre in search of iron. The Phœnicians however were not the only maritime nation which had settlements on the coast of Spain. The Rhodians visited the shores of Catalonia, and founded a town, which they called Rhode (now Rosas). [ROSAS.] They were followed by the Phocæans, who founded the town which is now Denia, and probably also that of Chersoneus (now Peñiscola), on the same coast, and who, having in time dispossessed the Rhodians, extended their settlements along the shores of Valencia. There were other Greek settlements, the names of which may still be recognised in their modern appellations, as Emporion, now Ampurias. The Carthaginians also directed their views towards Spain. Having insidiously possessed themselves of Cadiz, which they took from the Phœnicians, they proceeded into the interior with a view to the subjugation of the country, an attempt however in which they completely failed; for although the Carthaginian generals, Hamilcar, his brother Hasdrubal, and his far more celebrated nephew Hannibal, completely reduced the southern part of the Peninsula, they were unable to subdue the warlike tribes of the interior. This attempt led to the second Punic war. The Romans, either alarmed at the progress of Hannibal, who had taken Saguntum, B.C. 218, or wishing to have a footing in the Peninsula, sent the two brothers Publius and Cneius Scipio to the assistance of the Spanish tribes, with whom they had previously formed an offensive and defensive alliance. After several sanguinary encounters, Publius was routed and slain by Mago, and his brother Cneius met with the same fate near Tarragona, B.C 211; but Publius Cornelius Scipio, afterwards surnamed Africanus, who succeeded in command of the armies of the republic, soon turned the scale in favour of the Romans. After taking Carthago Nova (Carthagena), a town founded by Hasdrubal, defeating Hanno, whom he took prisoner, and gaining a decisive victory over Hasdrubal, the son of Gisco, he invested and took Cadiz, and for ever freed Spain from the Punic yoke. [SCIPIO.] But the Spaniards only changed masters; and Spain was made a Roman province, and divided into Citerior and Ulterior, the Iberus or Ebro being a boundary between them. The subjugation of Spain however was not easily or speedily accomplished. Numantia, when besieged by Scipio Æmilianus, emulated the heroism of Saguntum. [NUMANTIA.]

Until the time of Augustus, the Cantabri, the Gallaici, and the Astures, who inhabited the north-western parts of the Peninsula, were not even nominally subjected to the republic; and the other portions of Spain—Celtiberia in the north, Bætica in the south, and Lusitania in the west—became the scene of constant warfare and rebellion. The most remarkable of the native insurrections was that organized in Lusitania by Viriatus, who, during more than eleven years, defeated the ablest generals of the republic, and was only put down by the treachery of Cæpio, B.C. 140. [VIRIATUS.] Spain was soon afterwards the theatre of the civil war between Marius and Sulla. Sertorius, a leader of the defeated party, fled thither, and carried on the war for some time. Spain having espoused the cause of Pompey, Julius Cæsar repaired thither in person, and by his military skill triumphed over his enemies. Cneius, the son of Pompey, was defeated at Munda, and peace was restored to the country.

It was only under Augustus that Spain was completely subdued; even the Cantabri and the Astures were reduced to submission. Augustus himself visited Spain, and he divided the country into three great provinces, Bætica, Lusitania, and Tarraconensis, a division which subsisted until the reign of Constantine the Great. During this period Spain was considered one of the most valuable and flourishing provinces of the empire. According to Pliny, it contained three hundred and sixty large cities. The organization of the Spanish provinces is fully stated by Pliny (iii., 1, &c.). Spain gave birth to the poets Lucan and Martial, to the philosopher Seneca, and to the emperors Hadrian and Trajan.

About the beginning of the fifth century, the Suevi under their king Hermeric, the Alans under Atace, and the Vandals or Silingi under Gunderic, after overrunning the provinces of Gaul and crossing the Pyrenees, settled in the Peninsula. They were speedily followed (A.D. 411) by a host of Visigoths led by their king Athaulf, who established himself in Catalonia, though nominally dependent upon his brother-in-law Honorius, the Roman emperor. Wallia, one of Athaulf's successors, obliged the Vandals and the Alans to quit Spain for Africa, and the Suevi, after being defeated in many battles, acknowledged his superiority (416-8). It was not however until the time of Euric (466-83) that the Goths became complete masters of the Peninsula. Euric must be considered as the first Gothic sovereign of Spain, as the six kings, his predecessors, ruled over Gaul, and occasionally only over Spain. He was also the first legislator of his nation, and the laws which he collected or promulgated became in after time the foundation of the 'Forum Judicum' or *Fuero Juzgo*. After the death of Amalric, who fell in battle against Clovis, king of the Franks (531), the Gothic kings appear to have been either elective or hereditary according to circumstances The first king chosen was Theudis. His reign was troubled with wars, and terminated by his assassination in 548. One private individual then followed another upon the throne, none of whom occupied it long or died a natural death. In 554, Athanagild, a noble Goth, having usurped the royal power, purchased the assistance of Justinian, the Eastern emperor, by surrendering to him some fortresses along the south-eastern coast, and promising to hold the rest of his dominions as a fief of the empire. Under the reign of this monarch, the Suevi, who still held some districts of Galicia, following the example of their king Theodomir, abjured Arianism, and were admitted into the bosom of the church. Spain was not entirely emancipated from her dependence upon the empire until the reign of Leovigild, one of the greatest Gothic kings, who subdued the Suevi, and incorporated that vassal state with his own kingdom. He was just and brave. His first wife Theodosia had three brothers, who were canonized by the Catholic church for their piety, namely, St. Isidore, St. Fulgentius, and St. Leander. His son Hermengild, who revolted against him, has been canonized by the papal see, and represented as an humble and persecuted martyr, instead of a rebellious and ungrateful son, merely because he abjured Arianism and embraced the Catholic faith. In 672 the throne of Gothic Spain was occupied by Wamba, a monarch distinguished by his virtues and abilities. The Saracens of Africa having attempted to land at Gibraltar, Wamba fitted out a fleet and defeated them in the first naval action recorded in the annals of Spain. He was succeeded by Ervigius, and Ervigius by Egica, who repulsed the attacks of the Saracens, but is best known for his legislative labours. Egica associated his son Witiza in the empire, whose depravity and misgovernment reduced the country to the most deplorable condition. He was dethroned by Roderic, under whose reign (A.D. 711) the Arabs of Africa, commanded by Tárik Ibn Zeyád, crossed the straits, and, after defeating the whole force of the Gothic monarchy on the banks of the Guadalete [Moors], took the capital, Toledo.

*Second Period.—Spain divided into Kingdoms* (from A.D. 711 to A.D. 1518).—Músa Ibn Nosseyr, who followed in the steps of Tarik, prosecuted his conquests, and reduced the whole of Spain to the sway of Islám, with the exception of the mountainous districts of the Asturias, where the prelates and chiefs of the Goths fled for refuge. [Musa.] It was from those mountains, the cradle of Spanish liberty, that a Gothic nobleman, named Pelayo, attempted to rescue his country from the yoke of the infidel. Profiting by the divisions among the Moslems, he seized on some towns among the mountains, defeated the forces sent against him, and, having successively enlarged his dominions, founded the small kingdom of Asturias, which he transmitted to his son and successor Favila, in 737. [Pelayo.] Alfonso, surnamed the Catholic, who succeeded Favila (in 739), made ample additions to his territories. He was succeeded by his eldest son Fruela (757), and Fruela by Aurelio (768), under whose rule no important accessions were made to the territory of the Christian kingdom. Pressed on every side by the victorious Abdu-r-rahmán I., who occupied the throne of Cordova, the little state of Asturias, with its possessions in Leon, seems only to have had a precarious existence. Indeed Mauregato, a natural son of Alfonso the Catholic by a Mohammedan slave, who, with the aid of Abdu-r-rahmán, ascended the throne of Asturias in 783, is said to have insured peace only by payment of an annual tribute of 100 virgins, half of noble and half of ignoble birth. While these events were passing in the north-western parts of the Peninsula, another Christian kingdom was rising into existence in the recesses of the Pyrenees. In 758, according to the best native historians, Garcia Ximenez, a wealthy noble of Cantabrian origin, was proclaimed king by the inhabitants of the country of Sobrarbe, which became in time the foundation of the two kingdoms of Navarre and Aragon; but the early history of this little kingdom is involved in such obscurity, that the successive labours of critics and historians have hitherto failed in attempting to separate historical truth from romance.

About the beginning of the ninth century, Wifrid, a governor of the Spanish March for the French, assumed the title of count of Barcelona. Nearly two centuries after (A.D. 1005), the ancient province of Bardulia, which, from the numerous forts erected by Alfonso I. for its defence, took the name of *Castella*, after being long governed by counts, the first of whom was Ferran Gonzalez, was formed into a kingdom by Sancho el Mayor, who was likewise king of Navarre.

In 1137 Catalonia was annexed to Aragon by the marriage of Petronila, daughter of Ramiro II., with Raymond V., count of Barcelona.

The crowns of Castile and Leon were also united at times on the same head, either by marriage or by conquest. In 1072, after the assassination of Sancho II., king of Castile, before the walls of Zamora, his brother, Alfonso VI. of Leon, became king of Asturias, Leon, Galicia, and Castile. About the same time (A.D. 1095) the kingdom of Portugal was founded by Henry de Besançon, to whom Alonso gave in marriage his natural daughter Theresa, together with the right of conquest over the Moors. [Portugal.] To relate the particular history of these states falls not within the limits of this article. Their rulers were frequently at war with each other, instead of uniting their arms against the common foe, and thus the deliverance of the Peninsula from the infidel was retarded. It was not until the end of the eleventh century that these states began to extend their frontiers at the expense of the Mohammedans; and this was owing more to the dissensions and civil wars which broke out among their enemies, than to the wise policy or vigorous attacks of their Christian leaders. In 1085, Toledo and the neighbouring districts were reduced by Alonso III. of Castile, under whose reign Rodrigo de Vivar, surnamed *El Cid*, achieved most of his exploits. [Alonso VI.] His grandson and successor, Alonso VIII., usually styled the Emperor, advanced the frontiers of Castile from the Tagus to the Sierra Morena. Ferdinand III. took Badajoz and Merida in 1230, Cordova in 1236, and Jaen, Seville, and Murcia in 1243. To his brilliant successes over the Mohammedans he owed the surname of 'El Santo' (the saint), which the Spaniards gave him, and which was afterwards confirmed by a bull of canonization from Clement X. in 1671. His son and successor, Alsonso X., surnamed *el Sabio*, or the learned, is better known for the 'Astronomical Tables' which pass under his name, and for the compilation of the laws of the 'Siete Partidas,' than for his conquests. During this time the kings of Aragon were not inactive. As early as the beginning of the eleventh century (1035-63) Ramiro I. had extended the frontiers of his little kingdom, and made the Moorish kings of Tudela, Saragossa, and Lerida his tributaries. His successor (1063-94) Sancho I. reduced all the Mohammedan fortresses between the Pyrenees and the Cinca. Alonso I. took Saragossa in 1118, and made it the capital of his kingdom. He also conquered all the country south of the Ebro, and from his warlike habits was surnamed *el Batallador* (the warlike). Jayme I., the most celebrated king in the antient annals of Aragon, prosecuted the conquests of his predecessors. In 1229 he took the Balearic Islands, which, though reduced in 1115 by Raymond III., count of Barcelona, had again fallen into the hands of the Mohammedan pirates. The important city of Valencia, the capital of a Moorish kingdom of that name, submitted to him in 1238. Owing to these and other conquests of the kings of Castile and Aragon, the Spanish Moslems were driven to the mountains of Granada, where, in 1248, Mohammed Ibnu-l-ahmar founded a new kingdom. [Moors.]

After this several unsuccessful attempts were made by the Africans to re-establish the rule of Islám in Spain. In 1273 Abú Yúsuf Ya'kub Ibn 'Abdi-l-hakk, fourth sultan of Marocco of the dynasty of the Benu Merin, crossed the strait with a formidable host; but after some slight advantages, he returned to his dominions without making any important conquest. In 1339 Abú-l-hasan, king of Fez, having landed at Gibraltar with considerable forces, was defeated on the banks of the river Salado, near Tarifa, by the kings of Castile and Portugal united (October, 1340). During the reign of Pedro IV. of Castile, England for the first time interfered in the internal affairs of Spain. That prince, who from his tyrannical rule and cruelties, was surnamed 'el Cruel,' began his reign with the murder of his father's mistress, Eleonora de Guzman; his nobles and high vassals fell the victims of his cruelty, or, as it has been qualified by his apologist Zuñiga, of his unflinching severity and love of justice. In 1358 he treacherously murdered his natural brother Don Fadrique, who was grand-master of Santiago. His next victim was his cousin Juan, prince of Aragon. He divorced his queen, Blanche of Bourbon, threw her into a dungeon, and afterwards had her poisoned. Henry, count of Trastamara, Pedro's natural brother, alarmed at the fate of his family, took shelter in France. Having, with the consent of Charles V., raised a strong body of mercenary adventurers, commanded by Bertrand du Gueselin, he invaded Castile. Pedro was easily overpowered, and while his successful rival was proclaimed king at Burgos (1366), he hastily fled to Bordeaux, at that time the capital of the English dominions in France. He there implored the assistance of Edward, Prince of Wales, who, having obtained his father's consent, levied an army, and entered Spain. Henry encountered him at the head of 100,000 men, and, against the advice of Du Guesclin, gave him battle near Naxera. The English were victorious; Du Guesclin was made prisoner; Henry fled to France, and Pedro was again king of Leon and Castile. The Black Prince however had soon reason to repent of the aid he had given to Pedro, who not only refused the sums that he had agreed to pay for the English forces, but, disregarding the advice of his humane ally, again stained the throne with the blood of his relatives and courtiers. [PEDRO.] Accordingly, when Henry attacked him a second time, the Black Prince left him to his fate, and Pedro lost his throne and his life (1369). These events led to the connexion of the houses of Lancaster and Trastamara, by the marriage of Enrique III. of Castile with Catherine, daughter of John of Gaunt, duke of Lancaster, by Constanza, daughter of Pedro IV. Henry IV., surnamed 'the Impotent,' who succeeded John II. in 1455, was one of the weakest kings, both in mind and in body, that ever ascended a throne. The nobility, with the archbishop of Toledo at their head, combining against him, arrogated the right of trying and passing sentence on their king, whom they publicly deposed in 1465.

All the malcontent nobility were summoned to a plain not far from the city of Avila, where a scaffold was erected of sufficient elevation to be easily seen from the surrounding country. An image representing the king was seated on a chair of state, clad in sable robes and adorned with all the insignia of royalty; a sword at its side, a sceptre in its hand, and a crown upon its head. A manifesto was then read, and sentence of deposition pronounced, after which the archbishop of Toledo ascended the platform, and tore the crown from the head of the image; the marquis of Villena removed the sceptre, the count of Placencia the sword, the grand-master of Alcantara and the counts of Benavente and Paredes the rest of the regal insignia; the image, thus deprived of its honours, was precipitated from the scaffold amidst the mingled groans and clamours of the spectators. The young prince Alfonso, at that time only eleven years of age, was seated on the vacant throne, and the assembled nobility kissed his hand in token of obedience. This extraordinary transaction was followed by a civil war, which did not cease till after the death of the young prince, on whom the nobles had bestowed the kingdom. On the death of Alfonso (July 5, 1468), his sister Isabella was immediately proclaimed, but on her refusal to assume the government whilst her father was still living, the malcontents were compelled to come to terms with the dethroned king, who was suffered to resume his power on condition that he would divorce his queen, whose dissolute conduct was the cause of general detestation, and acknowledge Isabella, the only lawful heiress of the kingdom, to the prejudice of his daughter Joanna, who was reputed to be the daughter of his favourite, Don Beltran de la Cueva, duke of Albuquerque, whence she was called 'La Beltraneja.' The next step taken by the insurgents was to secure the marriage of the princess, who, after several months spent in negotiation, was betrothed to prince Ferdinand of Aragon in 1469. On the death of Henry (December 11th, 1474), his daughter Isabella was raised to the throne, though not without opposition. A considerable number of the Castilian nobility espoused the cause of Joanna, whom they caused to be proclaimed queen of Castile at Placencia, and betrothed to her uncle Alfonzo V., king of Portugal, who prepared to assert her rights to the throne at the head of a powerful army. But the superior talents of Ferdinand prevailed; the Portuguese king was defeated at Toro (May, 1476), and after several years of desultory warfare was obliged to retreat into his dominions, and to give up the cause of his niece and intended bride, who retired into a convent. By the death of John II., Ferdinand's father, which happened about this ime (January 20, 1479), the kingdoms of Aragon and Sicily were annexed to the crown of Castile. No sooner were Ferdinand and Isabella delivered from their internal enemies, than they turned their arms against the Mohammedans, who in the late civil dissensions had been seldom disturbed. In 1481, the important city of Alhama, one of the bulwarks of the Moorish kingdom, was reduced by the marquis of Cadiz; Loja, Velez, Malaga, Baza, and other strong places surrendered between 1483 and 1492; and the capital itself fell into the hands of Ferdinand after an obstinate and long protracted defence. [GRANADA; MOORS.]

The conquest of Granada was followed by the expulsion, or rather the pillage of the Jews, who had engrossed nearly all the wealth and commerce of Spain. The next important event was the discovery of a new world by Columbus [COLUMBUS], the credit of which was entirely due to Isabella. The counties of Rousillon and Cerdagne, which the French had retained since 1462, were restored by Charles VIII., who wished to conciliate Ferdinand previous to his expedition into Italy, but Ferdinand could not overlook the wild ambition of the French king, who laid claim to the kingdom of Naples, whose sovereign, Ferdinand I., was closely related to the house of Aragon. Accordingly Ferdinand sent an army to his assistance, under the command of Gonsalvo de Cordova, who in less than one year expelled the French from their conquests and reseated the king of Naples on his throne. Seeing however that Lewis XII., who succeeded Charles on the throne of France, was intent upon the subjugation of Naples, the wary Ferdinand proposed to him to divide that kingdom, on the plea that Frederic had refused his consent to the marriage of his son and heir the duke of Calabria with his aunt Joanna, daughter of Ferdinand II. of Naples, and had by ill treatment obliged that princess to quit Naples for Spain. Louis accepted the offer, and in 1501 Naples was conquered and divided between the allies. This infamous transaction turned entirely to the advantage of the Spanish king, who in 1506 caused his general Gonsalvo to attack the French, who were ultimately dispossessed of all their dominions in Italy. [GONSALVO; ITALY.] The establishment of the Inquisition in 1480 [OFFICE, HOLY], the compulsory baptism of the Moriscos, and the conquest of Navarre, which in 1512 was finally annexed to Spain, are among the important events of this reign. On the death of Isabella (1506), the crown of Castile devolved on her daughter Joanna, wife of Philip, archduke of Austria, and on the death of the latter, upon his son Charles V., afterwards emperor of Germany. Ferdinand died on the 23rd of January, 1516, after appointing Cardinal Ximenez regent of Castile until the arrival of his grandson Charles, who was only sixteen years old. Ximenez maintained order in the kingdom, and repressed the ambition of the haughty Castilian nobles, who disdained submission to one whom they considered their inferior. [CISNEROS.]

The history of Spain during this period is very rich in materials. Besides the Chronicles of Isidorus Pacensis, who lived in the eighth century; of Sebastian of Salamanca, of the anonymous monk of Abelda, who wrote in the ninth; of Sampiro, bishop of Astorga, whose narrative comes down to 982; of the monk of Silos, who brought down t.. national history to the reign of Alfonso VI.; and of Pelayo, bishop of Oviedo, who lived in the twelfth century—all of which are in the collection of Florez, entitled 'España Sagrada,' Mad., 1754-84—the history of Spain at this period is mostly indebted to Don Lucas, bishop of Tuy, whose 'Chronicon Mundi' apud Schottum, *Hisp. Illust.*, vol. ii. and iv., Francf., 1603-8), and to Don Rodrigo Ximenez, archbishop of Toledo, whose 'Rerum in Hispania Gestarum Chronicon (Gran., 1545), and 'Historia Arabum (Lugd. Bat., 1625), are most valuable. The reader may also consult Rodericus Sanctius, *Historia Hispanica;* Alfonsus à Carthagena, *Anacephalæosis* (apud Schottum, vol. i.); Zurita, *Anales de Aragon* (Sarag., 1610); Moret, *Anales de Navarra* (Pamp., 1665); Lopez Cortejano, *Chronica de Fernando III.* (Vallad., 1555); Villasan, *Chronica de Don Alfonso XI.* (Vallad., 1551); Ayala, *Chronica de los Reyes de Castilla;* Fernan Perez de Guzman, *Chronica de Don Juan II.*; and those of Ferdinand and Isabella by Valera, Palencia, and Nebrixa. A 'History of the Reign of Ferdinand and Isabella,' by Mr. Prescott (Boston, 1839), is highly praised.

III. *Establishment of the House of Austria* (1518-16).—Soon after his accession to the throne of Spain, Charles became one of the candidates for the vacant Imperial crown, and although Francis I. of France proved a dangerous competitor, he was chosen by the Diet in 1519. Thus originated the rivalry of the two kings, which gave birth to a series of wars, in which almost all Europe was involved. Whilst Charles was hastening to Aix-la-Chapelle to take possession of the empire, a formidable insurrection broke out in

Castile, which spread to other provinces of Spain. The avarice of the Flemings, to whom the administration of affairs had been almost entirely committed since the death of Ximenez, and the utter disregard shown by Charles himself of all constitutional forms, so incensed the people that they rose in arms for the defence of their rights. Toledo took the lead; the citizens expelled the king's officers, elected municipal governors and councils, to whom they gave the name of comunidades, and raised a body of troops, the command of which they entrusted to John of Padilla. The attempts made by Adrian, the regent of the kingdom during Charles's absence, to quell the insurrection proved unsuccessful. The royal troops were defeated near Segovia, and the rebellion spread through Leon, Galicia, and Estremadura. This seemed to Francis I. a favourable opportunity for reinstating Jean D'Albret in the kingdom of Navarre. A French army, under Andrew de Foix, speedily conquered that kingdom, the garrisons of which were then employed against the comuneros of Castile, but that young and inexperienced general having ventured to penetrate into Castile, the Spaniards, though divided, united their forces, routed his army, took him prisoner, and recovered Navarre in a shorter time than he had subdued it. The Count of Haro, who had succeeded Ronquillo in the command of the royal forces against the comuneros, retook Tordesillas, defeated the insurgents in several actions, and at length took Padilla prisoner, and had him executed. [Padilla.] His widow Donna Maria, a woman of high spirit, induced the citizens of Toledo still to defend the cause for which her husband had fallen, but all her efforts were in vain. Toledo was taken by the royalists, and she fled to Portugal. The consequence of this unsuccessful rebellion was a material accession of power to the triumphant party, and a proportionate reduction of those rights for the extension of which the vanquished had fought. A league was about this time concluded by the intrigues of Cardinal Wolsey, between the Pope, Henry VIII., and Charles, against France. By granting him the revenues of two sees in Spain, and pledging his word that he would assist him in obtaining the papacy, Charles won over to his interests the ambitious cardinal. Strengthened by this alliance, the emperor proceeded to expel the French from the duchy of Milan, where the insolence and exactions of Marshal de Lautrec had made them extremely odious. The papal army, commanded by Prospero Colonna, an experienced general, being joined by Spanish troops from Germany and Naples, attacked and defeated them, and after an unsuccessful campaign the French evacuated the duchy, retaining only the town of Cremona and the castle of Milan. The election of Cardinal Adrian, Charles's preceptor, who in 1521 was raised to the papal see, to the astonishment of all Europe, and to the great disappointment of Wolsey, roused the anger of his rival Francis, and war broke out again in Lombardy; but the advantage remained entirely with the Imperialists and Spaniards. At last, after a series of campaigns, during which the duchy of Milan, for which they chiefly contended, was alternately gained and lost by both parties, the year 1524 ended with the defeat and capture of the French king before Pavia on the 24th of February. [Francis.] On his arrival in Madrid, where he was removed under the escort of Don Antonio de Leyva, Francis asked to see his rival, who refused him an interview, and kept him in rigorous confinement until the terms for his liberation should be agreed upon. After a great deal of negociating, a treaty was at length concluded (1526), by which Francis was to cede Burgundy; to give up all claims on Italy, as well as on the sovereignty of Flanders and Artois; to restore Charles de Bourbon to his dignities and states; to marry Eleanor, queen-dowager of Portugal, sister of the emperor, and finally to deliver his eldest and second son as hostages for the fulfilment of these agreements. Should the states-general of his kingdom prevent the execution of this treaty, Francis solemnly swore to return to his prison. But while he pledged his oath and honour for the fulfilment of these conditions, Francis is said to have signed a secret protest against the validity of his promise, a subterfuge ill suiting a king whom the writers of his nation have represented as a model of chivalry and honour, in opposition to his imperial rival, whom they describe as equally perfidious and unfeeling. Long wars, acrimonious negociations, and a formal challenge to single combat from Francis to Charles ensued, ending in the taking and sack of Rome by the Constable of Bourbon (May, 1527) [Bourbon], the capture of Pope Clement, who was sent a prisoner to Spain, and the treaty of Cambray, by which Francis agreed to pay two millions of crowns as the ransom of his two sons; to resign the sovereignty of Flanders and Artois; and to forego all his Italian claims, while Charles was not to demand the restitution of Burgundy.

During these transactions, war had been carried on with various success against the Turks, who in 1522 took the island of Rhodes, and against the piratical states on the northern coast of Africa. No sooner was the peace consolidated, than Charles determined to turn his arms against the African pirates. In 1535 an expedition, conducted by the emperor in person, sailed for the port of Tunis, which had lately fallen into the hands of the corsair Barbarossa; Muley Hasan, the dethroned king of Tunis, promising to assist Charles with his forces. Goletta, a seaport town, fortified with 300 pieces of cannon, was taken, with all the Turkish fleet within; the corsair himself was defeated in a pitched battle; and 10,000 Christian slaves, having knocked off their fetters, made themselves masters of the citadel, whilst Charles was engaging the enemy outside the town. The sceptre was restored to Muley Hasan on condition that he should acknowledge himself the vassal of the emperor, deliver up all his fortresses on the coast of Tunis, and pay an annual tribute of 12,000 crowns for the support of the Spanish garrisons. An attempt made some years after (1541) upon Algiers was not equally successful. A storm drove the fleet from its moorings; the army, being deprived of provisions and ammunition, was cut off by disease or the sword of the Arabs, and Charles was compelled to raise the siege of that city, leaving his artillery and baggage behind. The remainder of his reign was spent in war with France or with the Protestant princes of Germany, who, in August, 1552, obtained the free exercise of their religion in their dominions. [Charles V. of Germany.] Soon after the decease of his mother Joanna (1555), Charles assembled the states of the Low Countries at Brussels on the 25th of October, and resigned the sovereignty of his paternal dominions to his son Philip, to whom he had already given his Italian possessions on the occasion of his marriage with Mary of England in 1554. Two weeks after he made over to him, before a large assembly of German princes and Spanish grandees, the rest of his European and American dominions; and in the following year (1556) he likewise resigned the Imperial crown to his brother Ferdinand, who had already been elected King of the Romans and his successor. In February, 1557, he retired to the monastery of St. Just, near Plasencia in Extremadura, where he passed the remainder of his days. During the reign of this able monarch, the empire of Mexico was conquered by Hernando Cortés (1318-21); Magalhaens, a Portuguese officer, discovered the westward passage to the East Indies, through the 'Strait of Magalhaens,' and opened to Spain the rich trade of India and China; in 1531 Pizarro, following in Balboa's steps, made his way to Peru, and overthrew the empire of the Incas. [Cortes; Magalhaens; Pizarro.] The following are the best histories of this reign:—Sandoval, 'Historia de Carlos V.' (Pamplona, 1618, fol.); Vera, 'Epitome de la Vida,' &c. (Mad., 1613, 4to.); Ulloa, 'Vita del Imperatore Carlo V.' (Venetia, 1559, 4to.); and Robertson's invaluable work.

Philip II. had neither the inclination nor the talents for war of his father; accordingly his first step upon his accession was to negociate a peace with France, through the mediation of his wife Mary of England. This however was of short duration. Henry II., having been induced by the pope to re-assert the rights of France to the sovereignty of Naples, sent the duke of Guise into Italy at the head of a powerful army; but the superior talents of the duke of Alba, who commanded the Spanish forces, prevailed, and the French were expelled from the Neapolitan territory. In 1557 the united forces of Spain and England, commanded by the duke of Savoy, gained the battle of St. Quentin, in commemoration of which a monastery, sacred to St. Laurence, was built at considerable expense. [Escurial.] The death of Mary, 1558, and the accession of Elizabeth to the throne of England, changed the state of affairs. Philip's return to Spain was followed by a most sanguinary persecution, by which he succeeded in crushing the germ of the Reformation in the Peninsula. The Moriscos, who, whatever might be their attachment to the habits and faith of their ancestors, had proved loyal subjects to his father, were so exasperated by his measures, that they revolted in several provinces of the kingdom; and after a furious and long-protracted contest, were reduced to submission, or compelled to seek refuge in Africa (1571). The Inquisition was armed with new and extraordinary power, and the flames of the *autos da fé* blazed in every corner of the Peninsula: that institution was extended by Philip to his Italian dominions. [AUTO DA FE.] The attempt to establish the Holy Office in the Netherlands first provoked a spirit of insurrection in that country (1566), which, soon growing into a formidable rebellion, exhausted the immense resources of Spain, baffled the talents of Alba and Don John of Austria, and ended in the separation of those provinces from the Spanish monarchy (1648). The death of the adventurous Don Sebastian, who fell in battle with the Moors of Africa near Alcaçarquivir [SEBASTIAN], united Portugal to Spain in 1580. The remainder of Philip's life was passed in designs for subjugating France and England. In the former country he at one time had some hopes of success by secretly allying himself with the queen's mother, Catherine of Medici, and the Romish party, for the destruction of the Huguenots; and afterwards by supporting the Roman Catholic league, under the Guises, against Henry IV. His project for the conquest of England completely failed, and the fleet which he had equipped for the reduction of this island was utterly destroyed. [ARMADA; ELIZABETH.] The execution of his eldest son, Don Carlos, in 1568; the murder of Escovedo; and the subsequent transactions with his private secretary Antonio Perez, have cast a dark shade over the character of this king, who was not deficient either in application to business or talents for administration; but his good qualities were overshaded by bigotry, his ruling passion. He was frequently heard to say that 'he had rather not be a king, than rule over heretics and infidels.' His Spanish admirers ascribe to him a degree of political wisdom equal to that of his great-grandfather Ferdinand; but as he failed in most of his enterprises, we must suppose his political prudence, if he possessed it, to have been in most instances overruled by his bigotry. (Watson's *Philip II.*; Vanderhamen, *Hist. de Don Felipe el Prudente* (Mad., 1625, 4to.); Cabrera, *Hist. de Felipe II.* (Mad., 1609.)

Under Philip III., who reigned from 1598 to 1621, the decline of the Spanish monarchy began. His extreme indolence led him to entrust the management of affairs entirely to his favourite the duke of Lerma. A peace with England was concluded in 1604, and an armistice with the Netherlands in 1609, and Spain once more traded freely with her colonies; but the benefits attending on these two measures were more than counterbalanced by the total expulsion of the Moriscos, which deprived Spain of a considerable part of her population, in whose hands all the wealth and trade were concentrated (1610).

Philip IV. was only sixteen years of age when he ascended the throne. He entrusted the sole management of affairs to his favourite Gaspar de Guzman, count-duke of Olivares, who, though not entirely destitute of talents, was unfit to govern a vast monarchy like Spain. In 1640 Portugal, severely oppressed by the Spanish governors, shook off its bonds by a successful insurrection, which placed John of Braganza on the throne. The war with the Netherlands was renewed, and though the abilities of Spinola, who commanded the armies of Spain, long maintained the Spanish ascendency in those provinces, the Dutch fleets were directed against the New World, and were everywhere victorious. Philip was at last obliged to recognise the independence of the Provinces by the peace of Westphalia in 1648. The war in which France had taken part against Spain and Austria, still continued for eleven years more, until the peace of the Pyrenees (November 7, 1659), by which Roussillon and Perpignan were finally ceded to France, and the marriage of Louis XIV. with a princess of Spain was concerted. A dangerous insurrection in Catalonia, provoked by the imprudent measures of Olivares, was only put down after several years war with the rebels. Philip died in 1665, after appointing his widow queen-regent during the minority of his son Charles II., who was only three years old. Charles II. reigned from 1665 to 1700, during which time Spain was reduced to the most miserable condition at home by bad administration, and abroad by the reverses sustained by her arms. Three successive wars with France ended only in the treaties of Aix-la-Chapelle (1668), Nimeguen (1679), and Ryswick (1697), all of which were extremely humiliating to Spain.

As Charles had no issue, numerous intrigues were formed to prevail on him to name his successor among the various claimants of the crown. After long hesitation, the French party prevailed, and Charles appointed Philip d'Anjou his successor. Louis XIV. instantly recognised his grandson as king of Spain; but the house of Austria advanced claims, and William III. of England and Stadtholder of the Netherlands urged a partition. This led to the war of the Succession, which lasted thirteen years, until Philip, having defeated the allies at Almansa in 1707, became undisturbed master of the Peninsula. (Marqués de San Felipe, *Commentarios de la Guerra de España*, Genova, 1719, 4to.; Lord Mahon, *Hist. of the War of Succession*, Lond., 1832; Coxe, *Historical Memoirs of the House of Bourbon*, Lond., 1813.)

*Fourth Period.—House of Bourbon* (1700-1841).—The peace of Utrecht stripped Spain of her European dominions; Belgium, Naples, Sicily, and Milan were given to Austria; Sardinia to Savoy; Minorca and Gibraltar to England; and though Alberoni afterwards conceived the bold design of restoring Spain to her former rank among European nations, the quadruple alliance of England, France, the Empire, and Holland defeated all his plans. In 1724 Philip abdicated the crown in favour of his son Louis; but this prince having died a few months after of the small-pox, he was compelled to resume the government. Philip died in 1746, and was succeeded by his son Fernando.

The reign of Fernando VI. exhibits little more than a contest between the British and French agents in support of the policy of their respective nations. However, as the king contrived to observe a strict neutrality in the European wars occasioned by the rivalry of England and France, Spain began to recover from her late wounds. His wise policy was at first pursued by his brother Charles III., king of the two Sicilies, who succeeded him in 1759; and under the administration of men like Olavide, Campomanes, and Floridablanca, Spain was once more respected and feared. The utmost efforts were made by these enlightened men to promote trade and agriculture; canals were dug and roads opened. Nor was their administrative zeal confined to such measures as these; reform was carried by them even into the church; the power of the Inquisition was restricted, and the Jesuits annihilated at one blow, by the Pragmatic Sanction of April 2, 1767, which banished them from all the Spanish dominions and confiscated their property. Unluckily for Spain, the Bourbon family compact involved her in the war between this country and France (1779-83). The expedition to Algiers miscarried, as well as the attack upon Gibraltar. The impulse given to the various branches of the administration during the reign of Charles III. continued through the early part of that of his son and successor Charles IV.; but Godoy, the queen's favourite, having succeeded Count Aranda in the administration, Spain entered on a new career of ruin and misfortune. On the 4th of March, 1793, the French convention declared war against Spain upon the ground of Charles's improper interference with her internal affairs. Spain at first entered with zeal into the crusade against the French republic, and a voluntary contribution, amounting to seventy-three millions of francs, was voted towards the expenses of the war, but Godoy, the favourite, who wished to conduct the operations from his palace, ruined all. Though, early in June, the forces of Spain and Portugal united invaded Roussillon, where they occupied Bellegarde and other places of less importance, and though on the 22nd September they defeated the French troops sent to oppose their progress, no advantage was derived from their victory. In 1794 General Dugommier invaded Catalonia, and Godoy was obliged to conclude the discreditable peace of Basle, by which half of St. Domingo was resigned to France. The next step of Godoy, who, on the cessation of hostilities, had received the title of 'Principe de la Paz' (Prince of Peace), was to conclude with the republic, the leaders of which deluded him with the prospect of placing a Spanish prince on the throne of France, a treaty of alliance offensive and defensive. By this treaty, which was signed and ratified on the 19th of August, 1796, at St. Ildefonso, it was stipulated that either power should, in case of war, be entitled to claim from the other fifteen ships of the line and an army of 24,000 men. It was further stated in the treaty that these stipulations referred especially to England, which was represented as the sworn enemy of Spain on account of her American dominions. War was accordingly declared against England; but Spain had soon reason to repent of her alliance with France. Her fleet under Don José de Cordova was defeated and dispersed by Sir John Jarvis, who was created Lord St. Vincent for his victory. Sir Ralph Abercromby attacked and took the island of Trinidad (February, 1797); and, after a short resistance, Minorca surrendered to General Stuart (November, 1797). In consequence of the entire interruption of the colonial trade, taxes and debts increased, whilst the credit of the nation sunk. Portugal having refused to comply with Bonaparte's demands to admit French and Spanish garrisons into her sea-ports and fortresses until peace with England should be concluded, the invasion of that kingdom was determined on. Forty thousand Spaniards, commanded by Godoy in person, drove the Portuguese beyond the Tagus, and Portugal, seeing her northern provinces also threatened by the French, consented to cede Olivenza to the Spaniards, and to shut her ports against England (1801). By the peace of Amiens, which ensued (27th March, 1801), England restored to Spain all her conquests except the island of Trinidad.

In the war between England and France in 1803, Spain did not join at first, having, it is said, purchased permission to remain neutral by a monthly tribute of five millions of francs to Napoleon; but the British ministry, having conceived the suspicion that the cabinet of Madrid only waited for the safe arrival of the American treasure-ships to declare openly against England, without any previous declaration of war, ordered the seizure of four Spanish frigates which were freighted with the precious metals. This measure, which no principle of international law could warrant, and which afforded a fair pretext to French declamation against England's naval tyranny, roused the indignation of the Spaniards, and on the 12th of December the cabinet of Madrid issued a manifesto 'calling upon every individual Spaniard to assist in avenging the insults of the tyrant of the sea,' and war was instantly declared against England. The reverses which Spain sustained in the maritime war of 1805 are well known; the battle of Trafalgar inflicted upon her navy a blow from which she has never recovered. In 1807 the secret treaty of Fontainebleau was concluded between France and Spain, by which Charles surrendered to Napoleon his infant grandson's kingdom of Etruria, on condition that he should receive for him the two provinces of Entre Minho e Douro and Tras os Montes, under the name of the kingdom of Northern Lusitania. The more important provinces of Alemtejo and Algarve were to constitute a principality for Godoy, who was the principal negociator of this treaty. Accordingly a French army under General Junot invaded Portugal and took possession of Lisbon, but when called upon to fulfil the conditions of the treaty of Fontainebleau and to instal the Prince of Peace in his dominions, the French emperor refused to admit any partners in his new acquisition, and gave orders to his ambassador Beauharnais to foment the dissensions then existing in the Spanish royal family. The Prince of Asturias (Ferdinand) had refused to marry the sister-in-law of Godoy, and, in order to secure himself against the vengeance of the offended favourite, had written to the French emperor for protection, and requested the hand of one of his nieces. He also addressed a letter to his father, exposing the mistakes and abuses of the administration, and requesting to be allowed some participation in the government. This was enough for Godoy. On the 29th Charles was informed that a conspiracy against his life was on foot, and having immediately proceeded to his son's apartments, he disarmed him, seized his papers, and made him a close prisoner. Escoiquiz and the Duke of Infantado were also arrested, and on the following day a proclamation was issued announcing to the nation the atrocious design imputed to the Prince of Asturias, and a solemn thanksgiving was ordered throughout the kingdom for the king's deliverance. The Junta however which was convened for his trial, unanimously acquitted the prince, who was released, and apparently reconciled to his parents. The other prisoners were banished. Thus ended, in November, 1807, the celebrated Process of the Escurial. In the meantime French troops had entered Spain, apparently on their way to Portugal, but in reality to achieve one of the most iniquitous acts of spoliation on record. Through stratagem they gained admittance into Barcelona, Figueras, St. Sebastian, and Pamplona, and Murat entered Madrid at the head of a strong division. Charles IV. still received them as allies, but the people of Madrid, driven to desperation, flocked to Aranjuez, where the court was then residing, and having attacked the house of Godoy, plundered it of its valuable contents and set it on fire. The favourite could only escape the popular fury by hiding himself in one of the cellars of his palace. On the morning of the 20th, Charles, wearied with the struggles of the last few days, publicly abdicated, and declared the Prince of Asturias king of Spain.

With a French army in his capital, Ferdinand saw that the stability of his throne depended upon his recognition by the French emperor. He therefore addressed him a note in justification of the late events, and renewed his solicitations for the hand of an imperial princess. In the meantime Charles also wrote to Bonaparte, protesting against his abdication as a forced measure; while the queen importuned Murat to save the life of her minion, who had been discovered and imprisoned. Ferdinand, having been persuaded by the French ambassador Savary to leave Madrid and meet the emperor, who was said to be already in Spain, was conveyed a prisoner to Bayonne with all his family, on the 15th of April. Here he had an interview with the emperor, who threw off the mask, and required him to make a formal cession of the Spanish crown; the kingdom of Etruria, lately taken from his nephew, and the hand of one of Bonaparte's nieces, were promised him in return. Ferdinand's conduct on this occasion raised expectations which were afterwards grievously disappointed; he refused to comply with the emperor's wishes, and declared that he would never consent to part with his father's inheritance. Shortly after Charles IV., his queen, and Godoy arrived at Bayonne, and Bonaparte had no difficulty in obtaining from the former an edict addressed to the council of Castile nominating Prince Murat lieutenant-general of the kingdom, and directing his orders to be obeyed as emanating from the king. On the 5th of May, Godoy and Duroc concluded and signed a convention by which Charles ceded Spain and the Indies to Bonaparte. Ferdinand was next applied to in order to sign an act of renunciation of all his rights in favour of the French emperor, which he did on the 10th of the same month. Whilst this scene of unexampled perfidy and violence was being acted at Bayonne, the French had so exasperated the Spaniards that the feelings of the nation were roused against them. An attempt to prevent the departure of the regent Don Antonio, and the Infante Don Francisco, Ferdinand's younger brother, from Madrid, brought about the first collision between the French and the Spaniards. The 2nd of May, 1808, will ever be memorable in Spanish annals for the sanguinary conflict between the unarmed inhabitants of the capital and 25,000 well appointed soldiers, and for the slaughter which Murat afterwards caused to be made of the defenceless inhabitants. That day too was like the spark of fire to the mine. No sooner were the events in the capital made known in the provinces, than the gathering tempest of Spanish indignation broke forth, and the people took up arms against the invaders, although the most enlightened part of the nation espoused the cause of Joseph Bonaparte, whom the French emperor had nominated king of Spain. The Asturians were the first to take up arms in the cause of national independence, the people of Aragon followed, and the rising soon spread to Seville, Badajoz, and Barcelona. Everywhere Juntas were instituted to act against the invaders. A French squadron under Admiral Rosilly was compelled to surrender within the harbour of Cadiz. Moncey was repulsed with considerable loss from before Valencia, and Duhesme failed in an attempt upon Gerona. The Spaniards under Cuesta and Blake having been defeated by Bessières at Rio Seco, the road to the capital was opened, and Joseph made his triumphant entry into Madrid on the 20th July, 1808, though, hearing of the defeat of Dupont by General Castaños at Baylen, he left it a few days after, and retreated to Vitoria. About the same time an insurrection broke out in Portugal, and the alliance of Great Britain with the Spanish nation was proclaimed. A struggle now commenced, which, it is generally admitted, led to the ruin of the French emperor. Sir Arthur Wellesley, having been sent from England to the assistance of the Spaniards, landed at Coruña on the 20th of August, and having subsequently defeated the French under Junot at Vimeira, Portugal was evacuated by the convention of Cintra. In the meantime discussions were going on in Spain as to the form of government to be adopted. Soon after the outbreak of Madrid, several Juntas had started up, simultaneously and without concert, in the provinces, to repel foreign aggression. At first a sense of common danger made them act in union with zeal and patriotism; but when the intrusive king and his foreign troops had been driven almost to the foot of the Pyrenees, provincial ambition, local and even individual interests, jealousy and intrigues, took the place of patriotism, and each province, with its own governing Junta, stood alone, jealous of every other province, and the necessity of some central executive power began to be felt. Accordingly a Central Junta was installed at Aranjuez on the 26th of September, and the count of Floridablanca was chosen president. Its first measure was a solemn proclamation of Ferdinand VII.

On the 8th of November Bonaparte himself entered Spain, and the influence of his superior military talent was immediately apparent. Soult attacked and defeated the centre of the great Spanish army (10th October, 1808). Victor's and Lefebvre's victories at Espinosa and Reynosa on the 11th, opened the way to Asturias and the northern coast. On the 23rd Lannes attacked Castaños and Palafox near Tudela, and defeated them. The mountain-pass of Somo-Sierra was taken by assault by the French and Poles under Bonaparte, and on the 4th of December the French army appeared before Madrid, which immediately surrendered. During this time, Sir John Moore, who was at Salamanca, found himself opposed to the victorious French armies which were rapidly advancing to cut off his retreat. Giving up all hope of the defence of Portugal, he commenced a rapid and precipitate retreat on Coruña. He was attacked on the 16th January, 1809, by Soult and Ney, at the head of superior forces, and he fell at the very moment when his army had gained the victory. [MOORE, SIR JOHN.]

The war continued with unabated fury in every corner of the Peninsula. The Spaniards, being much inferior in discipline to the French, were invariably defeated in the open field; but the French remained masters only of the places which they occupied, and the guerrillas continually surrounded and harassed them. No line of communication was safe for the French, and their means of support frequently failed. The obstinate defence made by the people of Saragossa [SARAGOSSA] and other towns, considerably thinned their numbers. Two objects chiefly occupied the French generals during the campaigns of 1809 and 1810—the reconquest of Portugal and the march over the Sierra Morena to Cadiz. The former was prevented by the tactics of Sir Arthur Wellesley, who advanced into Castile, and defeated Joseph, Victor, and Jourdan at Talavera (27th and 28th July, 1809); but after the defeat of the Spanish general Arizaga, Ocaña was carried by the French. In January, 1810, Desolles and Gazan took the pass of Despeñaperros; Sebastiani stormed the defile of St. Estevan and took the bridges over the Guadalquivir; Andalusia was overrun, and the cities of Jaen, Cordova, and Seville were taken. In Catalonia, Aragon, Navarre, and Castile, the guerrilla chiefs were not inactive. The Empezinado advanced to the gates of Madrid; and in Navarre the two Minas, uncle and nephew, were the terror of the enemy; and Porlier, Longa, Cuevillas, Rodriguez, and others scoured Old and New Castile. Masters of the country, these undisciplined bands performed great service. They harassed the enemy's communications, cut off his convoys and supplies, and by intercepting couriers, both procured intelligence and defeated the schemes of the French; and though it would be idle to assert that the guerrillas alone could have expelled the enemy from Spain, there can be no doubt that they gave great assistance to the English regular troops. In February, 1810, the French, under Victor, besieged Cadiz, where the Central Junta had retreated on the capture of Seville, but all their efforts to reduce that place were unsuccessful. The taking of Ciudad Rodrigo and Badajoz, and the victory of Salamanca [SALAMANCA], obliged the French to abandon Madrid, and to concentrate their forces in the eastern and northern provinces of the Peninsula. Lord Wellington, after having occupied Madrid, followed the enemy to Burgos, and after several engagements transferred his head-quarters to Fresneda, on the frontier of Portugal. Thus ended the campaign of 1812. Meanwhile the Central Junta had convoked the Cortes of the kingdom, and these deputies, assembled at Cadiz, were occupied in framing a constitution for Spain, which was signed on the 20th of March by the regents, and acknowledged by the allies of Spain. The Inquisition was abolished, ecclesiastical reforms were accomplished, monastic orders were suppressed, and their property taken by the state. At length Bonaparte's disasters in Russia decided the fate of the Peninsula. Soult was recalled, in the beginning of July, with 30,000 men from Spain. Suchet abandoned Valencia. King Joseph and Jourdan retreated to Vitoria, where Wellington overtook them, and gained a splendid victory. The French, pursued by Graham and Hill, retreated in disorder over the Pyrenees, and lost all their baggage (June 21, 1813). The conquerors immediately invested Pamplona. The Spaniards, under Count D'Abisbal, occupied the pass of Pancorbo, and Graham besieged St. Sebastian, which was afterwards taken. [SEBASTIAN, SAN.] Shortly after Suchet was compelled to evacuate Catalonia. Thus ended, after six years of continual struggle, one of the most sanguinary wars on record, in which one is at a loss what to admire most, the courage and perseverance of the Spanish nation, or the steady discipline of the British troops and the high military talents of their commander. (Those readers who may wish for more ample information on this interesting period of Spanish history, may consult Ibieca, 'Historia de los dos Sitios de Zaragoza,' Burgos, 8vo. 1830-1; 'Memoirs of Ferdinand VII. of Spain,' Lond., 1824; Toreno, 'Historia del Levantamiento Guerra, y Revolucion de España,' Paris, 1838, 5 vols.; 'Mémoires du Maréchal Suchet, Duc d'Albufera,' Paris, 1828; and the well known Histories of the Peninsular War, by Southey and Napier.)

Whilst Ferdinand's allies were triumphing over his oppressor, the captive prince had regained his liberty, and entered his kingdom amidst the acclamations of thousands of his subjects who went out to meet him. No sooner however had he set his foot in Spain than he began to show his ingratitude to those to whom he was mostly indebted for his throne. His kinsman the cardinal of Bourbon, one of the late regents, was immediately deprived of the archbishopric of Toledo, which was bestowed on one of the fiercest of the anti-constitutional clergy. Ferdinand refused to take the prescribed oath to observe the constitution of the state, and on the 4th of May, 1814, he issued a decree declaring that the Cortes had been illegally convoked, or rather illegally constituted, and the Cortes were accordingly dissolved, and their constitution abrogated. The Inquisition was re-established, though not with the power of capital punishment; the conventual estates were restored, and the Jesuits recalled; the prisons moreover were crowded with those patriots who had fought for the cause of national independence, and to whom he owed his throne. For six years (1814-20) Ferdinand reigned with absolute power, during which time several unsuccessful attempts were made for the restoration of the constitution, and Porlier, Lacy, and Vidal, who rose in various parts of the kingdom, ended their days on the scaffold. Mina, more fortunate than his companions, escaped. On the 1st of January, 1820, four battalions—making part of an expedition destined to suppress the American insurrection—proclaimed the constitution of 1812 at the Isla de Leon, and, with Riego at their head, marched against Cadiz. After some slight skirmishing with O'Donnel, the captain-general of Andalusia, Riego occupied Algesiras, entered Malaga, and proceeded through Ezija and Cordova to the centre of the Peninsula. Risings now took place in every quarter; the royal troops sent against the insurgents made common cause with them, and Ferdinand was compelled to yield to the general cry by accepting the constitution, proclaiming a general amnesty, and summoning the Cortes of 1812. The Inquisition was abolished, and obnoxious ministers were succeeded by others favourable to constitutional principles. The monastic orders were abolished, and their lands sold; the laws of entail were abrogated; and several liberal measures were passed by the house of representatives during the first session. But the clergy, thus stripped of their wealth and influence, again excited the lower classes to deliver their king from the fangs of freemasons and heretics, as the liberal party were termed by the hot partizans of absolutism. An Apostolical Junta established itself on the frontiers of Portugal, and bands of peasants, commanded by monks, took up arms for the purpose of restoring the privileges of the crown and the clergy. At the same time Mexico declared itself independent; Lima was occupied by the Chilians under San Martin; and the Spanish part of the island of Santo Domingo was lost by its union with Hayti. The guerrillas, though beaten by the troops, could not be entirely disarmed. In the third session of the Cortes, which began March 1, 1822, the moderate liberal party prevailed over the *Exaltados*, and tranquillity was in some measure restored; but the intrigues of the Spanish exiles, supported by the French court, kept discord alive. An attempt made on the 7th of July, 1822, by some battalions of the royal guards, to put down the constitution, was defeated through the energy and patriotism of the national militia of Madrid. A regency of the friends of absolute monarchy, under the marquis of Mataflorida, was established at Urgel, near the French frontier; but the troops raised by them were beaten by Mina and Milans, and the members of the regency fled to France in November, 1822. At last the French government aided the equipment of apostolical soldiers on the French territory, and acceded, at the congress of Verona, to the principle of armed intervention, pronounced by Austria, Russia, and Prussia, with relation to Spain. The duke of Angoulême, having previously issued a proclamation to the Spaniards declaring that France desired nothing but their deliverance from the evils of the revolution, crossed the Bidassoa, whilst Moncey entered Catalonia. The Cortes decreed a general arming of the people, and Madrid being deemed insecure, the seat of government was tranferred to Cadiz. An army of 120,000 men, in four divisions, commanded by Ballesteros, Murillo, Mina, and D'Abisbal, was sent to arrest the progress of the enemy, who had taken Santoña, Santander, St. Sebastian, and Pamplona. D'Abisbal, being suspected by the Cortes, fled to France. The duke of Angoulême entered Madrid on the 24th of May, and nominated a regency composed of the duke of Infantado, the duke of Montemar, the bishop of Osma, the baron D'Eroles, and Gomez Calderon. On the 26th of June Murillo declared himself against the Cortes, and surrendered to the French. In vain did Quiroga, in Coruña, where Sir Robert Wilson also was, collect troops te defend the place. General de Bourck, after a bloody contest, made himself master of the heights, and the city itself surrendered on the 13th of August. Mina, with only 6000 men, carried on a partizan war in Catalonia, but with no better success. The duke of Angoulême now besieged Cadiz, which, after the fall of the Trocadero, surrendered to him on the 4th of October. The members of the government, and most of the deputies of the Cortes, took refuge in England, where they were received with the respect due to their rank and misfortunes. The war still lingered in Catalonia, but was soon brought to a close by the capture of Riego, who, in violation of the terms of the military capitulation concluded with the French generals, was tried and executed at Madrid. Peace, if not order, was now re-established; but the apostolical party, being displeased with Ferdinand, some of whose measures were deemed too conciliatory and liberal, determined to raise his brother Carlos to the throne. A formidable insurrection in Catalonia (1825) was only put down by the severity of the count d'España and Ferdinand's presence. The fort of St. Juan de Ullóa, near Vera Cruz, surrendered in November, 1825, and the fortress of Callao, near Lima, the last place held by the Spaniards on the American continent, fell also into the hands of the insurgents on the 22nd of January, 1826. The foolish and ill-concerted expedition against Mexico terminated in the surrender of Barradas to Santana in 1829. In the following year Spain was evacuated by the French auxiliary troops. The French revolution of 1830 stirred the Spanish patriots in exile to cross the frontier with a view to recover their liberties; but the country did not rise at their approach, and the undertaking miscarried.

Ferdinand married Christina, daughter of the king of Naples, who, in 1830, bore him a female child named Isabella. By the antient laws of Spain, females could inherit the crown in default of male issue; but the Salic law of France had been introduced with the princes of the house of Bourbon, and females continued to be excluded from the throne until 1789, when Charles IV., by means of a secret sanction of the Cortes, abrogated the restriction, and restored the antient rule of succession. In 1812, however, the Cortes re-established the Salic law; and as Ferdinand had no male children, his brother Don Carlos was heir presumptive.

In 1830 Ferdinand issued a decree placing the right of succession on the same footing as before, and his daughter was thereby capacitated to ascend the throne; but in 1833 the approaching death of Ferdinand seemed to threaten a change in the Spanish succession. On the 17th of September his life was despaired of. His daughter was an infant, and Don Carlos, at the head of a powerful and bigoted party, began publicly to assert his rights. Ferdinand's ministers, eager to secure the favour of Don Carlos, surrounded the death-bed of the king, and made him sign a decree by which he restored the operation of the Salic law. However the very next day, after Ferdinand had been announced as already dead, and his body had been exposed in one of the halls of the palace, the disease unexpectedly took a favourable turn, and the king, being made aware of the designs of Carlos, dismissed his minister Calomarde, called Zea Bermudez to the ministry, and annulled the act wrung from him in the agonies of anticipated death. Queen Christina having regained the ascendency over the mind of her husband, several good measures were determined and carried into execution. The universities were reopened, and a general amnesty for all past political offences proclaimed. The death of Ferdinand, which happened on the 29th of September, 1833, was the signal for a general rising of the adherents of Don Carlos, in opposition to Queen Isabella, who succeeded Ferdinand. The insurrection broke out in the northern provinces, where apostolical principles had always been strong, and soon spread to Catalonia and other provinces.

On the 24th of July, 1834, Christina, who had been appointed queen-regent, opened in person the session of the Cortes, in compliance with the 'Estatuto Real,' a sort of constitution which she had granted to the nation in the preceding month of April, Martinez de la Rosa being prime-minister at the time. Among other measures of importance proposed by the government for the consideration of the Cortes, one was a bill for excluding Don Carlos from the throne, which passed both houses without opposition. Shortly after, Martinez de la Rosa, being unable to command a majority in the Cortes, tendered his resignation, which was accepted, and the count of Toreno was appointed to succeed him. In the meantime the rebel prince, who, after a short stay in England, had lately arrived in Navarre, maintained the contest with the same varying fortunes and indecisive results which had characterized the struggle from its commencement. But about the close of the year the enterprising general Zumalacarregui gained some advantages over the queen's forces, and Mina was sent against him. The campaign of 1835 proved unfavourable to the queen's cause; the advances of the Carlists towards Castile became more frequent and bolder; Zumalacarregui beat in succession the divisions sent against him, and all the resources and skill of Mina were insufficient to check the progress of the enemy. General Valdés, who succeeded him in the command of the army, was not more fortunate; and the aspect of affairs grew daily worse, when the death of Zumalacarregui, who was killed before Bilbao (June 25th, 1835), turned the scale in favour of the queen.

Some time before, and at the instigation of England, a convention had been signed between the generals of the two belligerent parties, purporting that prisoners should be treated according to the laws of war among civilized nations, instead of being butchered as before. The ill success of the war carried on against the Carlist insurgents, and the weakness and vacillation manifested by the government of Madrid, occasioned tumultuary risings in various parts of the Peninsula, which were only quieted by the dismissal of the Toreno administration and the appointment of Mendizabal. The new ministry began its career with great vigour and zeal. A levy of 100,000 men was decreed and raised. General Cordova, a young officer of talents, was raised to the command of the army in the north; an auxiliary legion, 8000 strong, recruited in England, and commanded by De Lacy Evans, was added to the army of operations in Biscay. A new electoral law, the liberty of the press, and the abolition of the monastic orders, were among the measures of the new administration. Everything promised fair for Spain; but as the minister, Mendizabal, who relied for support on England in preference to France, was about to conclude a treaty of commerce with Great Britain, France, alarmed at the consequences which the contemplated measure might have on her trade, protested through her ambassador, count de Rayneval, and every intrigue was set on foot to overthrow the Mendizabal administration. General Cordova joined in the plot, and leaving his army under the command of Espartero, proceeded to the capital to hasten the fall of the obnoxious administration. On the 14th of May, 1836, Mendizabal tendered his resignation, and was succeeded by Isturiz, who did not remain long in office.

On the evening of the 12th of August, a battalion commanded by Serjeant Garcia, broke out into rebellion at San Ildefonso, and obliged the queen to sign a decree for the dis missal of the ministry, and to swear to the constitution of 1812. Meanwhile Espartero, who had succeeded Cordova in the command, had obtained some successes over the Carlists, and he had relieved Bilbao, which the enemy had blockaded. In Catalonia and Lower Aragon however the Carlist chief Cabrera had the advantage. In the year 1837 the Cortes terminated their debates on the constitution of 1812, which the government had submitted to their revision, and on Sunday, the 18th of June, 1837, the new constitution was publicly sworn to by the queen-regent.

In 1839 the cause of Carlos began visibly to lose ground. General Leon pressed Elio in Navarre; a great portion of Biscay and Alava were in the hands of Espartero, and the Basques began to be weary of the civil war, which was at last terminated by the convention of Bergara, on the 31st of August. It was not until September, 1840, that the Peninsula was completely pacified by the breaking up of Cabrera's army in Valencia and the taking of Morella by Espartero.

The war being at an end, the two parties, namely, the *Moderados* and *Progresistas*, courted the friendship of Espartero and the army, with a view to strengthen themselves in power. The former having obtained a considerable majority in both chambers, an administration was formed under the presidency of Perez de Castro, which immediately proceeded to annul some of the measures carried by the preceding liberal administrations. Having succeeded in carrying through both chambers a most unpopular bill respecting the municipal corporations, whose rights were annihilated at one blow, and having obtained the royal sanction for the same, an insurrection broke out at Barcelona, and the municipality of Madrid refused to give publicity to the obnoxious law. The queen-regent was obliged to change her administration, and shortly after, of her own accord, she resigned the regency, and sailed from Valencia to Marseille, where, on her arrival, she issued a manifesto (November, 1840), declaring her abdication to have been voluntary. A regency was then appointed in Madrid to govern the country until the meeting of the Cortes, which, after a most interesting discussion, which lasted several days, chose General Espartero, Duke de la Vitoria, sole regent of the kingdom. At the moment we are now writing, the partisans of the queen-regent have made an attempt to rekindle civil war, and re-establish despotism, by a marriage between the Duke of Aumale and Queen Isabella; but the firmness and vigour of Espartero have defeated all their plans, and after the execution of General Leon and the principal leaders of the insurrection, the country again enjoys the blessings of peace. The following are the best general histories of Spain:—'La Cronica General de España,' Zamora, 1541, fol., generally attributed to Alfonso X. of Castile; 'La Cronica de España,' by Florian de Ocampo, historiographer of Charles V. (Alcalá, 1578, fol.), with the continuation by Ambrosio Morales (ib., 1574); Mariana, 'Historia General de España,' written first in Latin (Toledo, 1591), and then translated into Spanish (Mad., 1608). The best edition is that of Valencia, 1783, in nine volumes, folio, being enriched with critical notes by a society of literary men; Garibay, 'Compendio Historial,' Barcelona, 1648, 4 vols. fol.; Ferreras, 'Synopsis Historica Chronologica de España,' Mad., 1775-91, 17 vols. 4to.; Ortiz y Sanz, 'Compendio Cronologico,' &c., Mad., 1795, 7 vols. 8vo.; Masdeu, 'Historia Critica de España y de la Cultura Española,' (Mad., 1783-1800, 20 vols. 4to.), an invaluable work, which appeared at the same time in Italian and Spanish; Ascargota, 'Compendio de la Historia de España' (Paris, 1840), and the continuation of Mariana by Sabau (Mad., 1817-21), and Miñana (Mad., 1794-5). Of those written in this country, the best is that by Dr. Dunham, in Lardner's 'Cabinet Cyclopædia.'

*Language.*—Of the languages or dialects spoken in the Peninsula before it became a Roman province very little is known. Strabo (lib. iii., p. 139, Casaub.) says that various dialects were in use in his time among the inhabitants of the Peninsula, and that the Turditani had a written code of laws in verse. The Phœnicians and Greeks who settled in Spain must also have introduced their own languages, whilst the Celts, who occupied the north-western districts, spoke their own tongue. During the long period of Roman domination, all these languages seem to have made room for the Latin, except in the north and west of the Peninsula, where the Basque [BASQUE LANGUAGE] was always, and is still, generally spoken. The northern nations who invaded Spain in the fifth century of our æra made no effort to introduce their own tongue, but adopted that of the natives, and spoke Latin, which they corrupted by making the nouns indeclinable, as in their own rude dialects, and increasing the use of prepositions. They nevertheless introduced several words relating principally to their warlike habits, such as *hielmo* (helmet), *rico* (rich), *harpa* (harp), *jardin* (garden), *daga* (dagger), *bosque* (forest), *guantes* (gloves), *guarda* (guard), *guerra* (war), *garras* (claws), &c. A provincial dialect of the Asturias, called 'La Lengua Bable,' contains a still greater number of words which have not passed into the written Spanish. Then came the Arabs, whose language at one time must have been very generally spoken in the Peninsula. Alvarus Cordubensis, a writer of the tenth century, in his 'Indiculus Luminosus,' informs us that 'out of one thousand Christians scarcely one could be found capable of repeating the Latin forms of prayer, whilst many could express themselves in Arabic with rhetorical elegance, and even compose verses in that language. Nearly two centuries after the taking of Toledo by Alfonso VI., Arabic was still spoken there in preference to the Castilian, and most legal writings, even between Christian parties, were made in Arabic. Up to the end of the thirteenth century, the kings of Aragon were in the habit of signing their names with the letters of the Arabic alphabet. On the taking of Seville by Ferdinand III., it was deemed necessary to translate the Gospels into Arabic, in order to instruct the Christian population of that city in the duties of religion, which, as well as their native language, they had completely forgotten during their long captivity.

Of these heterogeneous elements the modern Spanish language is formed, although it would be difficult to say at what time it began to assume its present shape. Bouterwek is of opinion that the Castilian tongue had its origin before the Saracen invasion; whilst Dr. Puigblanch has gone so far as to assert that 'it was the sister of the Latin, and existed as early at least as the times of the Roman republic.' (*Opúsculos grammático-satiricos*, Lond., 1828, vol. i., App., p. 4.) But the earliest document written in *Romance* hitherto discovered bears the date of 1173, and although it might be inferred from the style that the language had existed in a similar form for upwards of a century, we are nowise justified in concluding that the *Romance* was formed before the tenth century, that is to say, two hundred years after the Mohammedan conquest.

About the beginning of the thirteenth century, three principal languages were spoken in the Peninsula. The Castilian prevailed exclusively in the two Castiles and Leon; the Catalonian, a dialect resembling the Provençal or Limosin of the south of France, was spoken in Catalonia, Aragon, part of Valencia, and the Balearic Islands; and, lastly, the Cantabrian or Basque, notwithstanding the intercourse of trade and civilization, still maintained its ground, though greatly corrupted, along the western side of the Pyrenees. [BASQUE PROVINCES.] About the same time the Portuguese, which originated in a mixture of the Galician dialect and the language spoken by the French knights who served under Henry of Besançon, became more distinct from the Castilian. [PORTUGAL.] How far the Arabic has contributed to the formation of the modern Spanish is a contested point among Spanish critics, some, like Mayans (*Orígenes de la Lengua Castellana*, vol. i., p. 27), asserting that it has only borrowed a few words from the language of the conquerors, whilst Conde (*Hist. de la Dom.*, vol. i., prol.) pretends that the Castilian is so much indebted to the Arabic, not only in its vocabulary, but in its idioms and phraseology, that it ought to be regarded as a dialect of the Arabic. Both opinions however are extreme. The former is that of a man well versed in the classical writers, but totally unacquainted with the Eastern languages, and who, like other learned men of his age, thought that no advantage whatever could result to his native tongue from an avowed connection with the language of the conquerors; whilst the latter is that of a scholar passionately fond of everything relating to the East, and who spent the best years of his life among the Arabic MSS. which he translated into Spanish, adopting, rather more than was either necessary or useful, the words and style of the Arabic. That the Castilian language has borrowed a considerable number of its words from the Arabic is a fact beyond all doubt. If any one opens the *Diccionario de la Lengua Castellana*, published by the Royal Academy in 1726, he will find that most words beginning with *al*, or with the letters *j*, *x*, *z*, are of Arabic origin. The names of plants, flowers, drugs, minerals, furniture, dresses, weights and measures, &c., are, with a few exceptions, all Arabic, although they have also corresponding names derived from the Latin. All words relating to the different branches of the mechanical arts which were introduced by the Moors into Spain are likewise borrowed from their language. In general nouns of Arabic origin abound more than either adverbs or prepositions, and these in proportion are more numerous than the verbs. The connection of both languages would still be greater, if the writers of the golden age of Spanish literature had not formed their style on the Latin, and avoided, as much as possible, words of Arabic origin; to which may be added, that when the Academicians compiled the above-mentioned dictionary, they left out many words authorised by use, which are found in the oldest Spanish works. It was not until the beginning of the sixteenth century, and during the reigns of Ferdinand and Charles V., that the Castilian became the language of the Peninsula, although works in Valencian, Catalonian, and Basque continued to be published from time to time, and although the above-mentioned languages were, and are still, spoken by the inhabitants of a great part of Spain. Even during the period when the Castilian was the general language of literature, it was far from having attained perfection. Juan del Enzina, a popular writer of the sixteenth century, complained that he was obliged, in his version of Virgil's 'Eclogues,' to invent a new vocabulary from the want of terms corresponding to those in the original. Half a century afterwards Ambrosio Morales (*Obras*, tom. xiv., p. 147-8) made a similar complaint. The Spanish language abounds in full sounding words which render it suitable for all poetical purposes. The Spaniards use two rhymes: the *asonante* and the *consonante*. The *consonante*, or full rhyme, is nearly the same as the Italian. The *asonante* is one which the ear of a foreigner would not immediately distinguish from the termination of a blank verse. An *asonante* is a word that resembles another in the vowel on which the last accent falls, as well as the vowel or vowels that follow. Thus *cabállo, armádo, pálo; guérra, riéga, halagueña; traidór, nació, vós*, are all asonantes. Hence the great facility of writing Spanish verses, instances being well known of poets who could converse in rhyme. There is a strong guttural sign in Spanish (that of the *j*) which, some people suppose, may be traced to the Arabic; but which was doubtless introduced by the German courtiers of Charles V., since before that time the letter *j* was universally pronounced soft, as the *g* in the Italian words *gioia, giardino, frigido, gioco*. The only guttural sound borrowed from the Arabs is that of *h* at the commencement of a word, such as *haca, harapo, huso*. The letter *x*, which is now pronounced with a harsh aspiration, was in former times used to express the *ch* of the French, *Marexal, xabon, xibia, xarabe*, &c. The Spanish is peculiarly fitted for the elevated and the pathetic, but not unfrequently its solemn dignity seduces the Spaniard into bombast. Poetry, having always been more cultivated than prose, there is a certain redundancy of expression in the best prose writings of the Spaniards. Further information on the origin of the Spanish language may be found in the following works:—Alderete, *Origen y Principio de la Lengua Castellana*, Roma, 1606, 4to.; Covarrubias, *Tesoro de la Lengua Castellana*, Mad., 1638, fol.; Mayans, *Origines de la Lengua Castellana*, Mad., 1737, 8vo.; Hermosilla, *Arte de Hablar en Prosa y en Verso*, Mad., 1830, 4to.; Garcé, *Fundamento del Vigor y Elegancia de la Lengua Castellana*, Mad., 1791; Cabrera, *Diccionario Etymológico de, &c.*, Mad. 1834, 4to, An English and Spanish Dictionary published in 1591, by Richard Percyvall (*Bibl. Hisp.*, 4to.) and the 'Spanish Schoolmaster,' by W. Stepney (Lond., 1591, 8vo.), are no more than two bibliographical curiosities. Pineda, Stevens, and Barretti also made dictionaries of both languages. The best is that of Seoane, London, 1832, 8vo. A Spanish grammer for the use of English students, lately published by Alcalá, is an inferior performance.

*Literature.*—In attempting a rapid sketch of the literature of Spain, the *romances*, or popular ballads, first demand our attention. As their name sufficiently implies, they must have been coeval with or subsequent to the formation of the *Romance* or Castilian language, but as to the origin and antiquity of this language critics are greatly divided. Some, as Mr. Southey ('Chronicle of the Cid,' Introd.), are of opinion that few if any are older than the fourteenth century; Bouterwek ('Geschichte der Poesie und Beredsamkeit,' p. 20) conjectures that all those which relate to the Cid are the produce of the eleventh century, while some Spanish writers give them a still greater antiquity. The question however is one of difficult solution; for how can we determine the age to which ballads belong whose authors are in most cases unknown, and whose style in the progressive improvement of language has been first altered by minstrels, and then modernised by collectors? The peculiar character of some of the earliest ballads, those of the Cid for instance, leads us to suppose that they were composed in the lifetime or shortly after the death of those heroes whose exploits they commemorate. How far these effusions of the Spanish muse are indebted to Arabian poetry for their metrical forms and spirit is another contested point. Those who happen to be acquainted with the poetry of the Spanish Arabs, can have no doubt that the *redondilla*, a verse consisting of eight syllables (the last foot and some or all of the preceding, as the case may be, being trochees), is borrowed from the Arabs, as were also the double hemistich, the intermixture of assonances and consonances, the repetition of the same rhyme, and other peculiarities of early Castilian poetry. After these ballads the rhymed chronicle of the Cid ('Poema del Cid Campeador') is the oldest monument of Spanish literature hitherto discovered. It is written in a kind of rude Alexandrine, and bears evident traces of being much posterior to most of the ballads which record the exploits of that warrior, and of being made up out of them, for the octosyllabic verse of the *redondillas* is frequently found incorporated with the Alexandrine. The supposed author of this poem lived about the end of the twelfth century. Nearly to the same age belongs a fabulous chronicle of Alexander ('Poema de Alexandro Magno'), written in the same metre. Gonzalo de Bercéo, a Benedictine monk, who lived about the middle of the thirteenth century, was the author of some Lives of Saints, in rhyme, and other poems on sacred subjects. About the beginning of the fourteenth century Juan Ruiz, archpriest of Hita, wrote an allegorical satire, not without some merit, which, together with the works of the above-mentioned poets, is in Sanchez, 'Coleccion de Poesias Castellanas anteriores al Siglo XV.,' Mad., 1779-90, 4 vols. 8vo.

About the same time Castilian poetry received a great impulse from the encouragement as well as the labours of Alfonso X., surnamed 'El Sabio' (the learned), who, besides 'El Libro de las Querellas' (the book of complaints), which has been lost, wrote a short poem, entitled 'Las Cantigas de Nuestra Señora,' and a few dactylic stanzas on the secrets of alchemy, his favourite pursuit.

Alfonso, who was the first king of Castile who ordered all public documents to be written in the *romance*, or popular language of the time, caused translations of the Bible, and of the work of William of Tyre on the Holy Land, to be made into Castilian. He was the author or editor of a general history of Spain, 'Cronica General de España.' The history of Spanish poetry continues barren of names until the middle of the fourteenth century, when the example of Alfonso XI. of Castile, and of his relative Don Juan Manuel, the celebrated author of 'El Conde Lucanor,' a book of moral and political maxims, operated powerfully on the Castilian nobility. Alfonso Gonzalez de Castro; Pero Lopez de Ayala, 'el Viejo,' author of the 'Rimado de Palacio;' Alvarez de Villasandino, the Jew; Don Santos Carrion, a favourite of Peter the Cruel, and others whose works are contained in the old Cancioneros, are among the poets of that time. It was not until the age of John II. (1407-54) that a spirit of improvement was discernible in the antient national poetry of Spain. Among the noblemen who composed the 'poetical court' of John II.—for so it has been termed by Spanish writers—Don Enrique, Marquis de Villena, was one of the most distinguished by his classical learning and his talents. Besides a translation of the 'Æneid' in verse, which has been lost, he wrote a mythological and moral work, entitled 'Los Trabajos de Hercules (the labours of Hercules), which was printed for the first time at Zamora, in 1483, fol., and an Art of Poetry, entitled 'La Gaya Ciencia,' extracts from which are contained in Mayans ('Origenes de la Lang. Cast.,' vol. ii., p. 321). It is to be regretted that the marquis did not confine his labours to literature, instead of travelling into the paths of natural science, which he learned in the writings of the Arabs; for as long as he lived he was regarded as a magician, and at his death, in 1434, a search was made in his library, and upwards of one hundred volumes, including his own poetical labours, were consigned to the flames, as savouring too strongly of the black art. (Cibdadreal, 'Cent. Epist.,' fol. 29.) His pupil, the Marquis de Santillana, was another of the poets who adorned the court of John II. He was the first who naturalized the Italian sonnet in Castile; and his epistle to Don Pedro, constable of Portugal, on the origin of Castilian poetry, is invaluable. His 'Doctrinal de Privados,' the earliest didactic poem in the Spanish language, consists of a series of moral reflections occasioned by the unfortunate fate of Don Alvaro de Luna, the favourite of John II. He also wrote an elegy on the death of his friend and master the Marquis of Villena, a short poem, entitled 'Los Gozos de Nuestra Señora' (the Joys of Our Lady), and other poems to be found in the old Cancioneros. A list of this nobleman's writings, among which there is a collection of Spanish proverbs ('Los Proverbios de Don Iñigo Lopez de Mendoza, con su Glosa,' Sevilla, 1494, fol.), of which an English translation, by Barnaby Googe, appeared in 1579 (Lond., 16mo.) may be seen in Sanchez (vol. i., p. 34).

John of Mena, whom Spanish writers call their Ennius, lived about this time. [MENA.] A host of other poets and rhymers, such as Fernan Perez de Guzman, Rodriguez del Padron, Alfonso bishop of Cartagena, who is better known as the author of the 'Doctrinal de Caballeros' (Burgos, 1483, fol.), Garci Sanchez de Badajoz, and others, whose works are printed either in the 'Cancionero General,' by Hernando del Castillo (Valencia, 1511, fol.), or in the still inedited* collection made by the Jew Alfonso de Baena, for John II., of the works of Castilian poets in his time, cultivated lyric poetry with success. The Chronicles of Don Alvaro de Luna (Milan, 1546), that of Don Pedro Niño, by Gutierrez Dias de Gamez; that of John II. himself, by Fernan Perez del Pulgar, the 'Centon Epistolario,' by the Bachiller Cibdadreal, Burgos, 1499, and other works still inedited, are remarkable instances of the cultivation of letters under this reign. Of the state of Spanish poetry under Ferdinand and Isabella, a correct notion may be formed from the perusal of the 'Cancionero General,' where no less than fifty Castilian noblemen figure as authors. Don Jorge Manrique wrote his beautiful moral couplets ('Coplas de Don Jorge Manrique,' Sev., 1494), which have lately been admirably translated into English, by Professor Longfellow, of Boston, in the United States ('Voices of the Night,' Cambridge, 1841). Padilla, a Carthusian monk, was the author of two poems in octaves: 'Retablo de la Vida de Christo' (Alcalá, 1529); 'Triumfos de los Apostoles,' (Sev., 1504). Traces of the origin of Spanish dramatic poetry are first visible in this reign. During the fifteenth century the Spaniards possessed their religious dramas and their farces, like the rest of Europe. In 1414 the Marquis of Villena composed an allegorical drama ('Comedia Alegorica') which was performed at the court of Aragon at the coronation of Ferdinand. In 1440 Don Pedro de Velasco wrote the 'Comedietta de Ponza.' An anonymous writer, who lived under the reign of John II., wrote a satirical work in form of dialogue between two shepherds, which was intended for acting ('Coplas de Mingo Revulgo,' Toledo, 1565). Rodrigo Cota is supposed to have been the author of the dramatic romance of 'Calistus and Melibœa' (Celestina, Salam., 1500), which Fernando de Rojas continued, and which was soon afterwards translated into Italian, French, and English ('The Spanish Bawde,' London, 1631). These rude essays were first converted into real dramas by Juan del Enzina, a chapel-master, or musical director, to Pope Leo, who gave great encouragement to dramatic amusements. He wrote several sacred and profane eclogues, in the form of dialogues, which were represented before distinguished audiences on Christmas-eve, during the Carnival, and on other festivals. With the exception of a few, they are all lost. ('Cancionero de todas las Obras de Juan del Enzina,' Sev., 1501; Moratin, 'Origenes del Teatro Español,' edic. Paris, p. 142.) In the reign of Ferdinand and Isabella considerable progress was made in historical writing. Alonso de Palencia [PALENCIA]; Bernaldez, whose valuable chronicle is still unpublished; Pedro Martyr de Angheria, or Anghiera, the author of the 'Opus Epistolarum,' Alcalá, 1530; Antonio de Valera, who, besides his chronicle of 'Ferdinand and Isabella' (still unpublished), wrote a general history of Spain (Saragossa, 1492), which was reprinted five times before 1500; Lucio Marinéo Siculo ('Obras Historicas,' Alcalá, 1530); Antonius Nebrissensis, or de Nebrija (Granada, 1550), who was also the author of a Latin and Spanish Dictionary (Sev., 1506), and several grammatical and philological works; and lastly Pulgar ('Reyes Catolicos,' Vallad., 1565) flourished under this reign. The conquest of Granada (1492) gave a new turn to the ballad poetry of Spain. It then became the fashion among the Spanish romance writers to select from the events of Moorish history materials for their songs. Such is the origin of the 'Romances Moriscos,' or Moorish ballads, with which the Spanish romanceros are filled, and which have erroneously been considered as the work of converted Moors, or as translations from Arabic songs. (Lockhart, 'Ancient Spanish Ballads,' Introd.)

Hitherto Spanish literature had developed itself without losing any of its antient forms, and a true national spirit prevailed in all the works, whether verse or prose; but the Italian wars having suddenly brought the Spaniards into contact with Italy, a change was slowly effected in the national taste. The introduction of the style and forms of Italian poetry was chiefly due to Juan Boscan Almogávar, who, by imitating the classical models of antiquity, and judiciously incorporating into Castilian poetry the excellencies of the Italian poets, gave a new direction to the literary taste of his countrymen. [BOSCAN.] He was greatly assisted by his friend Garcilaso de la Vega, whose beautiful eclogues, in the style of the 'Arcadia' of Sannazaro, are still unequalled, and of which an excellent English translation in verse has lately appeared, by Mr. Wiffen (Lond., 1823). The next Spanish poet who followed in the path of Boscan was Don Diego Hurtado de Mendoza, the minister of Charles V., equally well known for his classical learning and his fine collection of Greek MSS., as for his labours in almost every branch of literature. [MENDOZA.] Saa de Miranda and Jorge de Montemayor, both natives of Portugal, though they wrote chiefly in Spanish, followed the example of Boscan, and succeeded in giving to pastoral poetry a more elevated character. The latter was the author of a pastoral romance, entitled 'Diana,' which was soon translated into almost every European language. A second and third part to his work, the former by Alonso Perez (Venet., 1585), the latter by Gil Polo (Mad., 1778), were published after his death. Pedro Padilla was another successful writer of pastoral poetry ('Eglogas Pastoriles,' Sev., 1582), into which he introduced the Italian and antient Spanish metres. Fernando de Herrera, surnamed El Divino, among other works, published a commentary on the poetical writings of his friend Garcilaso. Fray Luis de Leon imitated the classics, and principally Horace, more successfully than any of his predecessors; and his metrical versions of the Psalms and part of the Book of Job are inimitable. As might be expected, the introduction of the Italian style met with violent opposition from those who asserted that the old Castilian metres and forms of rhyme were alone suited to the Spanish language. No one maintained the cause of the old Castilian poetry against the importations of the Italian school with more talent than Christoval de Castillejo, the secretary of the emperor Ferdinand I. of Austria, to whom Velazquez ('Origenes de la Poesia Española,' p. 25) and other Spanish critics assign the first rank among the poets of their nation. (Castillejo, 'Obras,' Mad., 1573.) During the whole of the sixteenth century several poets, encouraged by the example of Castillejo, continued to write in the old Castilian style, though they occasionally composed a few sonnets and *canciones* after the Italian. In this number are included Gregorio Sylvestre ('Obras,' Gran., 1591); Romero de Cepeda (Sev., 1582); Antonio de Villegas ('Inventario,' Medina del Campo, 1555). Fernando de Acuña, one of Boscan's disciples, was one of the first poets who, by writing in short strophes, endeavoured to form an intermediate style between the Italian *canzone* and the old Spanish *cancion*.

But if Spanish literature was rich in lyric and pastoral poetry, all attempts to imitate the romantic epic of the Italians completely failed; nor were their attempts in the serious epic more successful. Neither the 'Carlos Famoso' of Luis de Zapata, nor the 'Carlos Victorioso' of Geronimo de Urrea, who was likewise the translator of Ariosto's 'Orlando Furioso;' nor the 'Austriada' of Juan Rufo (Mad., 1584); nor 'La Parthenopéa,' a poem in honour of Gonsalvo de Cordova, are worthy of mention. The 'Araucana,' by Ercilla; 'Las Navas de Tolosa' by Christoval de Mesa;

* An edition of this invaluable manuscript, which during the Peninsular war was stolen from the Escurial library and brought to this country for sale is now, we understand, in progress of printing at Paris.

'El Bernardo,' by Balbuena, though written more in accordance with the forms of the true epic, are still far beneath the 'Gerusalemme Liberata' of Tasso or 'As Lusiadas' of Camoens. But dramatic poetry during this period, and principally during the first half of the seventeenth century, seems to have acquired its perfection. In 1570 Torres Naharro, an actor himself, wrote several comedies, which were mostly represented at Naples. Lope de Rueda followed with pieces in prose. Cervantes, who calls him 'the great Lope de Rueda,' says that he so far improved the Spanish stage, by adding to the decorations, &c., 'that the wardrobe of a theatre's company could no longer be packed in a bag, as before.' Juan de Malara, Juan de la Cueva, Geronimo Bermudez, and Christoval Virués, contributed to the improvement of the Spanish stage. In the meantime a contest was going on between the 'national party,' to which these dramatic writers more or less belonged, and the 'erudite party,' who wished to give the Spanish drama the form of the antique. To the latter belong—Simon Abril, who published a complete translation of Terence (Cord., 1586); Villalobos, a physician of Charles V., who translated the 'Amphitryon' of Plautus; Perez de Oliva, who made a prose version of the 'Electra' of Sophocles; and others. But the Spanish public preferred the former. Cervantes did nothing to improve the national drama. [SAAVEDRA.] The task was reserved for Lope de Vega, an author whose fertility of invention is unparalleled in the history of poetry [VEGA], who, according to his own statement, required no more than twenty-four hours to write a versified drama of three acts, interspersed with sonnets, tercets, and octaves, and abounding in interesting situations. He sometimes wrote a play in three or four hours. This astonishing facility enabled him to supply the Spanish theatre with upwards of two thousand original dramas, all in verse, of which only about four hundred have been printed. Lope was soon surrounded by a crowd of disciples and admirers, among whom were Mira de Amescua, Guillen de Castro, Guevara, and Matos Fragoso, who completed the triumph of the national drama over the classical but dull importations of the erudite party. Calderon followed, and the Spanish theatre became the inexhaustible source whence the best French dramatists drew the subjects of their plays. [CALDERON.] Until the latter end of the eighteenth century the plays of Lope de Vega, Calderon, and the writers of their respective schools, were universally acted throughout Spain; even now some of the best are still brought on the Spanish stage, though they have been recast or modernised.

About this time (1615-35) a new, irregular, and fantastical style was introduced into Spanish poetry, and the Italian school of the Marinists began to exercise an influence on the Spanish poets. Manoel de Faria e Sousa, a Portuguese by birth, was one of the first to adopt in his writings that turgidity and affectation which marked the Italian school. ('Fuente de Aganipe,' Mad., 1656; 'Divinas y Humanas Flores,' Mad., 1624.) Luis de Gongora carried this bombastic and forced style to the highest pitch; and as he was not without talent, he soon found a host of admirers, who were called *Gongoristas*, from the name of their leader, but who gave themselves the more honourable appellation of '*cultoristas*' (or writers in cultivated style), in opposition to the simple but irregular effusions of the national school, at the head of which was Lope de Vega. [GONGORA.] This innovation however was not without opponents: the two brothers Argensola, Manuel de Villegas, Jauregui, Espinel, and others, whilst censuring the style of their antagonists, upheld the national school; and Quevedo assailed them most bitterly in his 'Culta Latiniparla.' [QUEVEDO.] But Gongora's admirers were not easily defeated. A new school, called the *Conceptistas*, in imitation of the Italian term *Concettisti*, applied to the followers of Marino, started up, who, without the vigorous mind and superior talents of that poet, carried to excess the empty pomp and verbose obscurity of his artifical language, revelling in the wildest regions of fancy, and indulging in the most preposterous and extravagant ideas.

The cultivation of prose style during the above period was far from keeping pace with poetry. Indeed the literary men of Spain seem always to have paid little attention to the cultivation of historic and didactic prose, and, with very few exceptions, the best prose writers of the Peninsula were also poets. In the sixteenth century the most eminent writers of the Peninsula were of opinion that the Spanish language was incapable of expressing grave and noble ideas in prose, and hence the imitation of the antient classics was considered as the only means of improving the prose style. The learned theologian Fernan Perez de Oliva was the author of a dialogue on the dignity of man (*Dialogo de la Dignidad del Hombre* (Mad., 1772, 4to.), written in the manner of Cicero, which is perhaps the best fragment of didactic prose in Spanish literature. He was followed by his pupil and nephew the learned Ambrosio Morales, historiographer to Philip II., whose works on the history and antiquities of the Peninsula are greatly esteemed. Diego de Mendoza wrote his admirable history of the war of Granada (*Guerras de Granada*, Lisboa, 1627, 4to.), in which he imitated Sallust. Mariana, Solis, and Melo, who wrote the history of the wars of Catalonia (*Historia de los Movimientos y Separacion de Cataluña*, Lisboa, 1645, 4to.), are considered by the Spaniards as models of prose style. But the cultivation of the historical style received a severe check from the Inquisition. Even the Jesuit Mariana, who introduced into his history every tradition and idle legend which could gratify the pride of his countrymen, was arraigned before that dreaded tribunal, and accused of favouring wicked and rebellious principles; he was tried, and it was with the greatest difficulty that he escaped destruction.

In romantic prose the Spaniards were more successful than they had been in history. After imitating for some time the Italian novelists, the Spaniards invented a kind of novel, which, by way of distinguishing it from the pastoral romances in prose, and the numerous romances of chivalry, received the name of *Novelas del Gusto picaresco* (or novels in the roguish style). The 'Lazarillo de Tormes,' by Diego de Mendoza, which appeared for the first time at Antwerp in 1553, and was speedily translated into French, Italian, and English ('The Spaniardes Life,' by David Rouland Danglesey, Lond., 1586, 12mo.); 'Gusman de Alfarache,' by Mateo Aleman; 'El Escudero Marcos Obregon,' by Espinel; 'La Picara Justina, by Ubeda; 'La Garduña de Sevilla,' by Salas Barbadillo (Mad., 1642); 'El Bachiller Trapaza,' by Castillo Solorzano, are fair specimens of this style of writing, which is peculiar to Spain. Nor can we pass over the 'Novelas Exemplares' of the inimitable Cervantes, whose 'Don Quixote' is, independently of its other merits, the best written work in the Spanish language. About the end of the seventeenth century Gracian introduced Gongorism into Spanish prose, and the national taste was corrupted.

About the beginning of the eighteenth century the establishment of the house of Bourbon, and the introduction of French manners, prepared the way for a reform. At that time the literature of France began to exercise an influence over the whole of Europe, and it was natural that Spain, where Philip V. had instituted academies on the model of the French, should look up to France. Ignazio de Luzàn must be regarded as the founder of this new school, which soon found in Spain numerous advocates. With a view to the radical reform of the literary taste of his countrymen, Luzàn wrote his celebrated 'Arte Poetica' (Art of Poetry), which was first published at Saragossa in 1737; and the most eminent literary men of his time showed their readiness to conform to his precepts. Unaccustomed to the long neglected forms of Spanish poetry, the new party sought to improve it, as well as the drama, by translations of French works and imitations of the French style. Luyando undertook to introduce regular tragedy on the Spanish stage, and with this view wrote two tragedies, entitled 'Virginia' and 'Athaulfo.' Velasquez, Nassarre, and Mayans endeavoured to introduce the French style into other branches of literature. The change however which they tried to accomplish was neither radical nor complete; the mass of the nation still clung to the old forms of Spanish poetry; romances were still written and sung, resembling the productions of earlier ages, and Vances Candamo, Zamora, and Cañizares, continued to supply the stage with dramas in the style of Lope de Vega and Calderon, though they wanted the dramatic talents and invention of those two celebrated writers. Garcia de la Huerta, an academician and librarian to the king, attempted to revive the taste for antient national literature, by publishing a collection of the best Spanish dramas ('Theatro Escogido,' Mad., 1785), and writing a tragedy entitled 'La Raquel,' which was intended to combine the old Spanish forms with the dignity of the French tragic style, without however being subject to the rules of French dramatic art. Though this production—one of uncommon merit—was very well received even by the *Gal-*

*liciste*, or partisans of the French school, it did not produce the intended effect. In the second half of the last century, under the enlightened rule of Charles III., Spanish literature was in some manner revived by the labours of the two academies at Madrid, but chiefly through the encouragement given by the 'Academia de la Lengua,' which distributed prizes among the best poets. Some epic essays by Vargas Ponze and the elder Moratin show that the poetic genius of the Spaniards was not yet altogether extinct. Don Thomas Yriarte wrote a didactic poem entitled 'La Musica.' Juan Melendez Valdez wrote some Anacreontic odes not inferior in merit to those of Villegas. Cienfuegos, Salas, Quintana, Arriaza, Santos Pelegrin, Lista, Norofia, Gorostiza, Mora, Cadalso, the author of the 'Cartas Marrueras,' some of whom are still living, distinguished themselves in the various kinds of lyric or dramatic poetry. To Moratin the younger, whose translation of 'Hamlet' was a complete failure, the Spanish stage was greatly indebted, as he was the first who introduced the true comedy (Comedia de Costumbres) after Molière and the best French comic writers. He also wrote 'Origenes del Teatro Español,' a work of vast and rare erudition and research. [MORATIN.]

Among the present writers of Spain, Martinez de la Rosa is one of the most successful. As a comic writer he is considered equal to Moratin. He has moreover gained great reputation as the author of several tragedies, of which 'La Viuda de Padilla' and 'Edipo' are the most esteemed. An epic poem on the siege of Saragossa; a drama in prose, entitled 'La Conjuracion de Venecia' (the Conspiracy of Venice), an art of poetry in imitation of that of Boileau, a political work entitled 'El Espiritu del Siglo' (the spirit of the age), and several lyric poems, show his powers for all branches of literature. A new school of dramatic writers is now being formed in Spain, whose object seems to be to combine the French drama of the school of Victor Hugo and Dumas with the old national style. 'Los Amantes de Teruel,' by Hartzenbusch; 'El Trobador,' by Gutierrez; 'Felipe Segundo,' by Gil; 'Don Julian,' by Principe, are successful attempts in this line. Breton de los Herreros is considered the best writer of comedies. Zorrilla, Espronceda, Calderon, Quiroga, Garcia Tassara, are also popular poets. But among the numerous poets of Modern Spain there is scarcely one who can be said to cultivate prose with success, and with the exception of the satirical writings of Larra and Mesonero, of Clemencin's learned 'Commentary on Don Quixote,' of Toreno's 'History of the Peninsular War,' and a few essays printed in the Transactions of the Royal Academy of History, scarcely a work of ordinary merit has been published since the beginning of this century.

**SPA'LATRO, or SPA'LATO**, a town of Dalmatia, situated on a promontory in a bay of the Adriatic, formed by the islands of Brazza and Bua and the mainland. It is about midway between Zara and Ragusa, in 43° 30′ N. lat. and 16° 33′ E. long. Spalatro has a harbour, sufficiently extensive, but not very safe. The town is walled and fortified, but the principal defence on the land side consists of the fort of Clissa, which commands a defile in the mountains towards the Turkish borders. Spalatro stands principally on the site of the extensive palace which the emperor Diocletian built for himself near the antient town of Salona. [DIOCLETIAN.] Salona is now completely ruined, having been destroyed by the Slavonians in the seventh century, but many remains of antiquity are found by digging among the vineyards which occupy its former area, about three miles from Spalatro, and halfway between it and Clissa. The emperor Francis of Austria visited the ruins in 1815, and assigned a fund for carrying on the excavations and the formation of a museum at Spalatro.

The outer walls of the residence of Diocletian, which formed a square of nearly one mile, are in great measure still existing, as well as some of the gates. It is said that the name of Spalato, or Spalatum, is a corruption of Palatium. The cathedral of Spalato is made out of a temple built by Diocletian in the middle of the area of his residence; it contains some fine columns and is adorned with a handsome frieze. Other considerable remains of the Imperial buildings are seen within the precincts of Spalatro.

Spalatro is one of the most commercial towns of Dalmatia; the population is about 8000.

**SPALAX.** [MURIDÆ, vol. xv., p. 515, et seq.]

**SPALDING.** [LINCOLNSHIRE.]

**SPALDING, JOHANN JOACHIM**, was born on the 1st of November, 1714, at Triebsees, in Swedish Pomerania, where his father had a school, and was afterwards appointed preacher. Young Spalding studied at the universities of Rostock and Greifswalde; and although theology was the department to which he chiefly devoted himself, he paid great attention to other branches of learning. In 1745 he was appointed secretary to the Swedish embassy at Berlin; but he remained in this post only for two years, as he preferred the office of preacher at Lassahn, in Swedish Pomerania, which was offered to him. In 1757 he was appointed to the office of præpositus and first preacher at Barth; and it was about the same time that he began his numerous theological works, which are no less distinguished for clearness of style than of thought, and were received with general approbation. Owing to the reputation which he gained as an author and an orator, he was in 1764 appointed first pastor and provost to the Nicolaikirche at Berlin, where some time afterwards he was also elected a member of the chief consistory. In this new and extensive sphere of action, he showed so much mildness of character combined with dignity, that he won the affection and veneration of all who came in contact with him. Through his sermons however he exercised the greatest influence: they were full of deep feeling and profound thought; and in point of style they ranked, and still rank, among the best specimens of German pulpit oratory. There is little in them that will remind a reader that Spalding lived at a time when the German language was just entering upon its new career of development. In 1788, when the king Frederic William II., instigated by Wöllner and others of the mystic and pietistic party, issued an edict (Religions-edict) condemning all freedom of thought in religious matters, Spalding, who belonged to the opposite party, was in some degree obliged to resign his offices. This firm adherence to his principles raised Spalding still higher in public estimation: he spent the last years of his life in retirement. He died on the 2nd of March, 1804, at the age of ninety.

The works of Spalding are very numerous: they are partly on philosophical and ethical subjects, and partly on theology. The principal, which have all gone through several editions, are:—'Ueber die Bestimmung des Menschen,' Greifswalde, 1748; 'Gedanken über den Werth der Gefühle in dem Christenthum,' Berlin, 1761; 'Ueber die Nutzbarkeit des Predigtamtes,' Berlin, 1772; and 'Religion eine Angelegenheit des Menschen,' Berlin, 1797. His sermons were published in various collections at several times. The Life of Spalding was written by himself, and edited with notes by his son Georg Ludwig, at Halle, in 1804, 8vo.

**SPALDING, GEORG LUDWIG**, son of the former, was born in 1762, at Barth. He was educated at one of the gymnasia of Berlin, under Büsching. From 1779 to 1781 he studied philology and theology at the universities of Göttingen and Halle. He continued his studies in private after he had left the universities; and in order to improve his knowledge, he undertook a journey through Germany, Switzerland, France, England, and Holland. On his return to Berlin he was appointed tutor to the children of Prince Ferdinand of Prussia, and in 1787 he obtained a professorship at the gymnasium Zum grauen Kloster in Berlin. The Religions-edict, on account of which his father had given up his offices, induced the son, who held the same opinions, to abandon the study of theology altogether, and to devote himself entirely to philology. In 1792 he obtained from the university of Halle the degree of master of arts; and on this occasion he wrote a dissertation, 'Vindiciæ Philosophorum Megaricorum,' &c. A short time after, a Leipzig publisher requested him to revise the text of Quinctilian, and to prepare a new edition of this writer. Spalding agreed, thinking that the work could be accomplished in a short time. But when he had once entered upon his task, he found much more to do than he had anticipated; and that it was necessary, if the work was to be done well, to devote all his time to it. This was indeed henceforth the great object of his life. In order that he might not be disturbed in his work, he even refused the directorship of his gymnasium, which had become vacant, and was offered to him. In 1803 he was elected a member of the Berlin Academy. In 1805 he made a journey to Italy in order to collate a Florentine manuscript of Quinctilian. During the latter part of his life he held the high office of counsellor in the ministry for public instruction. He died in 1811, after he had spent the greater part of the last nineteen years of his life upon the critical study of Quinctilian; and yet the work was not finished at his death, for only the first three volumes had been published at Leipzig, in the years 1798, 1803, and 1808; the remaining two volumes were edited by Buttmann and Zumpt, 1816 and 1829.

Spalding has not written much, but what he has done is masterly. He was a man of very mild though lively temperament, and beloved and esteemed by men like Buttmann and Niebuhr.

See the memoir, or rather eulogium, on Spalding by Buttmann, in the *Transactions of the Berlin Academy of* 1814 *and* 1815.

**SPALLANZA'NI, LA'ZARO**, was born at Scandiano, a small town near Reggio, in the duchy of Modena, on January 12th, 1729. His early education was directed by his father, J. N. Spallanzani, who had considerable reputation as a lawyer; and when he had reached the age of fifteen, he was sent to the Jesuits' College at Reggio, where he remained during several years. He then repaired to the university of Bologna; and while there his studies were directed by his kinswoman the celebrated Laura Bassi. He hsd early imbibed a fondness for the natural sciences; but his family insisted on his embracing his father's profession, and he had completed the studies necessary for obtaining the degree of doctor of laws before he could obtain permission to abandon a pursuit which was extremely distasteful to him. Immediately on quitting the profession of the law he embraced the ecclesiastical habit, and applied himself to the study of languages so diligently, that in the year 1754 he was chosen to fill the vacant chair of logic, metaphysics, and Greek literature in the university of Reggio. He held the appointment for six years, during which time he published his first and only philological work, a critique upon a translation of Homer into Italian verse by A. M. Salviani, in which there are many important errors.

During his stay at Reggio Spallanzani's name had become known in many parts of Europe; and he received invitations from the universities of Coimbra, Parma, and Césène, all of which he declined from his desire not to be separated from his family. In 1761 however he accepted a professorship at Modena, which was only a few miles distant from his native town, and from this time dates the commencement of the high reputation which he acquired by his investigations into different branches of natural science. In 1766 he published a sketch of a work on the reproduction of animals; and though during his subsequent life he completed only a part of the researches which he had planned, yet his labours are most valuable. In opposition to the opinion of Buffon, which had been eagerly embraced by our countryman Needham, he maintained and proved that the Infusoria are really endowed with animal life, not mere organic molecules, as those authors had supposed. In 1768 he published the result of his investigations into the action of the heart and the circulation of the blood, a subject which had engaged his attention for many years. A translation of Bonnet's 'Contemplations de la Nature,' which appeared in 1769, was the last work published during his stay at Modena; and in the ensuing year he was chosen professor of natural history at Pavia, which appointment he continued to hold till his death.

His treatise on the circulation of the blood had led to his being invited to Pavia; and on entering on his new duties, to which those of director of the museum were soon added, he entirely gave up literary pursuits. The labours in which he now engaged are too extensive, and of a character too purely scientific, to admit of an analysis here. They were principally directed to elucidating the subject of the circulation of the blood, and the functions of respiration, digestion, and generation, on all of which he published treatises after his removal to Pavia. The number and ingenuity of his experiments are not more striking than his close and logical reasoning—excellencies which procured for him one of the greatest honours that a scientific man of that day could receive, in the dedication to him, by the illustrious Haller, of the second volume of his physiology. Besides his larger works, Spallanzani contributed numerous papers on natural history to the Transactions of various learned societies. Nor did he rest content with that knowledge only which could be acquired by books, or which the museum of Pavia or the surrounding country might afford, but he undertook journeys to different parts of Europe. In 1779 he travelled through the greater part of Switzerland. In 1781 he visited the coasts of the Mediterranean from Leghorn to Marseille, and remained in the latter city for six weeks. In the year 1782 and 1783 he visited Istria, traversed the shores of the Adriatic and Ægean seas, and explored the Euganean Mountains. All these journeys yielded some fruit to the scientific traveller; but in 1785 he undertook a longer voyage than any he had before made, and visited Constantinople. In his route thither he visited Corfu and Cerigo; and to him, and his companion Zuliani, the Venetian ambassador, we owe a description of the geology of these islands. Various objects of interest engaged his attention during a stay of eleven months at Constantinople; after which he quitted that city, and returned through Germany to his own country, from which he had been absent one and twenty months.

During his absence, the envy of some of his colleagues at Pavia had been at work, defaming his character and accusing him of having stolen various specimens from the museum. Spallanzani heard of this while at Vienna, from which place he sent an answer to the charges against him. His defence overwhelmed his enemies with shame, and the return of Spallanzani to Pavia was a sort of triumphal entry; the students met their professor outside the walls, and conducted him with acclamations to his own house.

Three years afterwards he visited Sicily and Naples, and various parts of the Apennines, in order to obtain geological specimens, in which the museum at Pavia was very deficient. On his return he devoted himself to lecturing, to arranging his numerous notes, and to cultivating his style, which he endeavoured to form on that of Buffon. The French republic offered him the professorship of natural history in the Jardin des Plantes at Paris, but he declined to accept it, and passed his latter years at Pavia, in the enjoyment of every honour which a man of science could desire. The comfort of his declining age was interrupted by severe bodily suffering, and after having experienced frequent attacks of apoplexy, he died from the effects of a fresh seizure, on February 12, 1799, aged 70 years.

A catalogue of Spallanzani's numerous works, many of which have been translated into English, is given at the end of his Life, in vol. vii. of the *Biographie Médicale;* and a lengthened analysis of his labours will be found in the *Eloge*, by M. Alibert, which is contained in vol. iii. of the *Mémoires de la Société Médicale d'Emulation.*

**SPANDAU, or SPANDOW**, a very antient town and fortress in the kingdom of Prussia, in the province of Brandenburg, is situated in 52° 30′ N. lat. and 13° 10 E. long., at the conflux of the rivers Havel and Spree. It was formerly the residence of the electors of Brandenburg, whose palace is now converted into a house of correction for 500 criminals. It has three suburbs, in one of which, called the Plan, there is a government manufactory of arms, which are sent to Potsdam to be finished. There are four principal and five small gates. The citadel, commenced by the elector Joachim II., is built on an island in the Havel; it is a regular quadrangle, surrounded on the north and west by a double fosse, which can be laid under water; and on the other two sides by the Havel. The walls, casemates, and outworks are of stone. The public edifices are—three Protestant churches, of which that of St. Nicholas contains several curiosities; and one Roman Catholic church, an hospital, the above-mentioned house of correction, and the manufactory of arms. There is also an asylum for destitute orphans and the children of criminals. The inhabitants, about 7000 in number, manufacture woollens, linens, silks, hats, and earthenware, and have considerable breweries, distilleries, and tanneries. They have also a good trade on the rivers, the fisheries in which are likewise a source of profit.

Spandau was taken, in 1631, by the Swedes, but restored in 1634. In 1806, soon after the fatal battle of Jena, it surrendered on the first summons to the French, by which 1500 prisoners and 60 pieces of cannon fell into their hands. On the retreat of the French from Berlin, on the 4th of March, 1813, the suburbs were burnt, and in the bombardment on the 20th of April, seventy houses were burned, and thirty others much damaged. On the 26th of April, 1813, the French surrendered to the Prussian general Thumen. (Müller, *Wörterbuch*, &c.; Stein; Hassel; *Conversations Lexicon.*)

**SPA'NHEIM, EZECHIEL**, the son of Frederic Spanheim, a theologian of some note, was born at Geneva, on the 7th of December, 1629. Respecting his early education nothing is known; but from the knowledge which he displayed when yet a young man, we must infer that it was well regulated, and supported by considerable talents on the part of the youth. When he was thirteen years old his father was appointed professor of theology in the university of Leyden, whither he removed with his whole family. Ezechiel here devoted himself first to the study of antiquity, and afterwards to that of theology, and attracted the attention of D. Heinsius and Salmasius, who guided and encouraged him in his studies. He also studied the Oriental languages, especially Hebrew and Arabic; and the first time that he appeared before the public as an author was in a controversy respecting the original characters of the Hebrew alphabet, which he denied to have been preserved by the Samaritans, as L. Capell had maintained. The work he wrote on this occasion bears the title of 'Theses contra L. Capellum pro Antiquitate Literarum Hebraicarum,' Leyden, 1645, 4to.

In 1649 his father died, after having shortly before written a work on Universal Grace, which was now severely attacked by Amyrauld. Spanheim fulfilled his filial duties towards his father by replying to this unseemly assault; but shortly after this event he returned to Geneva, where the chair of professor of eloquence was offered to him, which he accepted in 1651. This title of professor was however merely an honorary distinction conferred upon him by his native city, and he is not known ever to have undertaken the functions of a professor in the university of Geneva. He only delivered two occasional discourses in Latin, which however he published in French, under the title, 'Discours sur la Crèche et sur la Croix de Not. Sauv. Jesus Christ,' Geneva, 1655, 8vo., a new and corrected edition of which was published by the author at Berlin in 1695. In the meanwhile however the fame of his great acquirements was spreading and had reached the ear of the elector-palatine Louis Charles, who appointed him tutor to his son Charles. He discharged his duties to the perfect satisfaction of the elector, and devoted all his leisure hours to the study of the antients, and of the German law, on which he published a dissertation during this time. He also translated from the Greek into French the Cæsars of Julian, illustrated by coins and other antient documents. (Heidelberg, 1660, 8vo.; reprinted at Paris in 1683, and at Amsterdam in 1728.) As a translation, this work is of little value. The great prudence which Spanheim had shown during the time he stayed at the court of Heidelberg, induced the elector to send him to Italy to renew his connection with the princes and states of that country. In 1659 Spanheim thus set out for Italy, where he visited Florence, Mantua, Parma, Modena, and Rome, and was everywhere received with great distinction. The chief study which he pursued in his leisure hours was that of numismatics; and in 1664 he published his first work on this subject at Rome. For the purpose of prosecuting his antiquarian studies still further, he also visited Naples, Sicily, and Malta. In 1665 he returned to Heidelberg, and was henceforth employed by the elector in the most important political and diplomatical affairs. He was successively sent by the elector to the conferences of Oppenheim and Spire, and to the congress of Breda. Afterwards he was appointed minister resident of the elector in Holland, and then in England, at the court of Charles II. During his stay in England the ambassador of the elector of Brandenburg was recalled, and Spanheim was requested and undertook, with the consent of the prince-palatine, to manage also the affairs of the elector of Brandenburg. He discharged the duties of his twofold office so well, that the elector of Brandenburg desired him to enter his service exclusively. This Spanheim did, with the consent of his former master, though not without his regret. Shortly after, in 1680, the elector of Brandenburg sent him as his extraordinary ambassador to Paris, at the court of Louis XIV., which post he held for nearly nine years. In 1689 he went to Berlin, where for some time he gave himself entirely up to his favourite studies, which he had never abandoned during his public life. At Berlin he wrote his celebrated Letters to Beger and Morel, on some numismatical subjects, and some of the Commentaries on antient writers, which we shall mention hereafter.

After the peace of Ryswick, in 1697, Spanheim returned as ambassador to Paris, where he remained till the year 1701.

After the elector of Brandenburg had assumed the title of king, and was recognised as such by the other powers, Spanheim was raised to the rank of a baron, and was sent, in 1702, as ambassador of the new king of Prussia, Frederic I., to England. Here he remained until his death, on the 7th of November, 1710.

The principal works of Spanheim, besides those already mentioned, are—1, 'Dissertationes de Præstantia et Usu Numismatum Antiquorum,' which was first published in one volume, 4to., at Rome, in 1664, and reprinted at Paris in 1671. The last and best edition is that published at London, in 1706, fol., to which Verburg, in 1717, added a second volume from the papers of Spanheim. The whole work consists of thirteen dissertations, addressed to his friend Falconieri. It contains a store of information, though very inconveniently arranged.

2. 'De Nummo Smyrnaeorum inscripto Σμυρναίων πρυτάνεις, scilicet de Vesta et Prytanibus Græcorum Diatriba,' Paris, 1672. This work is reprinted in Grævius's 'Thesaurus,' v., p. 660.

3. 'Lettre sur l'Histoire Critique du Vieux Testament,' par Richard Simon, Paris, 1678.

4. 'Orbis Romanus, seu ad Constitutionem Imperatoris Antonini, de qua Ulpianus leg. xvii. Dig. de Statu Hominum Exercitationes Duæ,' the best edition of which is that published in London, 1704. This work is still of great value; it is also contained in the eleventh volume of Grævius's 'Thesaurus.'

Besides these works Spanheim wrote a number of Commentaries upon antient authors, some of which may still be consulted with great advantage. Among them we shall mention his Commentaries on Callimachus, in the edition of Grævius, and reprinted in that of Ernesti, Lugd. Bat., 1761; on Strabo, Amsterdam, 1707; on the first three comedies of Aristophanes, in Küster's edition of 1707-9; on 'Ael. Aristides,' in Jebb's edition, Oxford, 1722; on Josephus, Leyden, 1726; on Thucydides, in Duker's edition, Amsterd., 1731, and others.

Compare the 'Acta Eruditor.' of the year 1711; and the Memoir of Spanheim, by Verburg, prefixed to the second volume of his 'Dissert. de Præst. et Usu Num. Ant.,' p. viii.-xix.

SPANIEL, a variety of Dog, in which article a figure of the skull is given. [Vol. ix., p. 61.]

It is not at all improbable that dogs of this race were known to the Romans, as is observed by Lieut.-Col. Hamilton Smith, who remarks that the Spaniel, *Canis extrarius ?*, is clearly figured on some of the later monuments, and seems to be identical with the *Canis Tuscus* praised by Nemesianus; and indeed the lines in the *Cynegeticon*, beginning—

'Quin et Thuscorum non est extrema voluptas
Sæpe canum, forma est illis licet obsita villo.'

with the allusion to their hunting qualities—

'Moresque simul naresque sagaces'—

strongly favour that opinion. It may also be noted that Nemesianus in another part of the poem speaks of dogs—

'Quorum proles de sanguine manat Ibero;'

or, as the Aldine edition (8vo., Venet., 1534) has it, 'hibero.'

The Spaniel appears to have been the companion of the Falconer at a very early period. In *The Booke of Falconrie or Hawking* (1611), 'Heretofore published by George Turbervile, Gentleman,' we find among 'The Contents of this Booke,' 'A little treatise translated out of the Italian tongue, touching the diseases happening to Spanyels, with their Cures;' and on turning to the page we come to 'A Treatise and discourse of the cure of Spaniels when they be any way over-heat; devised and written by M. Francesco Sforzino Vicentino, the Italian Gentleman-Falconer,' and beneath the title a cut, where stands the falconer, hawk on fist, hat on head, staff in hand, and pouch on side, in trunk-hose, and with bare-headed attendants, accompanied by two couple of Spaniels.

'How necessary a thing,' begins the treatise, 'a Spaniell is to Falconrie, and for those that use that pastime, keeping hawks for their pleasure and recreation, I deem no man doubteth as wel to spring and retrive a fowle being flowen to the marke, as also divers other ways to assist and ayde Falcons and Goshawkes. Wherefore, seeing that hitherto in my collection I have spoken altogether of Hawkes both for the river and field, and in my conceite have left few needfull poynts for a good Falconer untoucht or treated of: now I shall not doe amisse, nor wander over wide from my purpose, if I say somewhat of Spaniels, without the which a Falconer (specially using to flee the field) cannot be without mayme of his pastime, and impayre of his gallant glee. And againe for that they are subject to many diseases and plagues (as wee commonly tearme them), for dogges, and longer than they are without infection wee may expect from them no pleasure, assistance, or recreation. I will onely in this treatise describe you their harmes with cures due to the same. Among all which I place the Mangie first, as the capitall enemy to the quiet and beauty of a brave Spaniell, wherewith the poor dogges are oftentimes greatly plagued, both to the infection of their fellowes, and the no slender griefe of theyr masters.'—Whereupon follow three prescriptions for 'The cure of the Mangie,' each more potent than its antecedent, as well as 'A way to cure the Mangie without any unguent—if a Spaniell bee not very much infected.' Then come cures for other ills that spaniels are heirs to, and the whole is wound up with the following conclusion:—'Thus much I thought good to write of Spanels, and their diseases and cures, for that they are superintendants, and necessarie servants, both for the Hawke and the Falconer, without whome the sport would bee but colde; and the toyle far more than it is to the man. Wherefore it shall not be amisse for a good Falconer always to breede and keepe of the best kinde of Spanels that he may come by, and so to respect them, as they heate not at any time; or if they doe by misfortune or neglygence of your lackey boye, then to regard their cure, which may be done in manner as I have heere set downe; and withall to use due correction to the boy. For a good Spanell is a great jewel: and a good Spanell maketh a good Hawke, and a curst maister a careful footeman. Farewell.'

In the sporting prints engraved by Hollar after Barlow, a whole team of spaniels are introduced giving tongue in 'Partridge Hawking,' with the following lines at the bottom of the plate:—

> 'The fearfull Partridge being sprung by quest
> Of Spaniells from their pleasing foode and rest,
> The keene and bloody Hawke pursues, the Knight
> Hath then his sport, and feasts on them at night.'

And again in 'Feasant Hawking,' with the following quatrain:—

> 'The Feasant Cocke the woods doth most frequent,
> Where Spaniells spring and pearche him by the sent.
> And when in flight, the Hawk with quickened speed
> With 's beake and savage talons makes him bleed.'

Spaniels, apparently of a stouter breed, are also introduced in 'Hern Hawking' by the same hands, a circumstance worthy of remark, inasmuch as in the cut in *The Booke of Falconrie*, with the superscription 'How to flee a Hearon,' the mounted gentleman-falconer, who is covered, is attended by bare-headed domestics, and accompanied by a couple of greyhounds.

The author of the *Sportsman's Cabinet* states that the race of dogs passing under the denomination of spaniels are of two kinds, one of which is considerably larger than the other, and known by the appellation of the *Springing Spaniel*, as applicable to every kind of game in any country, whilst the smaller is called the *Cocker* or *Cocking Spaniel*, as being more adapted to covert and woodcock shooting. This appears to be a correct definition, and most authors notice the two kinds, but some confusion has been introduced by the application of a name equivalent to that of *Springing Spaniel* to the *Cocking Spaniel*. Thus Bewick, who gives cuts both of the *Large Water Spaniel* and the *Small Water Spaniel* (both apparently modifications of the old *Old Springing Spaniel*), as well as one of the *Large Rough Water-dog* (*Canis aviarius aquaticus*, 'a Water-spagnelle,' of Gesner, probably the *Canis sagax ad aquas* of Aldrovandus, and *Grand Barbet* of Buffon, *Water-Dog* of Pennant), represents the small breed under the name of *The Springer or Cocker*. Bell also calls this last the *Springer*. Lieut.-Col. Hamilton Smith enumerates 'The Spaniel (*Canis extrarius?*), commonly called Water Spaniel;' 'The Springer;' 'King Charles's Spaniel;' and the 'Cocker,' as well as the 'Water-dog, *Canis acquaticus*.'

Dr. Caius, in his systematic table of British Dogs, makes the *Fowlers* consist of the Spaniel (*Hispaniolus*), Setter (*Index*), and Water Spaniel or Fynder (*Aquaticus*); whilst under the title Lap-dogs, the Spaniel gentle or comforter (*Melitæus* or *Fotor*—the Maltese Lap-dog), stands alone.

Aldrovandi has two cuts of Spaniels: one is described as 'Canis Hispanicus auribus demissis, pectore, ventre, pedibus albis maculis nigris distinctis, reliquo corpore nigro;' the other, which is much coarser and altogether larger, is merely noticed as 'Canis Hispanicus alter auribus demissis.' The first, making allowances for the rudeness of the drawing and engraving, might pass for a not ill-bred Spaniel of the present day.

Pennant, in following out the tract of Caius, says, 'The third division of the more generous dogs comprehends those which were used in fowling; first, the *Hispaniolus*, or Spaniel: from the name it may be supposed that we were indebted to Spain for this breed. There were two varieties of this kind, the first used in hawking, to spring the game, which are the same with our Starters. The other variety was used only for the net, and was called *Index*, or the Setter; a kind well known at present. [SETTER.] This kingdom has long been remarkable for producing dogs of this sort, particular care having been taken to preserve the breed in the utmost purity. They are still distinguished by the name of *English* Spaniels; so that, notwithstanding the derivation of the name, it is probable that they are natives of Great Britain. We may strengthen our suspicion by saying that the first who broke a dog to the net was an English nobleman of a most distinguished character, the great Robert Dudley, duke of Northumberland.'

The probability appears to be that all the varieties of the Spaniel, the small Water-Spaniel, the Cocking Spaniel, King Charles's Spaniel, and the Blenheim Spaniel, if that breed be not the true spaniel of King Charles I., are all the result of careful breeding from the large Water-Spaniel (not the Rough Water-Dog which some call a water-spaniel), which seems to have been the old Springing Spaniel.

The author of the *Sportsman's Cabinet* describes the true English-bred springing spaniel as differing but little in figure from the setter, except in size; varying only in a small degree, if any, from a red, yellow, or liver-colour, and white, which seems to be the invariable external standard of this breed. They are, he observes, nearly two-fifths less in height and strength than the setter, delicately formed, ears long, soft, and pliable, coat waving and silky, eyes and nose red or black, the tail somewhat bushy and pendulous, and always in motion when actively employed.

This appears to have been the setting-dog used by our forefathers for taking partridges and other birds with a net. We find in *An addition to the first book of the Ornithology of Francis Willughby, Esq., being an Epitome of the Art of Fowling collected out of Markham, Olina, and others* (1678), instructions 'how to take partridges and other birds with a setting-dog,' commencing thus:—'A setting-dog should be a lusty land-spaniel that will range well, and yet at such absolute command, that when he is in full career one hem of his master shall make him stand still, gaze about him, and look in his master's face, as it were expecting directions from him, whether to proceed, stand still, or retire; but the main thing he is to be traught is, when he sees and is near his prey, of a sudden to stand still, or fall down flat on his belly, without making any noise or motion till his master come to him'—'when you see him make a sudden stop or stand still, be sure he hath set the fowl; therefore presently make in to him and bid him go nearer; if he refuses, but either lies still or stands shaking of his tail, and withal now and then looks back upon you, he is near enough.' The dropping of our present breed of setters, which, as has been observed in the article SETTER, probably owe their origin to the old English spaniel and the pointer, which last does not seem to have been known to our ancestors, confirms the spaniel parentage; and this may be traced in another habit observable in many of the setters now in use, especially those whose markings and appearance approach most closely to the spaniel, namely, the slow lateral motion of the stiffened stern gently fanning horizontally when the dog is pointing, till it becomes quite steady and motionless, and in which we may perceive the chastened action of the tail so vigorously moved from side to side when the spaniel hits upon the foot of game. Setters so marked frequently exhibit an inclination to drop or set instead of pointing, especially when close upon their game.

We have above given the *Veteran Sportsman's* description of the springing spaniel. 'From this description,' says he, 'the cocker differs, having a shorter, more compact form, a rounder head, shorter nose, ears long (and the longer the more admired), the limbs short and strong; the coat more inclined to curl than the springer's, is longer, particularly on the tail, which is generally truncated; colour, liver and white, red, red and white, black and white, all liver colour, and not unfrequently black, with tanned legs and muzzle. From the great similitude between some of these cockers and the small water-dog, both in figure and disposition, there is little doubt but they may have been originally produced by a cross between the springing spaniel and the latter. Some of the largest and strongest of this description are very common in most parts of Sussex, and are called Sussex spaniels. The smallest spaniels passing under the denomination of cockers is that peculiar breed in the possession and preservation of the Duke of Marlborough and his friends; these are invariably red and white, with very long ears, short noses, and black eyes; they are excellent and indefatigable, being in great estimation with those sportsmen who can become possessed of the breed. It is upon record how much that unfortunate monarch Charles I. was attached to spaniels, of which he had always favourites about him; and although they were supposed to be of the small, black, curly sort which bear his name, they were much more likely to have been of the distinct breed of cockers, if judgment may be consistently formed from the pictures of Vandyke, in which they are introduced.'

It may be that the black and black and tan variety found favour in the eyes of Charles II., who generally had some choice spaniels about him.

It is no small proof of the merit of the spaniel that it has kept its ground amid all the revolutions of sporting. 'A good spaniel is *still* a great jewel.' The companion of the hawk and net now attends the greyhounds; and is indispensable in woodcock shooting; apart from its excellent services in cover, there is no more lively field-shooting than that with a team of thoroughly well bred spaniels broken never to give tongue, to range well, but not at a greater distance than fifteen or twenty yards from the gun, and never to chace either feather or fur. The sportsman's attention is always kept on the alert, and he who has accustomed himself to this style of shooting will generally be found to be a quick and sure shot.

Spaniels have a great share of intelligence and affection; these qualities, being combined with much beauty, make them highly prized as companions, and we have, in our day, the

'Spaniel, bred with all the care
That waits upon a fav'rite heir.'

Seventy pounds have been refused for one of these dogs.

Our space will not permit us to indulge in anecdotes of the sagacity and attachment of the spaniel; but we may mention the feat of Colonel Hardy's favourite spaniel-bitch. The Colonel, who had been sent for express to Bath, took the spaniel with him in his chaise, which he never quitted till his arrival there. After remaining at Bath four days, he accidentally left her behind, and returned to his residence at Springfield in Essex with equal expedition. In three days after, his faithful spaniel arrived. The distance between that place and Bath is 140 miles, and it is stated that she had to explore her way through London, to which she had never been but in her journey to Bath, when she was in a close carriage. It is also on record that in 1792 a gentleman who lived in Vere Street, Clare Market, went with his family to Drury Lane theatre, at about half-past five in the evening, leaving a small spaniel of King Charles's breed locked up in the dining-room, to prevent the chance of the loss of the dog in his absence. At eight o'clock his son opened the door: the dog, unperceived, watched his opportunity, passed the street-door, and immediately made his way to the playhouse, where he found out his master, who was seated nearly in the centre of an unusually thronged pit. Indeed it seems that they can have neither peace nor rest if they are not with their master or mistress. No one can have kept one of these affectionate creatures without observing this, and we could fill pages with the stratagems of these dogs to prevent their being separated from their kind owners. If excluded from a room, they will lie at the door, so that no one can go out without their knowledge; and when in the room with their mistress, some will not go to sleep when wearied, except upon a portion of her dress, so that she cannot rise from her chair without giving them notice. Nor does this strong attachment cease with life. We will not weary our readers with the well-known melancholy stories: that of the unfortunate sufferer during the French Revolution, a few days before the overthrow of Robespierre, and his faithful spaniel that clung to him during his mock trial, was with him at the guillotine, and died exhausted on his grave, is familiar to most; but we must mention a recent and well-authenticated instance of enduring attachment:—'While revising the letter-press of this article (14th April, 1840),' says Lieut.-Col. Hamilton Smith, in his elaborate and interesting work on *Dogs*,* under the title *Spaniel*, 'there was a dog allied to the spaniel race lying on the grave of his mistress, already the third day, in the churchyard of Charles Church, Plymouth, refusing all food; it is just now forcibly removed.'

The docility of the spaniel is equal to its intelligence and feeling of attachment. A spaniel has been taught to wait at table, take away plates and fetch others, carry wine in a glass without spilling, and to hold the stirrup in his mouth for his master while he was mounting his horse. The spaniel given by Mr. Daniel, author of *Rural Sports*, to the Hon. Mr. Greville, would, we are told, in addition to the common tricks which dogs trained to fetch and carry exhibit, bring bottles of wine from the corner of the room to the table by the neck, with such care as never to break one, and was the *Boots* of the mess-room.

But of all the stories that ever have been told of canine scholarship, the story of *Leibnitz's Dog*, as the four-footed orator was called, though he did not belong to that celebrated man, is the most marvellous. This dog, which was rather above the middle size, had the appearance of a large cross-bred spaniel. He belonged to a Saxon peasant, whose son fancied that he perceived in the dog's voice an indistinct resemblance to certain words, and so set to work, when the dog was about three years old, to teach him to speak. It is gravely asserted that the dog was able to articulate thirty words, and that he would call for tea, coffee, chocolate, &c. Leibnitz attested that he heard this extraordinary dog speak. In the fifth volume of Leibnitz's Works (*Gothofredi Guillelmi Leibnitii Opera Omnia studio Ludovici Dutens*, 4to., *Genevæ*, 1768) the following passage occurs in one of Leibnitz's letters:—'VII. Voici une nouvelle d'une autre espèce. Je viens de recevoir une lettre d'un Prince régnant de l'Empire, où S. A. me marque avoir vu deux fois ce printems, à la dernière foire de Leipzig, et examiné avec soin, un chien qui parle. Ce chien a prononcé distinctement plus de trente mots, répondant même assez à propos à son maître; il a aussi prononcé tout l'alphabet, excepté les lettres m, n, x.' (Lettre v., p. 72.)

This note is appended to the marvellous communication: 'Voyez le détail de cette singularité dans l'extrait d'une lettre de Mr. Leibniz à l'Abbé de St. Pierre, rapportée au tom. ii. de ce Recueil.'

When Leibnitz wrote the above, he does not appear to have seen the dog; but, on turning to the 'détail' referred to in the note, it is clear that he afterwards did see it. Here is the passage:—

'Exposé d'une lettre de Mr. Leibniz à l'Abbé de St. Pierre, sur un chien qui parle.'†

'Sans un garant tel que M. Leibniz, témoin oculaire, nous n'aurions la hardiesse de rapporter qu'auprès de Zeitz dans la Misnie il y a un chien qui parle. C'est un chien de paysan, d'une figure des plus communes, et de grandeur médiocre. Un jeune enfant lui entendit pousser quelques sons qu'il crut ressembler à des mots Allemands, et sur cela se mit en tête de lui apprendre à parler. Le maître, qui n'avoit rien de mieux à faire, n'y épargna pas le tems, ni ses peines; et heureusement le disciple avoit des dispositions qu'il eût été difficile de trouver dans un autre. Enfin au bout de quelques années le chien sçut prononcer environ une trentaine de mots; de ce nombre sont *thé*, *caffé*, *chocolat*, *assemblée*, mots François qui ont passé dans l'Allemand tels qu'ils sont. Il est à remarquer que le chien avoit bien trois ans quand il fut mis à l'école. Il ne parle que par l'écho, c'est à dire, après que son maître a prononcé un mot, et il semble qu'il ne repète que par force, et malgré lui, quoiqu'on le ne maltraite point. Encore une fois, Mr. Leibniz l'a vû et entendu."

That there was some foundation for this story cannot be doubted. No person familiar with domesticated dogs can have omitted to notice the variety of vocal intonations and modulations with which they endeavour to express their feelings. A careful observation of these, and an education founded upon such observation, *may* teach the dog to produce a given sound on a given occasion; and a lively imagination may perceive something like words in the sounds so produced, as it did when the visitors, aided by the proprietor, detected 'pretty queen,' &c. in the whistlings of the talking canary bird: but 'articulation' is a strong and

* 'Naturalist's Library—Mammalia,' vols. ix. and x.

† 'Cet exposé de la lettre de Mr. de Leibniz se trouve dans l'Histoire de l'Académie des Sciences, année 1706. Ce sont les auteurs de l'Histoire de l'Académie qui parlent."

an abused term when applied to such cases; though it is justifiable in the case of those anthropoglotts the parrots, and even in that of starlings, or ravens, or magpies, which *do* talk. Sir John Sebright performed wonders with dogs in the way of tuition, but we never heard that he made them speak.

SPANISH TOWN. [JAMAICA.]

SPAR, a word from the German *Spath*, employed, combined with specific terms, in mineralogy, to include a great number of crystallized earthy and some metallic substances, but chiefly the former. Thus callareous spar is crystallized carbonate of lime; fluor-spar, fluoride of calcium; heavy spar, sulphate of barytes, &c. By miners the term is frequently used alone to express any bright crystalline substance; but in mineralogy, strictly speaking, it is never so employed.

SPARGA'NIUM (from σπάργανον, a 'bandage'), a genus of plants which with the genus Typha constitute the natural order Typhaceæ. The species are monœcious. The flowers are arranged in dense spherical heads. Both the barren and fertile flowers are composed of a single perianth with three leaves. The stamens are longer than the calyx, and the fruit consists of a dry drupe with one seed. The species are found commonly in ditches and marshes of the northern hemisphere. Three of these are common in Great Britain. The *Sparganium ramosum* (branched bur-reed) is known by its branched flower-stalk, triangular leaves, and linear stigma. This species was the only one of the genus found by Dr. Sibthorp in Greece, and appears to be the σπαργάνιον of Dioscorides. It is an inhabitant of ditches, lakes, and stagnant waters, forming a handsome addition to their vegetation. The *S. simplex* (unbranched bur-reed) is known by its simple stem, and the *S. natans* (floating bur-reed) by its long, linear, floating leaves. They are both found in the same situations as the first.

SPA'RIDÆ, or SPAROI'DES, a family of fishes belonging to the section Acanthopterygii, which are distinguished by the following characters combined, viz. the possession of a single dorsal fin, the anterior half of which is supported by spinous rays, and which is not divided, nor is it protected by scales; the operculum is spinous, the palate destitute of teeth, the branchiostegous membrane has five or six rays, and the pyloric appendages are few in number. The body is usually of an ovate form, and covered with large scales. The mouth is not protractile.

The species of this family feed chiefly upon the animals of small shells, crustacea, &c., for crushing which their strong teeth are admirably adapted.

Guided by the structure of the teeth, Cuvier divides the family into four tribes. In the first the jaws are provided with teeth, which are rounded like paving-stones; in the second the teeth are conical and pointed; in the third the teeth minute and thickly crowded; and the fourth tribe have a series of trenchant teeth.

To the first of these tribes belongs the genus *Sargus*, where the incisors, or foremost teeth, are compressed, and have sharp cutting edges; the molars are rounded, and form several rows.

Of this genus numerous species are described in the 'Histoire des Poissons' of MM. Cuvier and Valenciennes; several are from the Mediterranean, and the others are chiefly from the coast of America, north and south.

The next genus, *Charanx*, is founded upon a single species, an inhabitant of the Mediterranean, which has sharp cutting incisors, like the species of *Sargus*, but the molars are extremely minute, and form only a single row.

The third genus of the first tribe is *Chrysophrys*, which is distinguished from *Sargus* by the incisors being conical, and usually four or six in number in front of each jaw; the molars, for the most part, are rounded, and form at least three rows on each side of each jaw, a character which serves to distinguish the present genus from *Pagrus*.

This genus is numerous in species, and these are almost entirely confined to the seas of the warmer and tropical parts of the Old World.

The *Chrysophrys aurata*, a species which is very common in the Mediterranean, is also occasionally met with on our coast, as well as that of France, and the same remark applies to the *Pagrus vulgaris*, which is an example of the next genus, *Pagrus*, which differs from *Chrysophrys* in having only two rows of molar teeth on each side of the jaw. Several species of this genus are found in the Mediterranean, others inhabit the Indian seas, some again are found on the coasts of New Holland and New Zealand and the *Pagrus argyrops* is found on the North American coast.

The last genus of the first division is *Pagellus*, the species of which are easily distinguished by the foremost teeth in each jaw being all of them small, curved, pointed, and dense.

Numerous examples of this genus occur in the Mediterranean; and two species, the *Pagellus erythrinus* and *P. centrodontus*, have been found on our own coast. The former appears to be of very rare occurrence on the British coast; the latter, known by the name of the Sea Bream and Gilt-head, is by no means an uncommon fish on the southern shore of England, and is not unfrequently found on the coast of Ireland.

To the second section belong the genera *Lethirinus*, *Dentex*, and *Pentapus*. The first of these genera is at once distinguished from all other genera of the first section by there being no scales on the cheeks; the mouth is but little cleft; and the teeth are, some of them, strong, pointed, and curved; others very small and dense, and the molars form only a single row.

In the genus *Dentex* the teeth are conical, and generally confined to a single row; some of the foremost of them are elongated, curved, and sharply pointed.

The species of this genus, which are very numerous, appear to be almost entirely confined to the temperate and tropical portions of the Old World. But one species is found on the British coast, the Four-toothed Sparus of Mr. Yarrell's work, *Dentex vulgaris*, Cuv. and Val.

The genus *Pentapus* is founded upon certain Sparoïd fishes found in the Indian Seas and off the coast of Australia, which approach the genus *Dentex*, but have two strong canine teeth in front of each jaw, between which sometimes are two or four much smaller teeth; the other teeth are minute, prickly, close together, and arranged in a single row in each jaw.

Close to the ventral fins on each side is a spine, and a third spine is situated between these fins. Similar spines are found in other species, but they are usually less developed than in the present genus. The name of *Pentapus* is applied to these fishes from these spines giving to them the appearance of having five ventrals.

The third section, in which all the teeth are minute and dense as the pile on velvet, contains but one genus, *Cantherus*. Of this genus an example is found on the British coast, and is known by the name of the Black Bream (*Cantharus griseus*, Cuv. and Val.). This fish, though more rare than the Sea Bream, is not uncommon on various parts of our coast.

In the fourth section Cuvier arranges the genera *Box*, *Oblata*, *Scatharus*, and *Crenidens*. All these genera have the foremost range of teeth compressed, placed close together, and with a cutting edge which is more or less notched. In the genus *Box* there is but one series of teeth in each jaw. The *Box vulgaris* (*Sparus boops*, Linn.) is a common species in the Mediterranean, and lives upon vegetable substances.

The genus *Oblata* is founded upon a fish from the Mediterranean, the *Sparus melanurus*, Linn., in which, in addition to the compressed front teeth, which are emarginated at the apex, there is an inner series of minute teeth.

The genus *Scatharus* is also founded upon a Mediterranean fish; here there is but one series of compressed teeth, and these are pointed or lancet-shaped.

Lastly, the genus *Crenidens* is distinguishable by the foremost row of compressed teeth being dilated at the apex and notched; behind these are numerous small globular teeth. There is but one species, the *Crenidens Forskalii*, Cuv. and Val., an inhabitant of the Red Sea.

SPARRMANN, ANDREW, the pupil and friend of the elder Linnæus, and the companion of the Forsters in their voyage round the world, was born in the province of Upland in Sweden, about the year 1747. He appears to have entertained from childhood a great fondness for the study of natural history, which was increased by a voyage which he made to China in the year 1765, in a vessel commanded by Captain Ekeberg, one of his kinsmen.

On his return to Sweden he repaired to the university of Upsal, and there applied himself to the study of medicine, but more especially of botany, in which science he had the advantage of the instruction of the celebrated Linnæus. Under the auspices of that distinguished man, he now published his 'Amœnitates Academicæ,' which gave ample proof that his voyage to China had not been made in vain. His scanty means presented an insurmountable obstacle to the accomplishment of his wishes, which would have led him to investigate the natural productions of foreign countries.

The kindness of his friend and relation Ekeberg at length procured for him an appointment which afforded him some prospect of being able to accomplish his favourite project, and he left Gottenburg on January 10, 1772, in order to become tutor to the children of M. Kerste, then resident at False Bay, near the Cape of Good Hope. He reached the Cape on April 30th, and soon after his arrival met his countryman Thunberg, whose zeal for botany had led him to visit those southern regions. Although Sparrmann's time was much occupied by duties in which he took no interest, he made some researches, which he was planning to extend, when Captain Cook touched at the Cape with the ships Resolution and Adventure. Messrs. Forster, naturalists to the expedition, being desirous of obtaining an assistant, gave him the offer of accompanying them, of which he gladly availed himself, and having with them sailed round the world, he returned to Africa, in March, 1775, after an absence of 28 months.

He now practised his profession at Cape Town for a few months, in order to obtain the means for his projected journey into the interior of Africa. During his voyage he obtained sixty ducats by translating a Swedish medical work into English, and with that money aud the fruits of a four months' practice, he started for the interior on July 25, 1775, in company with a young man named Immelman, who was born in Africa. He first visited Mossel Bay; then striking more into the heart of the country, he penetrated as far as the banks of the Great Fish River; and afterwards taking a direct northerly course he advanced as far as 28° 30′ S. lat., and 350 leagues from the Cape. On February 6, 1776, he turned southward, and occasionally varying a little from his former track, reached Cape Town on the 15th of April, laden with specimens of plants and animals.

In the course of the same year he returned home, and found that the degree of doctor of medicine had been conferred upon him during his absence. He was next elected a member of the Academy of Sciences at Stockholm; and on the death of Baron Geer, the entomologist, was appointed his successor in the office of conservator of the museum. His love of enterprise tempted him from his retreat to join Wadstroem's projected expedition to the interior of Africa [WADSTROEM]; but on its failure he returned from Senegal, and continued at Stockholm till his death, on July 20th, 1820.

Sparrmann's reputation is founded chiefly on his travels, which have been translated into English and several other European languages. In them he appears as a persevering traveller, an able naturalist, and a truth-telling narrator; and it is no small merit that the map attached to his book is the first in which the coast from the Cape to the Great Fish River is laid down with any degree of accuracy.

The younger Linnæus gave the name of Sparrmannia to species of plants belonging to the order Tiliaceæ of Jussieu.

SPARRMANNIA, the name of a genus of plants belonging to the natural order Tiliaceæ; it was named by the younger Linnæus in honour of his countryman, and the friend of his father, Andrew Sparrmann, who was companion of the Forsters in their voyage round the world. The genus is known by its calyx of 4 sepals, 4 roundish petals, numerous stamens, intermixed with tomentose threads; echinated, 5-angled, 6-celled, 6-valved capsules, with 2-seeded cells. There is only one species, the *Sparrmannia Africana*, which is a native of the Cape of Good Hope. It is a beautiful shrub, much cultivated, flowering in the beginning of the spring. It is found to grow best in a soil composed of loam and peat. The cuttings will root freely when placed under a hand-glass.

SPARROW, *Fringilla domestica*, Linn.; *Pyrgita domestica*, Cuv.

This well known bird, the constant attendant on civilized man wherever it is found, is the *Moineau* and *Passereau* of the French, *Passara* of the Italians, *Haus-Sperling* of the Germans, *Huis-Musch* of the Netherlanders, *Grasparf* of the Swedes, *Graaee-Spurre* of the Danes, *Huus-Kald* of the Norwegians, *Common Sparrow* and *House-Sparrow* of the modern British, and *Aderyn y to* and *Golfan* of the Welsh.

Belon makes it the Στρουθὸς (*Struthus*) of the Greeks and *Passer* of the ancient Italians, but it is by no means clear that this was the species meant. The Cisalpine Sparrow (*Pyrgita Italica*, Vieill., *Fringilla Cisalpina*, Temm., *Passero*, *Passera*, *Passero Commune*, and *Passero Tettajuolo* of the modern Italians) is much more abundant at the present day in Italy, where the common Sparrow is comparatively scarce; and there are two other European species.

*Geographical Distribution.*—Denmark, Norway, Sweden, in which last country it is more numerous if possible than with us, the whole of the British Islands, France, Spain, Portugal, Italy (rare), Liguria, and Dalmatia, in small numbers, and a stranger, as it were, in the midst of the numerous flocks of the Cisalpine Sparrow, according to Temminck; North Africa; the Levant, according to Mr. H. E. Strickland; Trebizond; the Nubian Mountains; the Deccan, according to Colonel Sykes, the Himalaya Mountains, and other parts of India.

The bird is everywhere before our eyes, even in our most populous cities, and cannot need description; but a London sparrow requires to be well cleaned before the true colours of his plumage appear. If one of these begrimed soot-collectors be placed near a bright trim sparrow from a barn-door, it is difficult to conclude that the rustic and the citizen are birds of the same feather.

There are many accidental varieties—pure white; yellowish white, with the colours hardly indicated; rusty yellow variegated with white; some part of the body white, ash-colour or black-brown more or less deep. The *Fringilla candida* of Sparrmann, *Passer flavus* of Brisson, and *Black Sparrow* of Latham, are founded on some of these variegated individuals.

The habits of the Common Sparrow, its amazing fecundity, its strong attachment to its young, the truculent battle-royal in which they will occasionally engage in troops, when excited upon some difference of opinion arising out of questions of love or nest-property, their familiarity, not to say impudence, and their voracity, are familiar to all; but few pause to inquire what service the sparrows do for the unlimited tolls they take. Mr. Knapp, in his highly interesting *Journal of a Naturalist*, has painted the best and truest sparrow-picture known to us:—

'We have no bird, I believe, more generally known, thought of, or mentioned with greater indifference, perhaps contempt, than the common sparrow (fringilla domestica), "that sitteth alone on the house-top;" yet it is an animal that nature seems to have endowed with peculiar characteristics, having ordained for it a very marked provision, manifested in its increase and maintenance, notwithstanding the hostile attacks to which it is exposed. A dispensation that exists throughout creation is brought more immediately to our notice by the domestic habits of this kind. The natural tendency that the sparrow has to increase will often enable one pair of birds to bring up fourteen or more young ones in the season. They build in places of perfect security from the plunder of larger birds and vermin. Their art and ingenuity in commonly attaching their nests beneath that of the rook, high in the elm, a bird whose habits are perfectly dissimilar, and with which they have no association whatever, making use of their structure only for a defence, to which no other bird resorts, manifest their anxiety and contrivance for the safety of their broods. With peculiar perseverance and boldness, they forage and provide for themselves and their offspring; will filch grain from the trough of the pig, or contend for its food with the gigantic turkey; and, if scared away, their fears are those of a moment, as they quickly return to their plunder; and they roost protected from all injuries of weather. These circumstances tend greatly to increase the race, and in some seasons their numbers in our corn-fields towards autumn are prodigious; and did not events counteract the increase of this army of plunderers, the larger portion of our bread-corn would be consumed by them; but their reduction is as rapidly accomplished as their increase, their love of association bringing upon them a destruction which a contrary habit would not tempt. They roost in troops in our ricks, in the ivy on the wall, &c., and are captured by the net: they cluster on the bush, or crowd on the chaff by the barn-door, and are shot by dozens at a time, or will rush in numbers, one following another, into the trap

Those and various other engines of destruction so reduce them in the winter season, that the swarms of autumn gradually diminish, till their numbers in spring are in no way remarkable. I have called them plunderers, and they are so; they are benefactors likewise, seeming to be appointed by nature as one of the agents for keeping from undue increase another race of creatures, and by their prolificacy they accomplish it. In spring and the early part of the summer, before the corn becomes ripe, they are insectivorous, and their constantly increasing families require an increasing supply of food. We see them every minute of the day in continual progress, flying from the nest for a supply, and returning, on rapid wing, with a grub, a caterpillar, or some reptile; and the numbers captured by them in the course of these travels are incredibly numerous, keeping under the increase of these races, and making ample restitution for their plunderings and thefts. When the insect race becomes scarce, the corn and seeds of various kinds are ready; their appetite changes, and they feed on these with undiminished enjoyment.'

This species must not be confounded with another British species, the Tree-Sparrow.

SPARTA, or, as it was sometimes called, Lacedæmon, the capital of Laconia, and the chief city of Peloponnesus, was situated on the right or western bank of the Eurotas (the modern Iri), about 20 miles from the sea, in 37° 4′ N. lat. and 22° 26′ E. long. It was built in a plain of some extent, and was bounded on the east by the Eurotas, and on the south by a smaller stream running into it, now called Trypiótiko, and supposed by Colonel Leake (vol. i., p. 151) to be the antient Knakion. Polybius (lib. v., 22), thus describes its general features: 'It is of a circular form, and though it is situated in a plain, contains within it several rising grounds and hills. On the east is the Eurotas, which during the greater part of the year is so large as not to be fordable; on the south-east, but on the other side of the Eurotas, is a range of hills, on which stands the suburb called Menelaium. These are rough and difficult of approach, and they command the space between the town and the Eurotas, for the river runs close by the bottom of the heights, and the whole space, including the river, between them and Sparta, is not more than a stadium and a half (about 940 feet) in breadth.' These hills of the Menelaïum form a part only of a steep bank which rises on the eastern side of the Eurotas to the height of 500 or 600 feet, and is surmounted by a table-land, beyond which, again, lies an uneven country, intersected with ravines and rivers, gradually rising to Mount Parnon and the other summits of the range of mountains which bounds the view from the plain of Sparta on the east. (Leake, i. 137.) A corresponding boundary on the west is formed by the more elevated range of Mount Taygetus; hence Homer applies the term 'hollow Lacedæmon' to the plain of Sparta, and to the city itself, which Strabo (vol. viii., p. 367) also speaks of as being in a hollow. In most parts there is a level space between the eastern bank and the Eurotas, but the hills on which the Menelaïum stands are washed by the river. The only villages on the antient site of Sparta are Magúla

[Topographical Sketch of the Site of Sparta.]

1 Termination of a branch of Mount *Taygetus*.
2 Ancient vestiges.
3 Acropolis.
4 Antient Aqueduct.
5 Antient foundations.
6 Church
7 Hellenic ruins.
8 Remains of Temple. 9 Roman remains.
10 Theatre.
11 Tombs of *Leonidas* and *Pausanias*.
12 Remains of Roman Baths and other buildings.
13 A scattered Village, with Gardens.
14 Ruins of an Hellenic building.
15 Circular building.
16 Remains of Bridge.
17 Site of the Temple of *Juno Argeia*.
18 Tombs of the *Agidæ*.
19 Tombs of the *Eurypontidæ*.

(Μαγοῦλα), and Psykhikó (Ψυχικόν), the former of which names is often applied to a height with ruins, especially when they are in a plain. The principal modern town in the neighbourhood is Mistra, which lies about two miles to the west, on the slopes of Mount Taygetus.

The only considerable remains of Hellenic workmanship are the theatre, from which Mistra and the surrounding neighbourhood have been supplied with stone for building. Colonel Leake could perceive only a few fragments of seats in the cavea, and thought that the exterior masonry and brickwork which still subsist are not older than the time of the Roman empire. Nevertheless the theatre itself may have existed from an early period, though not originally used for dramatic purposes, but for gymnastic and choral exercises and public meetings. (Herod., vi., 67.) The centre of the building was excavated in a hill, but the ground does not afford much advantage compared with the situations of other Greek theatres. The largest diameter, says Sir W. Gell, was 418 feet in length; the orchestra is 140 feet wide, and adjoining are two parallel walls about the length of a furlong. According to Colonel Leake, 'it is impossible to determine the interior diameter or length of the orchestra without excavation: the breadth of each wing appears to have been about 115 feet, and the total diameter about 450 feet, so that this theatre must have been one of the largest in Greece.' In front of it there is a sepulchal chamber carefully built of large quadrangular stones.

'Not far from the theatre,' observes Colonel Leake, 'I found two opposite doors, each formed of three stones, and buried almost to the soffit. On one side of these doors is some appearance of seats, as if the building had been a place of public assembly.' In another place he found two other similar doors buried in the ground to nearly the same height.

Another relic is an antient bridge over the Trypiótiko, which is still in use, constructed of large single blocks of stone, reaching from side to side. There is also part of an old causeway of similar construction at each end of the bridge.

Every part of the site of antient Sparta is covered with fragments of wrought stones; and here and there are scattered pieces of Doric columns of white marble, and other relics of antient buildings. The materials of the Roman walls, now nearly ruined, which once surrounded the principal heights of the city, are formed of similar fragments.

Of Sparta, Thucydides (i. 10) observes, that if 'it were evacuated, and only the temples and foundations of its buildings left, posterity would be very incredulous about the extent of its former power, which was so great that it possessed two of the five divisions of Peloponnesus, and had the command of the whole country, and many allies out of the Peloponnesus. Of this however no adequate idea would be afforded by the city itself, as it was not embellished with temples and splendid edifices, nor built in contiguity, but in separate quarters.' Such was the state of Sparta about 400 B.C.; but architecture and the arts in general had not then reached their greatest development, nor had Sparta so entirely relaxed from the severity of its antient manners as it did afterwards, when, with the increase of riches, public monuments also multiplied with more rapidity than in earlier ages. These monuments, it appears from Pausanias, were still remaining about A.D. 200, in a more perfect and uninjured state than those of any other Grecian city except Athens. From this fact, and the indications afforded by the present accumulations on the old site of Sparta, Col. Leake has inferred that it would not be a more unpromising field for research than at least the second-rate cities of Greece.

We proceed to give a summary of the antient topography of the city, as described by Pausanias, and illustrated by the annexed sketch from Colonel Leake's work, which is copied with his permission (vol. i., pl. 2):—

1. He begins with the Agora, or public square, which contained the council-house of the senate and the offices of the principal magistrates. The most remarkable building in this part of the city was the Persian stoa or portico, originally built of the spoils taken in the Persian war, but subsequently repaired and augmented. It was ornamented with statues, in white marble, of some of the Persian generals, including that of Mardonius; and also with one of Artemisia, the queen of Halicarnassus, an ally of Xerxes. The Agora also contained shrines of Julius Cæsar and the emperor Augustus. A part of it was known by the name of the chorus, or dancing-place, in which young men danced at the games in honour of the Dorian god Apollo. In its immediate neighbourhood were various statues and temples.

2. Pausanias next describes the street called Aphetæ (Ἀφέται) or Aphetaïs, leading from the Agora, along the line of which was a number of public monuments, including a temple of Minerva Keleutheia, with a statue said to have been dedicated by Ulysses. At the end of the street, close to the city walls, was a temple of Dictynna, or Diana, and the royal tombs of the Eurypontidæ.

3. The street in which the Skias was situated led out of the Agora to the walls. This was an antient place of assembly, said to have been built by Theodorus of Samos, of a circular form, and with a roof shaped like an umbrella (skiadeion). (Pausan., 12, 8; Etymolog. in Σκιάς.) Along this street also, or in its immediate neighbourhood, were various monuments, such as temples, statues, chapels, and altars, erected in honour of the tutelary divinities of Sparta (such as Apollo Carneius) and its heroes. In connection with these, Pausanias also mentions a kind of quadrangular Change, surrounded with porticoes, in which second-hand goods were sold.

4. Pausanias describes the district to the west of the Agora. Here was a cenotaph of Brasidas, and near it a splendid theatre of white marble; opposite to which were the monuments of Pausanias and of Leonidas; near the latter was a pillar inscribed with the names of those who fell at Thermopylæ, with those of their fathers.

5. There was a place called Theomelida at Sparta, in which were the tombs of the royal house of the Agidæ. In the same quarter was the temple of Diana Issôra, or Pitanatis, and those of other divinities. Not far off, and on the banks of the Eurotas, was the Dromus, or racecourse, which contained two gymnasia, and in which, observes Pausanias, young men are exercised in running till this day. The Dromus was also embellished with various statues and temples, among which was a temple of Æsculapius, surnamed Agnitas, from his statue being made of the wood of the agnus, which is still called Agneia (ἀγνειά). At the beginning of the Dromus were statues of Castor and Pollux, surnamed Apheterii, because they stood at the starting-post. A little outside of the Dromus, Pausanias was shown the site of the house of Meneläus, one of the Grecian leaders at Troy. At the south-east of the Dromus was the Platanistes, which was an island, or nearly so, surrounded by running water, and so called from the plane-trees (platani) growing there. Two bridges formed the approaches to it, on one of which was a statue of Lycurgus, and of Hercules on the other.

The Platanistes and its neighbourhood, like other parts of the city, contained several architectural remains in the time of Pausanias. Close to the city walls, in this quarter, temples were raised to Helen and Hercules, and to the east of the Dromus was a temple of Minerva Axiopoenus, *i.e.* who requites according to desert.

Pausanias appears to form a sixth division of Sparta, in which he places the public hall (λεσχή), called the decorated (or ποικιλή), with various heroa, or chapels dedicated to heroes, about it. Not far from the theatre, he adds, was a temple of Neptune Genethlius; and, after advancing a little, there was a small height, on which was an antient temple, with a wooden statue of Venus in armour, and having an upper story sacred to Venus Morpho—the only building of this description which Pausanias had ever seen. A similar specimen of two perfect churches, one built above the other, is still existing at a village nearly opposite Bonn on the right side of the Rhine, called Schwarz-Rheindorf. (Petit, 'Church Archit.,' i., p. 86.)

Lastly, there were temples of Diana Orthia and Latona in the place called Limnæum, or 'marsh land,' not far from which the Acropolis was probably situated. On this subject Pausanias remarks, that the Lacedæmonians had not a citadel of conspicuous elevation, like the Cadmeia at Thebes and the Larissa at Argos; but as there were several hills within the city, the highest of these was called the Acropolis. It contained, amongst a great number of other buildings, the temple of Minerva Chalcioecus (*i.e.* of the bronze house), begun by Tyndareus, and afterwards made of bronze, on which the actions of Hercules and of Castor and Pollux were worked in relief, together with other representations, of which the largest and most admirable were the Birth of Minerva and the figures of Neptune and Amphitrite. Of the other monuments in the same locality we shall only mention a bronze statue of Jupiter, which Pausanias says was the oldest extant of that material; it was formed of several separate pieces hammered together with nails. Col. Leake observes that the only point in Pausanias's description which can be determined with certainty is the theatre, the position of which was such that the Agora was in the hollow of the great height behind it, with its eastern extremity not far distant from an opening, still observable towards the middle of the bank of hills which overlooks the valley of the Eurotas, and forms the front of Sparta on the north-east. This opening is itself nearly opposite an old bridge over the Eurotas, so that it would seem that all the roads from the east of Laconia crossed the river into the city, and then proceeded to the Agora.

Of the remaining parts of Sparta the most important to determine is the Acropolis. From the description of Pausanias it seems to have been situated on the hill at the extreme north of the city, which was detached from the others, and better suited for an Acropolis than any of them.

From the antient authorities it appears that Sparta was divided into five local tribes, viz. the Pitanatæ, the Limnatæ or Marshmen, the Messoatæ, the Ægidæ, and Cynosurenses. Col. Leake has determined their position, as laid down in the annexed sketch, with considerable probability.

The general form of the city was circular, or rather semicircular, and, according to Polybius, its circumference was forty-eight stades, or about six Roman miles.

It was not regularly fortified till the time of the Roman interference in Greece, though fortifications had been hastily thrown up against the attacks of Demetrius Poliorcetes (B.C. 280) and Pyrrhus (B.C. 272): it was at last completely surrounded with walls by order of Appius, the Roman legate. (Pausan., vii., 9, 3.) Two hundred and fifty years afterwards, when Pausanias visited Sparta, both walls and gates were in existence: no traces of them are visible now. The soil of the plain in which Sparta is situated is in general a poor mixture of white clay and stones, difficult to plough, and better adapted for olives than corn; exactly agreeing in this respect with the words of Euripides (Strab., viii., p. 366), who contrasts Messenia with Laconia, and describes the latter as a poor land, in which there is plenty of arable soil, but hard to work. The women of Mistra and the plain, says Colonel Leake, are 'taller and more robust than the other Greeks, have more colour in general, and look healthier;' a statement agreeing with Homer's expression, Λακεδαίμονα καλλιγύναικα (Lacedæmon with handsome women).

The chief modern authorities on the topography of Sparta are: Dodwell; Sir W. Gell, *Itinerary of the Morea;* and Leake's *Travels in the Morea.*

*The Constitution and Government of Sparta.*—This was of a very mixed nature, consisting of three or even four distinct elements, viz. royalty, a council of elders or senate, a general assembly, and, in later times, the Ephoralty.

The kingly authority existed at Sparta from the time of the conquest of the Peloponnesus by the Spartans, and was always shared by two persons at the same time, so that it was, properly speaking, a diarchy, or divided royalty. The two kings were the successive representatives of the two royal families descended from Eurysthenes and Procles, the twin sons of Aristodemus, under whom the conquest of Laconia was achieved. According to the national legend, the establishment of the diarchy arose from the circumstance of Aristodemus having twins born to him, but as the sanction of the Pythian oracle was said to have been procured for the arrangement, it may not have been purely accidental, but rather a work of design and contrivance. (Herod., vi. 52.) The constitutional powers of the kings were very limited. They presided over the council of elders as 'principes senatus,' and though it seems probable that the kings of the older house had a casting vote (Herod., vi. 57; Thucyd., i. 20), still the vote of each counted for no more than that of a private senator. Nevertheless the kings had some important prerogatives. In common with other magistrates they had the right of addressing the public assembly; they sat as judges in a separate court of their own, where they decided upon private matters of importance, as in the case of heiresses claimed by different parties. But it was in foreign affairs that their prerogatives and powers were greatest. They were the commanders of the Spartan forces, and had the power of choosing from among the citizens persons to act as Proxeni, or protectors of foreigners visiting Sparta. When they had once crossed the borders of Laconia at the head of their forces, their authority became unlimited. Some of the Ephors indeed sometimes accompanied the kings on their expeditions, but the operations of the latter were not under the control of those magistrates; they merely watched over the proceedings of the army. However, there can be little doubt (and especially after the increase of the Ephoral authority) that the kings on their return home were accountable for their conduct as generals. In fact in some instances the kings were dethroned or punished for misconduct and mismanagement as generals. Nor were their military powers connected with any political or diplomatic functions; they were not allowed to conclude treaties, or to determine the fate of cities, without communicating with the authorities at home. In the most antient times the two kings had a joint command, but this led to inconvenience, and a law was consequently passed, that in future one only of the two kings should have the command of the army on foreign service. The honours and privileges of the Spartan kings were greater than their prerogatives and powers. They united the characters of priest and king (Herod., vi. 56), and officiated as high priest of the nation at all the public sacrifices offered for the state. They were well provided by the community with the means of exercising the heroic virtue of hospitality. Whenever any citizen made a public sacrifice to the gods, the kings were invited, and treated with especial honour: a double portion of food was given them, and they made the first libation to the gods. (Herod., vi. 57.) These, and other distinctions of a like kind, were however of a simple and old-fashioned nature, and prove that to a certain extent the Spartan royalty was of the same character as that which Homer describes as existing in what are called the Heroic times.

The accession and demise of the Spartan kings were marked by observances of an Oriental character. Whenever the former event occurred, all debts due, from private individuals, to the state or the king, were remitted: and on the death of one of the kings, his funeral solemnities were celebrated by the whole community. There was a general mourning and suspension of all public business for ten days. (Herod., vi. 58.)

A second element in the Spartan polity was the Gerusia (γερουσία), or assembly of elders. This was the aristocratical element of the constitution, and not peculiar to Sparta alone, but also found in other Dorian states. It included the two kings, who sat as presidents (ἀρχαγέται), and consisted of thirty members, ten from each of the three tribes, and one from each of the divisions called obæ (ὠβαί). It was confined to men of distinguished character and station: no one was eligible to it till he was sixty years of age (Plut., *Lycur.*, 26), and the additional qualifications were also of an aristocratic nature. (Arist., *Pol.*, ii. 6, 15.) The election was determined by vote, and the office was holden for life, and irresponsible: as if a person's previous character and the near approach of death formed a sufficient security for uprightness and moderation. The duties of the counsellors were deliberative, judicial, and executive. In the first capacity they prepared measures and passed preliminary laws, which were laid before the popular assembly; so that they had the important privilege of initiating changes in the government or laws. As a criminal court they could punish with death or degradation (ἀτιμία), and that too without being restrained by a code of written laws. (Arist., *Pol.*, ii. 6.)

They also appear to have exercised a judicial superintendence and censorship over the lives and manners of the citizens (Aul. Gell., xviii. 3), and probably were allowed a kind of patriarchal authority to enforce the observance of antient usage and discipline. (Thirl., *Hist. of Greece*, i., p. 318.) It is not however easy to ascertain accurately what was the original extent of their functions; especially in the last-mentioned capacity, since the Ephors not only encroached from time to time upon the prerogative of the kings and the council, but also possessed in very early times a censorial power which they were more likely to extend than suffer to be diminished.

The third element was the Ecclesia (ἐκκλησία), or general assembly of the Spartan citizens. From various authorities quoted by Müller (*Dorians*, iii., c. 5, 8), it appears that the general assembly was not competent to originate any measure, but only to adopt or reject without alteration the laws and measures submitted to it by the proper authorities, a limitation which almost fixed the character of the Spartan constitution, and justifies an observation of Demosthenes (*c. Lept.*, p. 489), that the γερουσία at Sparta was in many respects supreme. All citizens above the age of thirty, not labouring under any disabilities, were admissible to the ἐκκλησία, or ἀπέλλα, as it was called in the old Dorian dialect; but except magistrates, and especially the ephors and kings, no one addressed the people without being called upon. The same public officers also put the question to the vote; and as the magistrates only were the speakers and leaders of the assembly, the resolutions of the whole people are (particularly in foreign matters) spoken of as the decrees of those authorities alone. The close connection of the ephors with the assembly is shown by a phrase of frequent occurrence in the decrees of the assembly: 'Resolved by the ephors and assembly,' &c. The voting was by acclamation, and the place of meeting to the west of the city between the brook Knakiôn and the bridge Babyca. The regular meetings were holden every full moon, and in cases of emergency extraordinary assemblies were called.

The functions and powers of the Spartan ἐκκλησία are thus described by Müller, in his 'Treatise on the Dorians' (iii.; iv. 9). The popular assembly alone had the power to 'proclaim a war, conclude a peace, enter into an armistice for any length of time, and all negotiations with foreign powers, though conducted by the kings and ephors, could be ratified by the same authority only.' And with regard to domestic affairs, the highest officers of the state, such as magistracies and priesthoods, were filled up 'by the votes of the people; cases of disputed succession to the throne were decided by them; changes in the constitution were proposed before them, and all new laws, after a previous resolution of the senate, were ratified by them.' So that the general assembly, according to the theory of the constitution, possessed the supreme political and legislative authority at Sparta, but subject to so many checks and limitations, that the government of the state is often spoken of as an aristocracy. One of these limitations was the Ephoralty, a power apparently foreign to the constitution as established by Lycurgus, and which appears in the first instance to have owed its aggrandisement to the connection established between itself and the assembly. In after-times it encroached upon and overpowered the royal authority, and became the supporter of oligarchical principles and privileges.

The free citizens of the community were divided into two classes: one composed of the Spartans, or descendants of the Dorian conquerors of Laconia, and other individuals from time to time, but sparingly, associated with them; the other, of a subject population, living not in the city, but in the country, and called Periœci, or 'dwellers round,' who, though personally free, were denied all political privileges, the government and administration of the state being confined to the Spartans exclusively.

The various elements we have mentioned have given rise to the question—'What was the nature of the Spartan constitution?' By antient authors it is generally spoken of as an aristocracy; but it has been maintained (Arnold, Thucyd., vol. i., Appen. II.) that this aristocracy was one of conquest, in which the Spartan conquerors and their descendants stood to the Periœci in the relation of nobility to vassals, and that it is in this respect principally that the Spartan constitution was of an oligarchic or anti-popular character. But this is not altogether true. For the fact is that, in theory and name, the constitution as settled by Lycurgus was a democracy, with two hereditary magistrates at its head; but in practice (at least before the encroachments of the ephoralty) it worked as if the supreme authority had been placed in the hands of a minority, and therefore was in reality a limited aristocracy, independent and irrespective of the relation between the subject and the ruling classes. The chief circumstances which justify this conclusion are the restraints imposed upon the assembly, the extensive powers of the councillors, their election for 'life, their irresponsibility, the absence of written laws, of paid offices, of appointments determined by lot,' and of other peculiarities which the Greeks considered characteristic of a democracy. Aristotle (*Politica*, ii. 6) gives the following account of the Spartan constitution, and the opinions which prevailed about it: 'Some affirm that the best form of government is one mixed of all the forms, wherefore they praise the Spartan constitution; for some say that it is composed of an oligarchy, and a monarchy, and a democracy—a monarchy, on account of the kings; an oligarchy, on account of the councillors; and a democracy, on account of the ephors; but others say that the ephoralty is a tyranny, whereas, on the other hand, the public tables and the regulations of daily life are of a democratic tendency.'

Many of these regulations however, and the social institution of Sparta, were suggested, and almost rendered necessary, by the position in which her citizens stood with respect to their subjects and serfs. They were in fact 'like an army of occupation, or a beleaguered garrison,' surrounded by a number of enemies ready to overpower and crush them on every opportunity. Hence all the regulations and usages of daily life at Sparta were subservient to the development of a martial spirit, and contributed to maintain the superiority of the dominant classes over the inferior population; with a view to which results, individual interests and comforts were always made subordinate to the real or supposed interest of the state. The spirit indeed of Spartan legislation and Spartan feeling established and recognised the principle that the citizen was born only for the state; that his powers and energies were to be devoted to its service; and that any sacrifice, however painful or costly, was to be made by him for its welfare. Now it is almost evident that no legislator could so far have acted upon the minds of a nation as to have created the spirit implied in such a principle. It must either have been natural to the people actuated by it, or the result of the circumstances in which they were placed, an isolated handful of men, in an unwalled town, surrounded by an unfriendly population, superior to themselves in number, and yet ruled by them as their subjects and serfs. We cannot therefore, it would seem, assert that the peculiar features both of public and private life at Sparta, and the principles which in the best days of her history pervaded and modified her social institutions and regulated the conduct of her citizens, *were* the *creation* of her lawgiver Lycurgus. Still there can be no doubt that in legislating for his country he both availed himself of a disposition which he found already existing, and gave a greater and more systematic development to the principle of which we have been speaking, than it had received before his time. The influence and bearing of this principle were strongly marked in the distribution of private property as settled by Lycurgus, who assigned an equal portion of land to every one of 9000 Spartan citizens. But we may illustrate its force more fully in all the various regulations by which a Spartan citizen was trained for the service of the state, and which affected the arrangements even of families and private houses. From his very birth every Spartan boy was treated as the child of the state, and as such was liable to be exposed to die at the discretion of his father's kin, if he was a deformed or sickly infant. In his earliest years he was not left entirely to the management of his parents, though under their care, and at the age of seven he entered upon a course of public discipline, increasing in severity as he approached manhood. The education of the young indeed, and to a certain extent the care of all the elder citizens, was under the especial superintendence of a public officer appointed for this purpose (the παιδονόμος), and he again selected a number of the best qualified young men, just above twenty years of age, to act as captains of the companies (ἀγέλαι) into which the boys were divided; and as this education had only one end in view, that of training citizens to serve and defend their country, the discipline was in every respect subservient to this object. No accomplishments or arts, except of a military character, were taught, while every effort was made to ensure military skill, activity, fortitude, and bravery. The Spartan was to be taught both to dare and to bear with fortitude; and for this purpose he was inured from his youth to a coarse and scanty fare, to insufficient clothing, to self-denial, and the severest trials of pain and hardship. One of these is said to have been instituted by Lycurgus, in which noble youths standing by the altar of Artemis vied with each other in submitting to the lash, and sometimes died in the contest without uttering a groan (Cicero, *Tus. Quaest.*, v. 27.)

By another custom, the Spartan youths were compelled, sometimes from hunger, sometimes at the command of their captains, to get provisions or anything else by foraging in the fields or plundering houses: if successful, they retained their spoil, and were honoured with praise; if detected, they were punished, not for the attempt, but for their want of ingenuity. We scarcely need observe that this practice must not be considered as a violation of the rights of property; the community agreed to submit to it, for the sake of the advantages which they conceived to be derived from it. Even what might be considered the accomplishments of a Spartan youth were cultivated in the same spirit. He was taught music, to sing, and to play on the flute and the harp; but only with the view of forming his moral tastes; and therefore the airs and the songs that he learnt were of a sacred or martial character. Hence the poetry of Homer, with its lively description of the Heroic age, was in very early times introduced and welcomed at Sparta; and Tyrtæus, the lame schoolmaster of Attica, but martial poet, was held in especial honour, as animating and encouraging their youth. Gymnastic dancing also formed a part of Spartan education; and the Pyrrhic dance was taught to boys as a warlike exercise, imitative of the movements and actions of a combatant in battle. But the lessons most strongly impressed upon the young Spartan, and the duties most carefully inculcated, were those of modesty, obedience, and respect to rank and age; qualities and habits of vital importance to the permanence of the constitution, as securing a ready compliance with the commands of the magistrates, and inconsistent with innovations in the laws and form of government. Together with all this, the young Spartan was impressed, both by precept and example, with a sense of shame; and taught to consider dishonour and disgrace as more terrible than death, when met either for the honour or at the command of his country. At the expiration of eighteen years, the Spartan youths passed from boyhood; and from this period to thirty they were considered to be in a state of transition to manhood. At twenty they served in the ranks, but were perhaps chiefly employed in such duties as the Crypteia, and other service within the frontiers, like the Athenian youth called Peripoli (Περίπολοι). (Müller, *Dorians*, iv. 5, 3.) But even after maturity, the Spartans, though not under a course of training, were still expected to employ themselves in gymnastic exercises and amusements, such as the chase, which served as a preparation for war. (Xenop., *De Rep. Lacon.*, v. 7.) Nor were they exempt from military service till sixty. The last years of their life were spent in the service of the community, in the council of the Gerusia, or in superintending the education of the young; and nowhere, it has been remarked by Cicero, had old age a more agreeable or more honourable position than at Sparta. When advancing years disabled them from active service, they still had the resource of the Lesche (λέσχη), a place of resort for public conversation, where they might enjoy the society of their equals, and live over again their past lives. Another important feature of the Spartan institutions was the Syssitia, or public meals, in which all the citizens of a suitable age joined. The guests were divided into societies, or clubs, generally of fifteen men; any vacancy was filled by ballot, and unanimous consent was requisite for the admission of new members. The repast of each club was of a frugal and temperate character, but enlivened by social and cheerful conversation, and the entertainment was provided by the contributions of the individual members. It is evident that an institution of this sort was calculated to unite the citizens in the closest relations of intimacy and friendship, and to increase the power of public opinion; every individual of the state being thus brought under the inspection of his fellows, and made dependent for his happiness and honour upon their esteem. Moreover the Syssitia served important purposes in a military point of view, as each company formed a small band in itself, the members of which were bound by every tie to assist and protect each other in the field, after living together as brethren at home.

The care and attention which the Spartans bestowed upon military exercises, and the military spirit which pervaded all their institutions, illustrate the fact 'that no nation considered war as an art in the same sense and to the same degree as they did.' War seemed to be their element and delight, and all pains were taken to make it attractive. The life in the city was, to a certain extent, like that of a camp; but the life of the camp was comparatively more easy, being freed from many of the restraints and duties of the city. On the eve of a battle they combed their long hair and crowned it with chaplets as if for a festival, and entered upon it rather as a contest for glory than as a struggle for life or death; but still even in battle and in war the Spartans did not forget the caution which was in general their characteristic, for we are told of a maxim of Lycurgus which forbade them to make war too often on the same enemy, lest they should teach others their own tactics, and convert a weak adversary into a bold and formidable one. This maxim indeed was not always observed. Agesilaus in particular was charged with violating it. But there was another rule dictated by the same spirit, and which we are told by Thucydides (v. 73) was really enforced, that of pursuing a foe only so far as was necessary to secure a victory. Müller indeed observes that in these rules we may recognise the antient principles of Greek humanity; but they seem rather to have been the dictates of policy and prudence.

The tactics of the Spartan army were distinguished for simplicity, though apparently of a very complicated character, and are praised by Xenophon for this quality. The point of their superiority thought worthy of notice was the rapidity with which the general's orders were passed through a whole army, by means of a well-regulated subordination and connection of the various officers. The chief strength of the Spartan forces was in the heavy-armed infantry which was superior to that of any other state in Greece. Cavalry service was not thought highly of amongst them, the country being not fitted for the production of horses. The horsemen of Sparta, in the Peloponnesian war, were at first only 400, and afterwards rose to 600 men (Müller, iii. 12, 6), a very small force for so powerful and warlike a state. The naval service was chiefly confined to the Periœci.

From what has been stated it is evident that the Spartan institutions were almost entirely of a military spirit and tendency; but they also incidentally served other important ends, such as the invigoration and health of the body, and the production of physical beauty. (Müller, iv. 5, 9.) That these results were produced by them appears from the fact that about 540 B.C. the Spartans were the most healthy of the Greeks (Xenop., *Rep. Lacon.*, v. 9), and that the handsomest men and women were found amongst them. But the systematic training which we have described was not coupled with excellence in the arts and sciences which embellish and ameliorate man's condition. Nor indeed could it be expected that Sparta should produce among her citizens the painter, the sculptor, the poet, or the historian. They were all warriors; and therefore the cultivation of the arts and sciences, and even of agriculture, was left almost entirely to the Periœci and the Helots. Lyrical and choral poetry indeed, for which the Dorian communities were famous, were cultivated and encouraged, but chiefly for religious purposes; several foreign lyric poets were naturalized among them, even in spite of their jealousy of foreigners, and the names of some native writers of lyric odes have come down to us. Still we have no remains of Spartan lyric poetry, with the exception of some of a poet called *Alcman*. Nor do we read of any distinguished epic poets, or dramatists, or historians or philosophic writers among the Spartans. The arts of rhetoric and eloquence too were studiously discouraged among them, as being instruments of deceit and misrepresentation, and inconsistent with the concise and sententious method of expression on which the Spartans prided themselves, and which they enforced on their youth by a regular training. With respect to architecture and sculpture our information is scanty and of a negative character; but we have every reason for supposing that these arts were confined to a few, especially in their higher departments, as there was little room for the employment of either, except in the building and decoration of the national temples. At any rate, history has not transmitted to us the names of any Spartans eminent as painters, sculptors, or architects. Trade and commerce also were alien to their character. They were thought beneath their dignity, and inconsistent with the enjoyment of leisure; hence they were left entirely to their provincial subjects. Any extensive trade indeed was rendered almost impossible by the want of a gold and silver coinage, iron being till the latest time their only legal currency; a regulation ascribed to Lycurgus, but probably of later origin, if, as is generally supposed, the use of silver money was not known to the Greeks for more than a century after his time. The very possession of gold or silver money was prohibited by their laws: an interdiction which would of course contribute to preserve a simplicity of manners, though, from the tendency of human nature to long for what is forbidden, it probably increased, if it did not cause, the venality and avarice of which many instances are mentioned among the Spartans. 'Avarice appears to have been the vice to which the Spartan was most prone: money, for which he scarcely had any use, was a bait which even the purest patriotism could not resist.' (Thirl., *Hist. of Greece*, i. 326.) The law however was evaded by the money being deposited in foreign countries: and after the time of Lysander, (B.C. 400) the possession of the precious metals must have been allowed to individuals under certain restrictions. (Müller, iii. 10.)

We have already described the education of the Spartan young men; the female sex, at least the unmarried portion, were in many respects brought up similarly and with similar views. The Spartan women had their own gymnasia, and practised themselves in running, wrestling, and other exercises, which contributed to their health and vigour of constitution, in order that they might prove the mothers of a healthy progeny. Their costume too was different from that of the rest of Greece. The Spartan virgins, even in the company of men, generally wore but a single robe, without an upper garment; in which respect they were distinguished from married women. But the most remarkable feature in the social position of the Spartan women was the indulgence and respect universally shown to them, presenting a strong contrast with the treatment of the female sex among the Athenians and other nations of the Ionian race. The domestic relation of the wife to the husband was for the most part the same as that described by Homer as prevailing among the antient Greeks, and common among the old nations of the West. She was honoured by him with the title of lady or mistress (δέσποινα), an appellation not used unmeaningly, but expressive of the esteem and regard in which she was held; and so great was the influence of the women at Sparta, that the Spartans were often censured by other nations for submitting to their yoke.

The Spartans, and the Dorians generally, also differed from the rest of the Greeks in the freedom of intercourse which they allowed in public between the youth of both sexes, who were especially brought into contact at religious festivals and choruses. The young men in fact were constantly in the presence of the unmarried women, whose praise and admiration were considered as the highest reward of merit, as their derision and contempt were an object of dread. Hence at Sparta it was very possible for marriage to be the result of affection and love, which was seldom the case in the Ionian states of Greece: it has been remarked that 'at Athens we have not a single instance of a man having loved a free-born woman, and marrying her from any strong affection, whilst a single narrative of Herodotus (vi. 61, 65) contains two love-stories at Sparta.' But still in this, as in everything else, private feelings and wishes were made subordinate to the interests of the community; and marriage was not considered merely as a private relation, in which the state had little or no concern, but as a public institution, the chief end of which was to supply the state with a strong and healthy progeny, and consequently it was to a certain degree looked on with a primitive simplicity, repugnant to the more refined feelings of later times. Intermarriage with foreign women was forbidden to all the Spartans, and to the Heracleids, or royal family, by a particular rhetra, or constitutional ordinance.

The Spartan national character, as exhibited in its greatest purity, was distinguished by a love of fixedness and an aversion to change; by simplicity and sobriety of taste; by steadiness and composure under exciting circumstances; and a patriotism in which all selfish and personal considerations were forgotten. Other elements of this character were, a calm and steady courage, perseverance in the pursuit of desired ends, a strict regard and ready submission to the laws, a comparative indifference to personal independence and individual freedom, a constant striving after uniformity and unity, and a strong attachment to the usages and manners of their ancestors, and to existing institutions. Hence it has been said that the Spartans were better as members of a state than as members of a society; and as they were accustomed to follow implicitly national custom without consulting the dictates of their own conscience, whenever this guide failed they wandered wholly and entirely from the path of rectitude.

The exclusiveness and independence to which the Spartans were naturally inclined, were perhaps increased by their geographical position, which, with the exception of the Arcadians, was more retired and isolated than that of any other people in Peloponnesus. It produced however a stiffness and haughtiness in their dealings with foreigners, which, as contrasted with the more conciliating and courteous manners of the Athenians, excited a disgust which was the main cause of their losing their supremacy over the confederated forces of Greece at the close of the Persian war. Connected with this exclusiveness was the reserve which formed so striking a point in the Spartan character, and the concise and sententious mode of expression, which sometimes served as a cloak for the concealment of real opinions and intentions. To such an extent was this carried, that the Lacedæmonians, after the Persian war, appear to have gained an unenviable character for artfulness and duplicity in their dealings with strangers. It would be easy to prove this from various passages of Aristophanes, in one of which (*Acharn.*, v. 308) they are said to have regard neither for altars nor pledges nor oaths; and also from Euripides, who in one place (*Androm.*, 452) calls them 'deceitful flatterers, masters of lies.' But we have more unexceptionable testimony to this point in the historians Herodotus and Thucydides, the former of whom (ix. 54) describes the Lacedæmonians as being in the habit of saying one thing and meaning another; while the latter (v. 105) affirms, or rather makes the Athenians affirm of them, that as far as respects themselves and their native institutions they were virtuous and well principled; but that in their dealings with foreign states they undisguisedly made expediency and their own interest their only rule of action. We must however remember that the character of the Spartans suffered much in its better qualities from their intercourse with foreigners after the close of the Persian war, and that in the later times of Spartan history the institutions of Lycurgus had lost much of their power over and their adaptation to the minds of the people.

*History of Sparta.*—The occupation of Laconia by the Spartans dates, according to the received chronology, from the year 1104 B.C., the 80th after the Trojan war: but some writers place that event in B.C. 1048. About one of those periods the Dorians migrated from Doris, a district lying between the chains of Mount Œta on the north and Parnassus on the south, and, under the command of three leaders, Aristodemus, Temenus, and Cresphontes, reputed descendants of Hercules, invaded the Peloponnesus; they were accompanied and guided in their expedition by Oxylus, an Ætolian chief, and soon succeeded, according to the poetical legend, in making themselves masters of the country. In the division which took place, Laconia was assigned to Aristodemus, Argos to Temenus, Messenia to Cresphontes, while Elis was given to Oxylus as a reward for his assistance. According to the historian Ephorus, quoted by Strabo, the subjugation of Laconia was effected in a very short time. The capital of the old inhabitants was Amyclæ, where their chief strength was collected; but the city was betrayed, or the people induced to capitulate, by the treachery of Philonomus, one of their countrymen. Eurysthenes and Procles, the twin sons and heirs of Aristodemus, then divided Laconia into six districts: one of these, that of Amyclæ, they gave to Philonomus; Sparta they appropriated to themselves; whilst over the other four they set four governors, with the title of kings. During the sovereignty of the twin brothers, the Achæans, the old inhabitants, enjoyed the same political privileges and franchises as their conquerors; but the next king, Agis, deprived them of their rights, and reduced them to a state of vassalage or dependence on the Spartans. The story adds that all the Achæans submitted at once, with the exception of the inhabitants of Helos, a town on the sea-coast, who endeavoured to shake off the yoke, but failing in their revolt, lost both their political independence and personal freedom, and were afterwards distinguished, they and their posterity, by the name of Helots. The account which we have briefly stated would lead us to suppose that the Spartans achieved the conquest of Laconia without difficulty, and that after the death of Philonomus, Amyclæ and its district fell into their possession. There are however indications which would lead us to infer that the conquest was not so soon completed; for it is certain that the capture of Amyclæ was not effected till the end of the ninth century B.C., and the manner in which the capture is described as the result of stratagem and other circumstances, justifies the conclusion that it had never before submitted to Sparta. (Paus., iii. 2, 6.) And if it be true that the subjugation of Amyclæ, so near to Sparta, was thus long in being accomplished, it is natural to suppose that the conquest of the more distant provinces was the work of equal or longer time. According to one account indeed, even Helos itself, from which the Laconian slaves are commonly supposed to have derived their name, preserved its independence till the reign of Alcamenes, the son of the conqueror of Amyclæ. Till the conquest of Laconia was thoroughly effected, the Spartans were probably too much occupied at home to engage in foreign wars. Their earliest expeditions were into Arcadia and Argos. Against Tegea, the capital of the former country, they continued to wage war, and always unsuccessfully, for many generations. Herodotus tells us that he himself saw at that city the fetters which the Spartan army had brought with them on an expedition to Tegea under their king Charilaus, and in which they themselves were compelled to till the land of their enemies. The prosecution of this war however was interrupted by the prospect of a more important and tempting conquest, that of Messenia. The first of the Messenian wars commenced about B.C. 743, and terminated in the defeat and subjection of Messenia. The struggle was renewed in B.C. 685, but ended in a like result, B.C. 668.

The conquest of this country was attended with the most important consequences to the fortunes of Sparta. The greater part of the conquered territory was shared amongst her citizens; and it is recorded that Polydorus, one of the kings who achieved the conquest, doubled the number of plots of land possessed by them; a story which, taken in connection with other circumstances, leads to the conclusion that he at the same time doubled or considerably augmented the number of the citizens themselves. It seems to have been connected also with some change in the Spartan constitution, and perhaps with the introduction or enlargement of the powers of the ephoralty, as some writers ascribe its origin to Theopompus, the colleague of Polydorus.

From B.C. 668, the close of the second Messenian war, Sparta continued in a course of uninterrupted success, till she became supreme in Peloponnesus, and pre-eminent in all Greece. The old contest with Tegea was at last decided in her favour, about the year 545 B.C. (Herod., i. 68.) Nearly at the same time the contest with Argos, for the possession of the tract of land called Thyreæ, of which the Spartans had made themselves masters in the third generation after the conquest, was decided by a battle of 300 champions on each side, in which Argos lost the day, and Thyreæ was won by the Spartans. (Herod., i. 82.) Herodotus observes that by this time the greater part of the Peloponnesus was under the power of Sparta; and so widely had her fame spread, that Croesus, the king of Lydia, when directed to ally himself with the most powerful of the Greeks, solicited her aid against Cyrus and the Persians. Some time after this, about B.C. 525, we find the Spartans again in hostilities with Argos, and victorious over them in a decisive battle. The next occasion of their prominently appearing in history was at the instigation of the Delphian oracle, when they invaded Attica, under their king Cleomenes, for the purpose of expelling the usurper Hippias, an object which they effected in B.C. 510. Five years afterwards they again appeared in Attica, but in a more appropriate character, as the supporters of the aristocratic party headed by Isagoras: they were led by Cleomenes; but the result of the expedition was not only fruitless, but ignominious; the Spartan king, who had occupied the citadel, being at last obliged to capitulate, and submit to the terms dictated by the popular party at Athens. He afterwards endeavoured to avenge the disgrace, and, with the other king, Demaratus, advanced as far as Eleusis; but their Corinthian allies deserted them, the two kings quarrelled, and the Spartan forces retreated without effecting anything. Shortly after this occurred an incident as disgraceful as any in Spartan history. The Spartans saw reason to regret the expulsion of Hippias from Athens: they discovered that the Pythian priestess had been tampered with by Cleisthenes, the opponent of his family: they saw that Athens was growing powerful, and likely to become a formidable rival if left to herself, and uncontrolled by a 'tyranny.' Accordingly they summoned Hippias from Sigeum on the Hellespont, whither he had retired; called a congress of the allies, the Corinthians amongst the rest; and pretending a regard for the welfare of Greece, endeavoured to persuade them to join in his restoration. But the allies saw through the Spartan hypocrisy, and repudiated the design: the scheme failed, and the Spartans were obliged to submit to the development of the Athenian resources under a democracy. Hippias retired again to Sigeum, and thence to the court of Darius, king of Persia. The expulsion of the Pisistratidæ from Athens, and the aid furnished by the Athenians to some of the revolted subjects of Persia, gave occasion to the Persian war. This was preceded by a formal demand of earth and water as tokens of submission, made by the heralds of Darius to the different states of Greece. The Æginetans complied with it, and the supremacy of Sparta was recognised by the Athenians, who sent thither to accuse them of betraying the cause of Greece. The battle of Marathon followed (B.C. 490), the honour of sharing in which the Spartans lost, though solicited by the Athenians to help them, from a superstitious regard to an antient custom which forbade them to set out on an expedition before the moon was at the full. (Herod., vi. 106.) But ten years afterwards, when Xerxes invaded Greece, they fought against him, first at Thermopylæ, then at Salamis, and lastly at Platæa. At Thermopylæ, Leonidas, the Spartan king, with a handful of troops, long defied the hosts of the enemy; and at last, after dismissing his allies, fell, with his 300 Spartan citizens, in obedience, as their epitaph recorded of them, to the laws of their country. No achievement recorded of the Spartans was more brilliant and glorious than this; and but for it, they would have been little distinguished in the great national struggle of Greece. At Salamis, the chief command on the Greek side was entrusted to the Spartan Eurybiades, though the Lacedæmonians furnished only sixteen ships, and the Athenians one hundred and eighty; and had not Themistocles interposed, Greece would have been ruined by his irresolute and narrow-minded policy. At the battle of Platæa, B.C. 479, the Spartans were present with a force of 5000 citizens, 5000 provincials, and 35,000 Helots: the chief command was in the hands of Pausanias, their general, and the valour and firmness of his troops mainly contributed to the success of the Grecian arms. But the previous behaviour of the Spartans was in every respect dishonourable and contemptible. On hearing that the Persian general Mardonius was endeavouring to persuade the Athenians to detach themselves from the Grecian cause, they sent a pressing embassy to dissuade them. The Athenians answered, that so long as one Athenian survived, never would they unite with Xerxes. A few weeks passed, and the Athenians in their turn sent to Sparta to solicit aid against Mardonius: the Spartans were then celebrating the festival of the Hyacinthia, and paid no heed to the request of the ambassadors, repeated from day to day for a period of ten days, but continued in the mean time to fortify the Isthmus with a wall; nor did they send assistance till they were reminded that, if the Athenians joined the Persians, their wall, however strong, would prove no security against the stranger. Herodotus simply observes on this subject:—'I cannot tell why, when Mardonius was negociating with the Athenians, the Spartans were so anxious that they should not join the Persians, and afterwards showed no concern about it, except that *then* the Isthmus was walled, and they found that they had no further need of the Athenians, whereas *before* it was not.'

Immediately after the battle the Athenians set about rebuilding their city walls, which had been razed by the Persians. But Sparta, instead of generously assisting them, was mean enough to show her jealousy of Athens, and hypocritical enough to do so under the pretence of a regard for the general weal of Greece. She represented to the Athenians that a walled town outside the Isthmus would only serve, as heretofore, for a shelter to the barbarians, and that therefore they had better assist themselves in dismantling the walls of all towns north of the Isthmus. The pretence was too flimsy not to be seen through, and the intention of the Spartans was frustrated by Themistocles.

In the year 477 B.C. commenced what is called the Athenian ascendency, under the following circumstances. The war was still carried on against Persia, in the Hellespont, and off the coast of Asia Minor, by the confederates, under the command of the Spartan Pausanias; the Athenian admirals being Aristides and Cimon. Pausanias, elated by past success, and the prospect of future aggrandizement, assumed a haughtiness and arrogance in his command which disgusted the allies, particularly the Ionians, who had just asserted their independence, more especially when contrasted with the courtesy of the Athenian commanders. Accordingly all the confederates, except Ægina and the Peloponnesian states, called upon the Athenians to accept the supremacy in the alliance, which had formerly been held by Sparta. (Thucyd., i. 95.) In the mean time Pausanias was recalled, and another commander was sent out in his stead; but it was too late; the confederates refused to submit to his command, and as himself and colleagues would not brook a subordinate station, they retired altogether from the conduct of the war, and left it to the Athenians. The immediate result of this determination was that the supremacy of Sparta was henceforward confined to her Peloponnesian allies, whom the increasing power of Athens attached to her more closely than ever. The position in which Athens was thus placed was not calculated to allay the rivalry and jealousy of Sparta; and accordingly, when the Thasians, who were involved in a war with Athens, B.C. 465, solicited her aid, it was readily but secretly promised, and the Spartans were on the eve of fulfilling their engagement by invading Attica, when a domestic disaster occurred to prevent them. This was caused by a shock of an earthquake (B.C. 464), so violent that the whole of Laconia was shaken by it, and, according to one account, only five houses were left standing in Sparta.

(Ælian, *Var. Hist.*, vi. 7; Plin., ii. 79.) The Helots, the descendants of the conquered Messenians, took advantage of this occurrence to rise against their oppressors, and, in conjunction with some of the Periœci, occupied their former stronghold of Ithome. The Spartans, not being very skilful as besiegers, were unable to take it, but they did not scruple to solicit the assistance of the Athenians. It was generously granted at the instance of Cimon, and he was sent with a force to help them.

Their assistance however not proving so efficacious as was expected, the Spartans doubted their good faith, and dismissed them, retaining at the same time their other allies. The Athenians resented the affront by allying themselves with the Argives, the old enemies of the Spartans, and shortly afterwards met them at Tanagra in Bœotia, as they were returning from an expedition into Doris, their mother country. A pitched battle was the consequence, in which the Athenians were defeated with great loss (B.C. 457). In B.C. 455 the third Messenian war was concluded by the surrender of Ithome; but the Peloponnesians suffered considerably from an armament of the Athenians, which sailed round the coasts, and burnt the Spartan arsenal at Gythium In 450 a truce for five years was concluded through the intercession of Cimon; at the expiration of which the Spartans took advantage of the revolt of the various dependencies of Athens to invade Attica, and advanced as far as Eleusis, but were then prevailed upon to retire, their commanders being, as it was said, bribed by Pericles. A second truce for 30 years was then agreed upon (B.C. 445), by which the Athenians gave up the towns they had acquired in the Peloponnesus, and which was in other respects very favourable to the Spartans. But the jealousy and distrust between the two states were too great to admit of its observance; and circumstances occurred in various parts of Greece which occasioned a renewal of hostilities in its fifteenth year, B.C. 431, and ended in the Peloponnesian war of 27 years. The history of this war is given in vol. xi., pp. 390, 391; it ended in the overthrow of Athens and the restoration of Sparta to the undisputed supremacy over the rest of Greece, after Athens had divided it with her for 73 years. One of Sparta's most valuable allies in the latter part of the war was the Persian Cyrus, and the Spartans were soon called upon to show their gratitude to him. This they did by furnishing him with auxiliaries in his attempt to dethrone his brother Artaxerxes, the king of Persia, an event intimately connected with the destinies of Greece and some of the most important revolutions of the antient civilized world. (Thirlwall, *Hist. of Greece*, iv. 281.) Cyrus failed; and the Ionian cities which had favoured him refused to submit to the satrap Tissaphernes, the successor of Cyrus in his province. Being too weak to resist him, they applied to Sparta, who gladly availed herself of such an opportunity of aggrandizement, and sent a considerable force to aid them in asserting their independence, though when in want of money, during the Peloponnesian war, she had acknowledged the title of the king of Persia to the whole of Asia. Her forces were commanded by Thimbron (B.C. 399), and afterwards by Dercyllidas, who carried on the war successfully against the Persian satraps Pharnabazus and Tissaphernes. A reinforcement was afterwards (B.C. 396) sent out under the king Agesilaus, with a view of anticipating a threatened invasion of Greece by the Persians. His successes against the Persians are detailed in his life. [AGESILAUS.] They were so great as to encourage him to form the design of overthrowing the Persian empire. But he was unexpectedly stopped in his preparations for this design, of which everything promised a glorious result.

His antagonist the satrap Tithraustes, on finding himself unable to cope with him in the field, had recourse to the expedient of sending a sum of money into Greece, for distribution among the leading individuals of the different states, with a view of inducing them to stir up a war against Sparta at home. The supremacy which Sparta had so long enjoyed had not been exercised with moderation or discretion, and consequently the Persian agents soon succeeded in raising a confederacy against her, which included amongst its members Thebes, Argos, Corinth, and Athens. War first broke out between Thebes and Sparta; and the Lacedæmonians, having invaded Bœotia, were defeated at Haliartus, B.C. 395, with the loss of their general Lysander, who was slain under the walls. Pausanias, the Spartan king, had hastened to their relief, but he arrived too late, and was obliged to submit to an ignominious truce. Agesilaus was therefore summoned home by the ephors, and had the patriotism and fortitude to obey their call. But before he arrived another engagement was fought, 'the great battle,' that of Corinth (B.C. 394), in which the Lacedæmonians gained the victory with a very trifling loss. But the Athenians had by this time re-established their navy under Conon, and the victory of Corinth was counterbalanced by a naval defeat off Cnidus. An army of the confederates was again assembled on the plain of Coronea, where Agesilaus met them on his march homewards, and completely defeated them. This however did not finish the Corinthian war as it was called; it continued to be waged for several years by incursions and irregular expeditions, in one of which a Lacedæmonian brigade of heavy-armed infantry, the mora, was defeated by the light-armed targeteers of Iphicrates, an Athenian general. This, which was an unheard-of event in Greece, produced the greatest alarm at Sparta, and corresponding exultation among her enemies, although her loss amounted to only 250 men. Insignificant as this loss may seem, the moral effect of it was very great; it broke the charm of the Spartan name, and taught the confederates that the Spartan heavy-armed troops were not invincible. Reverses of this kind, coupled with the successes of the Athenians in the Ægean, and the descents on the Laconian coasts by Conon and Pharnabazus, disposed the Spartans to peace, which was at last negotiated in the eighth year of the war, under the mediation of the Persian king, whose interference the Lacedæmonians had the address to secure in their favour. The convention was known by the name of the peace of Antalcidas (B.C. 387) and was highly favourable to Sparta.

To avoid a break in the narrative we have hitherto omitted giving any account of a conspiracy, the first known at Sparta, which was formed and detected in the first year of the reign of Agesilaus. The author of it was a Spartan citizen called Cinadon: his design was to overthrow the constitution as it then existed, and he calculated upon the aid of the Helots and unprivileged classes for carrying his schemes into effect. To understand the motives which seem to have prompted Cinadon to this step, we must observe that the Spartan citizens were divided into two classes; the members of one of which were called 'equals' or peers. They constituted the smaller division, and enjoyed considerable privileges in the administration of the state. Cinadon was a man of spirit, unable to brook his exclusion from the higher class, and therefore dissatisfied with his position. Hence the conspiracy which he planned; and which, though crushed in its germ by the promptitude of the ephors, was nigh involving the state in a bloody war, and showed the unsoundness of its whole system.

The peace of Antalcidas was, as we have observed, highly favourable to Sparta. All the Greek states were declared to be independent, a provision which detached the Bœotian towns from Thebes, but did not oblige Sparta to surrender her control over her Laconian and Messenian dependencies, as she was constituted interpreter of the treaty, and was backed by the power of Persia in her exposition of it.

An Argive garrison was withdrawn from Corinth, and Spartan influence restored there; and, on the whole, the power of Sparta was more completely established by the peace than by the arrangements which terminated the Peloponnesian war. The first use Sparta made of the advantages she had gained was to make an unprovoked attack upon the people of Mantinea, a truce of thirty years with that city having just expired. The charge laid against them was that they had failed in their duty as allies in the late war; but one powerful motive which actuated Sparta was the dislike of their democratic form of government. The city was taken, and the inhabitants distributed into four country towns, so as to be under the influence of the aristocratic party, which was powerful and supported by Sparta (385 B.C.). Three years after this she was engaged in more distant operations. The cities of Acanthus and Apollonia in Chalcidice solicited her aid against the growing power of Olynthus, representing that the latter city was likely to become a formidable rival, and was already preparing to ally itself with Thebes and Athens. The fears and jealousy of Sparta were roused, and she determined to send troops against Olynthus. One division of the forces marched by Thebes (under Phœbidas) and encamped near the walls, under the pretext of obtaining a reinforcement, but probably with a different motive. At any rate, an offer was made by the oligarchic party in the city to put them in possession of the Cadmeia, or citadel, and thus make Thebes entirely dependent on Sparta. The offer was accepted, and the design carried into execution, nor did Sparta hesitate to profit by the unauthorised act of her general, although he was fined 10,000 drachmæ; an incident which shows that the old regulation about money had fallen into desuetude. Still she did not restore the Cadmeia, but defended its retention, a defence in which Agesilaus joined on the ground of expediency; thus confirming the assertion in Thucydides, that 'of all states Sparta most glaringly showed by her conduct, that in her political transactions she measured honour by inclination and justice by expediency.'

The war against Olynthus lasted four years, and ended in the capture of the city, B.C. 379. The Spartans were now at their highest point of power. Olynthus was overthrown, Bœotia was dependent, Corinth friendly, Argos reduced, and Athens without allies. But a change came upon them; and they suffered a deserved retribution for their flagrant violation of the treaty which provided for the independence of the states of Greece. So great in fact was the degradation of the reverses by which she was afterwards humbled, that Xenophon recognised in them the hand of a retributive Providence, exacting vengeance for her iniquity at Thebes. The Cadmeia was soon recovered by a band of exiles of the democratical party, and the Lacedæmonians were entirely expelled from the city; and shortly afterwards, by an intrigue of the Theban Pelopidas, and through an indiscreet aggression of the Spartan general Sphodrias, Athens was prevailed upon to ally herself with Thebes against Sparta (B.C. 379). Hostilities were carried on for six or seven years, during which Sparta made several expeditions into Bœotia, and greatly distressed Thebes by ravaging and plundering its territory. In the meantime, the Athenians were victorious at sea under Chabrias, off Naxos (B.C. 376); but they soon became tired of their alliance with a new friend, and concluded a separate treaty with Sparta (B.C. 374), and by virtue of which their fleet, then under Timotheus, was called home. This general however, as he was returning, restored to their country some Zacynthian exiles, an act which the Spartans precipitately voted to be a wrong, and that it should be redressed by arms; a vote the more unjust, as Sparta had been relieved from the pressure of the war, and Athens had broken up her fleet, not conscious of any intentional wrong. The result was what was called 'the second or after war;' but friendly relations were soon re-established (B.C. 371), and a treaty made from which Thebes was excluded, as she would not consent to one of its stipulations, according to which every state of Greece was to be independent; to which Sparta agreed, relying on the antient connection between herself and the other states of Peloponnesus for the continuance of her supremacy over them. Thebes however refused to surrender her sovereignty over the cities of Bœotia, and Sparta gladly availed herself of the refusal, as a sufficient reason for ordering an army, then in Phocis, under Cleombrotus, to invade Bœotia; in direct contravention of the treaty, which provided that all armies should be forthwith disbanded. The Spartans met the Theban forces, commanded by Pelopidas and Epaminondas, on the plain of Leuctra. To their astonishment and surprise, they were utterly defeated in a regular pitched battle, by inferior numbers, a circumstance unparalleled in the previous history of Sparta (B.C. 371). The battle was most decisive, and from it we may date the decline of the Spartan power: but it is interesting to observe how the news of the defeat was received at Sparta, as it gives us some insight into their national character, and shows the still continuing power of the institutions of Lycurgus. The Spartans were then solemnising a great festival in their theatre, and a chorus was exhibiting. Still the ephors did not allow any interruption of it; they only communicated the names of the slain to their kinsfolk, and ordered the women to abstain from the usual mourning. The next day, the friends of the slain went about with cheerful countenances, and the only signs of sorrow and shame were shown by the relatives of the survivors. Still with all this show of unconcern, deep despondency was really caused by the defeat. The influence of Sparta over her dependencies was shaken; the people of Mantinea again assembled, against her wishes, in one fortified city, which they called Megalopolis, and established a democratic government. The Thebans invaded Laconia, under Epaminondas, to help them, and advanced into the immediate neighbourhood of the unwalled capital, burning and pillaging, till it was filled with the utmost consternation, which was increased by the disaffection prevalent amongst the subject classes. For the first time, the women of Sparta saw fires kindled by an enemy; and but for the vigilance and energy of Agesilaus, the city would have been taken. The whole plain of the Eurotas, as far as the sea-coast, was devastated; but this was not the greatest injury inflicted upon the Spartans. The Theban general collected together the expatriated Messenians, and restored them to their fatherland, thus establishing a permanent enemy close to Sparta (B.C. 367), and depriving many of her citizens of the greatest part of their property. But this was not his last expedition into Peloponnesus; he undertook no less than four; in the last of which he nearly surprised and took Sparta in the absence of Agesilaus. He then resolved on a general engagement, and met the Spartans and their allies, amongst whom were the Athenians, at Mantinea. His army was victorious, but he himself was slain; the supremacy of Thebes fell with him (B.C. 362); and Xenophon observes that greater confusion prevailed in Greece after the battle than before. Still one result flowed from it, the recognition of the independence of Messenia by the allies of Sparta, in which she refused to acquiesce, and was consequently excluded from a treaty to which the other belligerent parties agreed (B.C. 361).

From this time Sparta ceases to appear in history as one of the leading states of Greece; but although she lost all chance of recovering her former position, she had the satisfaction of seeing neither Thebes nor any other city able to take her place. Another power soon assumed the control in Grecian affairs, and when the Spartans attempted to enforce their claim to Messenia, we find Philip of Macedon opposing their pretensions, and supporting the independence of that country. After the battle of Chaeronea (B.C. 338), he invaded Laconia, and, according to Polybius (ix., 28), obliged her to surrender several small districts to the Argives, Arcadians, and Messenians. In the reign of Alexander, and while he was engaged in his Eastern conquests, the Spartans made an attempt to overthrow the Macedonian empire, but they were defeated by Antipater, Alexander's lieutenant, and Agis, their king and commander, was slain, B.C. 331. (Diod. Sicul., xvii.; Thirlwall, *Hist. of Greece*, vol. vi., p. 257.) In the contests which divided Greece after the death of Alexander, Demetrius, the son of Antigonus, was at war with the Spartans, and victorious over them in two engagements. Their next assailant was Pyrrhus (B.C. 268), against whom they made a gallant defence, assisted and animated by the women, whose spirit saved the city from capture. At that time it was walled. After that event we hear little of Sparta till the reigns of Agis III. and Cleomenes (B.C. 240). The institutions of Lycurgus, though existing in name, were then no longer of any force at Sparta. The regulation by which every head of a family was ensured the possession of a plot of land had been repealed. The number of Spartan citizens was considerably reduced, and a great accumulation of property was vested in the hands of a few people, many of whom were females. Agis and his friends wished to return to the original constitution, and the mode of life of former times. He perished in the attempt to carry out his views (B.C. 240), being murdered in prison at the instigation of the ephors, who had now monopolised almost all authority in the state. In B.C. 236, Cleomenes III. ascended the throne, and by stratagem and force succeeded in the attempt in which Agis had failed; a general division and re-distribution of property took place; some of the Periœci were adopted amongst the Spartan citizens; the old mode of education and the public meals were resumed; the ephors put to death, and their office abolished. Cleomenes also defeated the troops of the Achæan league in several engagements, and had conquered a great part of the Peloponnesus, when Aratus, the strategus or general of the Achæans, summoned Antigonus Doson from Macedonia to oppose his progress. The Macedonians and Spartans met at Sellasia, on the borders of Laconia, and after a hard-fought and decisive battle Antigonus was victorious. He then marched to Sparta, and restored the former state of things. Cleomenes fled to Egypt.

Pausanias (iii., 6, 5) observes of him, that he was the last of the Agidæ, and shortly afterwards the sovereignty was sold by the ephors to Lycurgus, who was not even a Heracleid. He sided with the Aetolians in the confederate or social war between them and the Achæans. (Polyb., iv., 2.) He was succeeded by Machanidas, who is called a tyrant, and was conquered and slain by Philopœmen, the general of the Achæans. (Livy, xxviii., 5.) Nabis, the last of these usurpers, resisted the Achæans and Romans, who had now appeared in Greece, but was eventually assassinated, B.C. 192. Shortly afterwards Laconia was invaded by the Achæans, and as they were superior in force, the Spartans were compelled to submit to their orders to destroy their walls, to abolish the institutions of Lycurgus, and to join the Achæan league. The Roman senate however afterwards decreed that the walls should be rebuilt, and that the Lacedæmonians should no longer be included in the Achæan confederacy (B.C. 148).

After the capture of Corinth (B.C. 146) all Greece was reduced to a Roman province, but the inhabitants of Laconia, we are told by Strabo (viii., p. 366), enjoyed more freedom than the other states, being treated not so much like subjects as allies.

Some of the old provincial towns around Sparta were honoured by Augustus with the title of Eleuthero-Lacones, or free Laconians, and released from all dependence upon Sparta.

The colonies of Sparta were but few. The principal were —the island of Calliste or Thera, Cnidos, and Tarentum. (Herod., i. 65; vi., 52-59; Xenophon, *De Repub. Lacon.*; Pausanias, *Laconica;* Thirlwall, *Hist. of Greece*, caps. viii. and ix.; Cramer's *Ancient Greece*, vol. iii., *Laconia*.

SPA'RTACUS. [GLADIATORS.]

SPARTALITE. [ZINC.]

SPARTIA'NUS, ÆLIUS. [AUGUSTA HISTORIA.]

SPARTUM, a name applied by the Romans to the plant much used by them for cordage. It is fully described by Pliny (*N. H.*, xix. 2), who says that it had not been noticed by Theophrastus, and that it is a herb growing of itself without setting or sowing, and that it might be called the rush of a dry and lean ground. That it is common about Carthago Nova (Carthagena), and that whole mountains are overspread with it. When pulled, which it is with some difficulty, it is made into bundles, afterwards dried, and then steeped in water, a process which is repeated two or three times; also that no cordage was considered better than that of this plant when exposed to wet. Authors have differed much respecting the plant intended; some conceiving that some of the brooms are intended, as *Spartium junceum*, or Spanish broom, which produces a fibrous thread of which cloth is made; and *S. monospermum*, which is found on the coasts of Spain as far as the moving sands reach; its twigs are used for tying bundles, and herbs are brought to market tied together with them. The leaves of both afford food for sheep and goats. Others are of opinion that some of the grasses are intended, which grow in the same places and are used for the same purposes, as, for instance, *Lygeum Spartum* and *Stipa tenacissima*, both of which are called *esparto* by the Spaniards, and both are used for making ropes, baskets, nets, and for filling paillasses. Both have also been employed in making a kind of cloth, and the manufacture of this, as well as the various purposes to which these grasses are applied in Spain, was introduced some years since into the neighbourhood of Paris, and a considerable commerce of exports exists from Spain to the south of France and to Italy, where *esparto* is employed for making baskets, sacks, cordage, and even cables.

SPASM (from the Greek σπασμός) is an unhealthy, involuntary, and forcible contraction of muscular tissue. The term is almost synonymous with *convulsion*, but is more generally applied than that word is to the unhealthy painful contractions of the heart, intestines, and other involuntary muscles.

Nosologists have distinguished spasms into clonic, in which the muscular contractions alternate rapidly with relaxations (as in epilepsy), and tonic, in which the contracted fibres remain for a long time rigid, as in tetanus; but in nature the distinction is not well marked. Spasm has also often been regarded as occurring in many tissues, in which it is perhaps not possible, such as the small blood-vessels. In the present day its occurrence is believed to be limited to the muscles. What their condition is when affected by spasm is not precisely known. Very generally the contraction is unnatural, not only in its origin and its continuance, but in its extent; for it does not take place simultaneously, or in a regular succession, in each part of the muscle, but, as one may often see in common cramp, it affects a single portion of the muscle, drawing it up into a hard mass, while the fibres above and below it are much less contracted, or are even elongated.

The greater number of spasms seem to depend on an irritation of the nervous centres. Sometimes they are produced by primary disease in those parts, but much more commonly they are the results of irritation propagated from some disordered organ to the brain or spinal chord, and thence reflected through the motor nerves of the muscles in which the spasm occurs. Hence probably the frequency and the aggravation of cramps, and other more important spasmodic affections, when the digestive organs are disordered, the dependence of a variety of spasms or convulsions on the irritation of teething, &c. Much less however is known of the nature of spasm in general than of the best methods of treating it, and of the effects which it produces in the several organs which it affects. These are treated of in the articles ANGINA PECTORIS, ANTISPASMODICS, ASTHMA, COLIC, CONVULSIONS, EPILEPSY, HYDROPHOBIA, TETANUS, &c.

SPATHE (the Greek σπάθη). This term is applied to the sheathing involucrum of many plants. It is seen in the greatest perfection in the flowers of Palmaceæ and Araceæ, where, during the flowering of the plants, it embraces the entire inflorescence. This organ is considered by most botanists to be a modification of the bract, and as the plants in the above orders have no corolla, it probably performs the function of the ordinary floral envelopes. Link considers the spathe a modification of the petiole. The flowers of the Narcissus, the Snowdrop, and the Iris are invested, in the early periods of their growth, with a spathe which only encloses a single flower.

SPAVIN. [HORSE.]

SPAWN is a term frequently used in gardening to indicate the buds or branches which are produced from underground stems. These, from the facility with which they form roots when separated from the parent stem, are capable of maintaining an independent existence, and on this account are employed as a means of propagating many plants.

Spawn is also applied to the white fibrous matter which, shooting through earth, dung, decaying vegetable matter, &c., is the matrix from which mushrooms and other fungi are produced. It is generally composed of small white thready fibres, which produce, at various distances, little white knobs, from which the stem and cap of the mushroom proceed. This matrix or spawn, called mycelium, is in fact the real stem of the mushroom, and the stipes and pileus, with their appendages, are the inflorescence. This spawn is made use of for the purpose of procuring from it the growth of the edible mushroom (*Agaricus campestris*). It is introduced into beds consisting of dung and earth, which are called spawning mushroom-beds. [MUSHROOM.]

Mushroom-spawn for the purpose of sowing may be procured at all seasons of the year, but in most abundance at the end of summer and commencement of autumn. The positions in which spawn may be looked for in greatest quantity are in places where horse-dung has been collected in any quantity and remained for some time, as in dunghills, compost-heaps, old melon or cucumber hot-beds, horse-mill tracks, stable-yards, &c. In these situations, the spawn is found adhering to lumps of dung and earth, which should be placed entire in the beds for the growth of the mushroom. It may also be obtained from meadows and pastures from spots where the mushroom is found growing.

SPEAKING-TRUMPET. The occasional use of instruments for enabling the human voice to be heard at a great distance may be traced back to a period long prior to the æra of their general adoption; but it is often difficult to ascertain how far such contrivances bear the character of speaking-trumpets, for strengthening and conducting the sound to a distance; or that of hearing-trumpets, by which the sound is collected and conveyed to the ear. In some cases also, in which the relations of early writers have been supposed to indicate the use of something like speaking-trumpets, it is doubtful whether the instruments referred to were used for transmitting articulate sounds, or whether they were merely wind-instruments of extraordinary power.

Beckmann (*Hist. of Inventions, &c.*, vol. i.) alludes to the monstrous trumpets of the antient Chinese, as referred to in a French work published by Renaudot in 1718, entitled

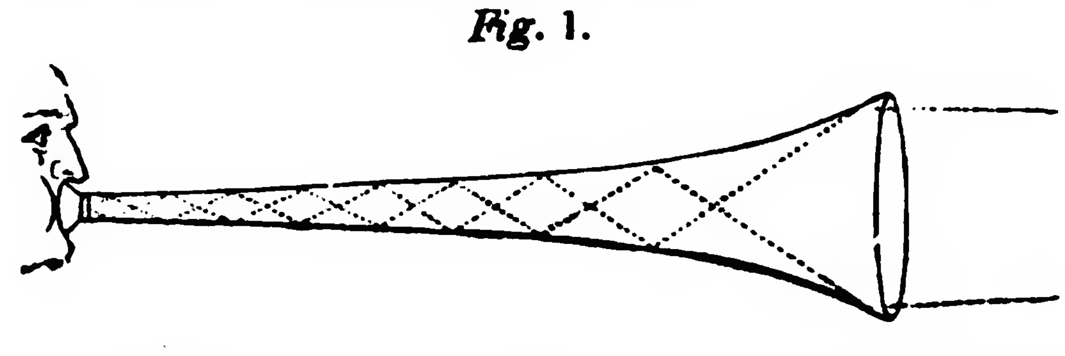
Anciennes Relations des Indes et de la Chine, de deux voyageurs Mahometans, qui y allèrent dans le neuvième siècle,' as if they were used for the communication of articulate sounds; but we find nothing in the passage referred to (p. 25 of the French work) to justify such a supposition. Even Beckmann himself, while he describes them as 'instruments by which words could not only be heard at the greatest distance possible, but could also be understood,' observes, in a note, that they are 'improperly called speaking-trumpets' by Haller, in his 'Elementa Physiologiæ,' vol. v. Some have considered the great horn described in an old manuscript in the Vatican library as having been used by Alexander the Great to assemble his army, to be the oldest speaking-trumpet on record; but Beckmann conceives that it has received that name without sufficient evidence, since the description does not expressly say that Alexander *spoke* through the horn; and the book itself, which is entitled 'Aristotelis Secretum Secretorum ad Alexandrum Magnum,' is certainly not the production of Aristotle, though probably very old.

The credit of the invention of the modern speaking-trumpet has been warmly contested by the partisans of Sir Samuel Morland and Athanasius Kircher. The claim of the former is supported by a pamphlet which he published in 1671, of which some account has been given under MORLAND, SIR SAMUEL, vol. xv., p. 408. The title of the copy which is preserved in the library of the British Museum differs from that given as above, being 'Tuba Stentoro-Phonica, an instrument of excellent use, as well at sea as at land, invented and variously experimented in the year 1670.' The title-page also says, 'The instruments (or speaking-trumpets) of all sizes and dimensions are made and sold by Mr. Simon Beal, one of his Majesties Trumpe., in Suffolk Street.' As stated in the article above referred to, Morland's first speaking-trumpet was of glass, and only two feet eight inches long; it was two inches and a half in diameter at the small end, and increased very gradually in size to near the other end, where it suddenly enlarged, like the mouth of an ordinary trumpet, to eleven inches diameter. The next he made was of brass, about four feet and a half long, twelve inches in diameter at the large end, and only two inches at the small end, to which was affixed a mouth-piece, 'made somewhat after the manner of bellows,' to move with the mouth, and thereby to prevent the escape of the breath. This was tried in St. James's Park, and rendered the voice audible at a distance of near half a mile. The third instrument was of copper, recurved in the form of a common trumpet. Its total length was sixteen feet eight inches, the large end nineteen, and the small end two inches in diameter. With this the voice was heard about a mile and a half. Morland made another of the same form, still larger, and two others of the straight form, and five feet and a half long. With the latter a man could make himself heard a mile and a half; and with one of the largest trumpets, tried at Deal Castle, the voice was conducted a distance of between two and three miles over the sea.

In 1673, when Morland's invention had attracted much attention on the Continent as well as in England, Kircher, in the preface to his 'Phonurgia,' claimed the invention for himself, and intimated that he had published a description of the speaking-trumpet several years before the appearance of Morland's pamphlet. His claim does not however appear to be very well supported, since, according to Beckmann, the 'Ars Magna Lucis et Umbræ' of Kircher, which seems to have been first published about 1643, contains only an account of Alexander's horn, and of a tube, of which one end was to be applied to the mouth of the speaker, and the other to the ear of the listener. His 'Musurgia,' printed in 1650, affords little more evidence in his favour, being only a description of a kind of funnel by which the voice of persons near the large end might be conducted to the small end. Such a funnel, which seems rather like a large hearing-trumpet than a speaking-trumpet, he had, according to his 'Phonurgia,' constructed as early as 1649, in the Jesuits' college at Rome. Whatever may have been the justice of his claim as its inventor, Kircher tried a proper speaking-trumpet in or about 1673. For further information on this question, the reader is referred to Beckmann.

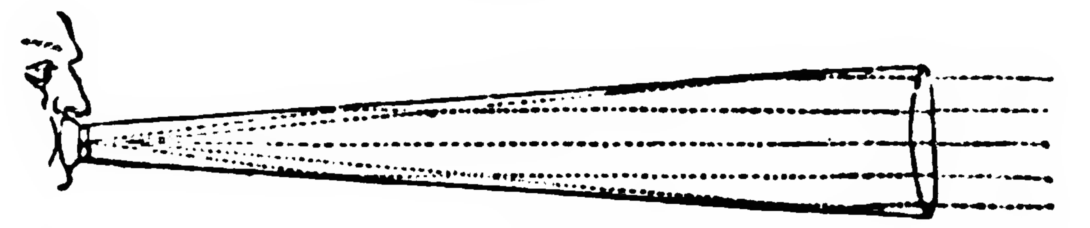
The action of the speaking-trumpet has been variously explained by different writers; but its efficiency has been most commonly attributed to the repeated reflection of the sound from side to side in passing through it, and its ultimate reflection from the mouth of the trumpet, in such a way as either to collect the rays of sound into a focus at a distance, or to project them forward in parallel lines, instead of allowing them to diverge in all directions. The annexed diagram, *Fig.* 1, illustrates this theory, of which there are

*Fig.* 1.



many modifications, some of them founded on the supposition of a very close analogy between the motion of sound and that of light. These have given rise to many suggestions respecting the best form and degree of curvature of the sides of the trumpet. Some writers recommend a simple cone, the mouth-piece being at the apex: these explain the motion of the rays of sound on the principle shown in *Fig.* 2, in which, as in the former diagram, the

*Fig.* 2.



dotted lines represent the rays. In Professor Leslie's 'Experimental Inquiry into the Nature and Propagation of Heat,' and in the article 'Acoustics,' in the Supplement to the 'Encyclopædia Britannica,' written, we believe, by the same author, the action of the speaking-trumpet is explained in a different way. 'Its performance,' observes the Professor, 'does certainly not depend upon any supposed repercussion of sound; repeated echoes might divide, but could not augment the quantity of impulse.' He further conceives that the instrument has no peculiar power of transmitting sound in any particular direction, and accounts for its effect as follows:—'The tube, by its length and narrowness, detains the efflux of air, and has the same effect as if it diminished the volubility of that fluid, or increased its density.' 'The organs of articulation,' he continues, 'strike with concentrated force; and the pulses, so vigorously thus excited, are, from the reflected form of the aperture, finally enabled to escape, and to spread themselves along the atmosphere.' The experiments of Hassenfratz, a French philosopher, are cited in support of this theory. He tried the power of a speaking-trumpet by measuring the distance at which the ticking of a watch could be heard through it, and found the effect the same, whether the metal tube were used simply, or wrapped round in such a way as to prevent vibration. It was also heard at the same distance when the inner surface was lined with linen or woollen cloth to diminish reflection, and the range of a cylindrical trumpet was the same as that of a conical one.

SPEARMINT. [MENTHA VIRIDIS.]

SPE'CIES. [GENUS.]

SPECIES. This word is used in mathematics, or rather has been used, in two different senses. In the first place, by Euclid, who means by figures of the same species those which have the same form, whatever may be their size. Thus, in the Data, when the form of a figure is given, he designates it as given in species (τῷ εἴδει δεδομένον). The word species is here used in its primitive sense of *appearance*.

But the term was again used by Vieta in its logical sense, as opposed to individual, in designating the algebraical notation which he first distinctly proposed. Lawyers were in the habit of describing general cases by using individual names, as Caius or Julius, to signify any person concerned, which they termed description by species. Vieta borrowed the word to signify the use of letters to stand for numbers, when such letters were used to designate members generally, without reference to any one in particular. The logistics (a common term for the science of calculation) thus introduced he called *specious*, and his first tract on the simple operations of algebra is headed 'De Logistica Speciosa.' Hence, for some time, the language of algebra was called the specious notation.

**SPECIES OF PLANTS.** All the individual forms of plants, as well as animals, that occur on the globe, may be collected into groups resembling each other, and these groups are called *species*. A species has been defined to be 'a combination of individuals alike in all their parts;' 'a systematic combination of homogeneous individuals;' 'a collection of individuals which will breed together and produce fertile offspring.' De Candolle says, a species is 'a collection of all the individuals which resemble each other more than they resemble anything else, which can by mutual fecundation produce fertile individuals; and which reproduce themselves, by generation, in such a manner that we may from analogy suppose them all sprung from one single individual.' However clear such a definition may be, it would assist a botanist only in a very limited degree in determining whether a new plant should be looked upon as a new species. If there were perfect structural identity between two individuals of the same species, or if we could ascertain, on the physiological ground, that the individuals after fecundation reproduced similar individuals, it would then be a more easy task. But perfect structural identity does not exist, and the physiological test cannot be always applied, and hence the difficulty of determining what is really a species. From this some have gone so far as to deny the existence of species altogether, and assert that the supposed distinctions between plants are altogether arbitrary and imaginary. This notion is however altogether upset by the well-known fact of plants maintaining for centuries the same structural characters.

However much it may be regretted on account of the vexatious multiplication of species, that some fixed rules cannot be laid down for their formation, it does not appear at present that anything more than general rules can be given, and that much must depend on the judgment and experience of the observer.

As a general rule species are not distinguished by differences in the internal organization, such differences being left for the higher divisions into genera, orders, and classes; but upon those superficial and external differences which are independent of internal structure. Of these may be named duration, dimension, surface, form, division, numerical proportion, colour. The value of each of these points varies according to circumstances, and in proportion to the knowledge of the observer will be the skill with which he selects them for distinguishing species. The *duration* of a plant is a point of great importance, as in no instance do we find, unless from change of climate, plants of the same species differing in being annual, biennial, &c. *Dimension* is rarely of any importance, and should only be taken into consideration in extreme cases. Differences of *surface*, depending on structural peculiarities, are of importance; smoothness, roughness from tubercles, and the existence of stinging hairs and prickles, are points of value. The presence or absence of lymphatic hairs on the surface of leaves is a point that may mostly be disregarded; they are of more importance on other parts. The *form* of parts is only of importance when it is the consequence of anatomical differences, that is to say, the arrangement of the veins, &c. The *division* of organs is not of much importance where it depends on the degree of the laceration of the parenchyma. The union or non-union of contiguous organs, as the parts of the calyx, corolla, &c., is of the greatest value, being mostly uniform in all the individuals of the same species. The *numerical proportion* of the parts of a plant is of value in proportion to the small number of parts or organs; the greater the number, the more subject it is to variation. Differences in *colour* are little to be relied on; the same may be said of odour and taste; as all these properties are liable to undergo change by a slight alteration of the circumstances of the plant.

Those departures from identity of structure, which are considered insufficient to constitute a species, are called *varieties*, and the points of structure that should constitute a species or variety is frequently a matter of difference, and it is no unfrequent thing for one author to reduce the species of another to mere varieties. Thus Borrer has made 71 species of Salix, but Koch has reduced them to 29, and numerous examples could be cited. A careful attention to the influence of climate, soil, elevation, &c. on species, would save much trouble and vexation on this point. De Candolle has elegantly summed up the influence of these agents on plants. 'Let us suppose,' he says, 'what really happens, that the seeds of plants are scattered at hazard over the surface of the earth; or, to speak more correctly, by causes that have no necessary connection with the existence of those plants; such seeds will find themselves in an infinite variety of situations; some which have fallen in soil that is too tenacious or too loose, too dry or too wet, too hot or too cold, do not grow, and are soon destroyed. But between these extremes some will succeed, although it may be under very different circumstances. Thus, for instance, if the place has not light enough, the plant will be half blanched, which will be indicated by its paleness and feebleness, or by being spotted, or by the diminution or even loss of its hairs; if the light is too bright, the plant will be stronger, smaller, more deeply coloured, harder, and more velvety than usual. Temperature also exercises some influence, though in a less degree; in a cold climate the same plants are smaller and weaker than ordinary; the colour of the flowers and fruits is paler, the wood worse ripened, their leaves more deciduous, their fruit often abortive, and the sap destined to nourish it, throwing itself into the neighbouring parts, sometimes changes their appearance. In a hot climate plants become larger, produce more wood, and their leaves have brighter colours and a higher flavour. In the same climate humidity causes the appearance of differences without end; plants that grow in water lose all their hairs, their leaves become divided into capillary segments so as to look like hairy roots, their stems and flower-stalks lengthen to reach the surface of the water, and these different effects are further variable as the water is still or agitated, clear or turbid, pure or mixed with heterogeneous substances; the varieties of *Ranunculus aquatilis* offer a remarkable example of this. If on the other hand a plant accustomed to water is found to live in a drier soil, it becomes covered with hairs, remains smaller than usual, and acquires greater hardness. In air rarified like that of mountains, plants are generally found smaller and more stunted than usual, while their flowers are larger than upon the plains. The influence of soil is not less manifest: if it is tenacious, the roots, which penetrate it with difficulty, are small, hard, and clustered; if it is very sandy, the roots become large, fleshy, and fully formed; if it contains a great quantity of carbon, the colours of the flower are often altered, as those of the Hydrangia into blue, and of the Pink into violet; if it is charged with salt, or if the plant is within the reach of salt, even brought through the atmosphere, we usually find the leaves more fleshy and more glaucous, as in *Lotus corniculatus*. All these different circumstances, combined with each other in nature, are fertile causes of varieties, which are still further multiplied by cultivation.'

**SPECIFIC GRAVITY**, or, more properly, specific weight, is a term used to express the weight of any gas, liquid, or solid, under some given volume; but the unit of weight and unit of volume are usually such, that for some one particular substance the weight of the unit of volume shall be expressed by the unit of weight, or by 10 times, 100 times, or 1000 times that unit. Thus the numbers expressing the specific gravities of different substances denote the actual weights of those substances under the unit of volume; and hence the ratio between the numbers expressing the specific gravities of any two substances is the same as the ratio between the weights of those substances under any two equal volumes, the density of the atmosphere and also the states of those substances with respect to temperature being the same.

Distilled water is the substance usually employed for the purpose of comparing together the weights of all substances except the gases; and because the volume of any substance varies with its temperature, in determining from experiment the specific gravity of any substance, the weight under a given volume is reduced to that which it would become at one constant temperature. The constant temperature adopted in this country is, in general, that which is expressed by 60 degrees of Fahrenheit's thermometer.

From the experiments of Sir George Shuckburgh Evelyn it was found that at the temperature expressed by 39° Fahrenheit, the height of the column of mercury in the barometer being 29·79 inches, the weight of a cubic foot of distilled water was 999·8066 ounces avoirdupois; and reducing this weight conformably to the table of the densities of water at different temperatures which has been given by Biot, it will be found that at a temperature expressed by 60° Fahrenheit, and when the height of the mercurial column is 30 inches, the weight of the cubic foot of water is 999·54 ounces. But in the Parliamentary regulations, which were made in 1825, a cubic inch of water is stated to weigh 252·458 troy grains, the temperature being 62° Fahrenheit, and the height of the barometrical column, 30 inches; and 7000 troy grains are made equivalent to one pound avoirdupois: hence it follows that a cubic foot of water should weigh 997·136 ounces. Either of these numbers is sufficiently near 1000 to make it very proper that this last should be adopted for the specific gravity of water, since a change in the value of the avoirdupois ounce, which would be scarcely appreciable in the ordinary transactions of commerce, would render the ounce an accurate and convenient unit of weight, while the cubic foot constitutes the unit of volume.

On the Continent, since the employment of the decimal scale of weights and measures has become general, the cubic centimetre (·061028 cubic inches English) is the unit of volume, and the gramme (15·407 troy grains) is the unit of weight. The gramme having been determined by the weight of a cubic centimetre of distilled water of the temperature at which its density is a maximum (38·25° Fahr.). Thus the weight of a cubic centimetre of any substance being expressed by any number $n$ of grammes, $n$ is the specific gravity of that substance.

The numbers expressing the specific weights of substances are also taken to represent their densities. Density, properly speaking, denotes the degree of closeness of the particles of a substance to one another; but this is evidently proportional to the number of particles within a given volume of that substance; and since the weight of a body is only the sum of the actions of gravity upon all its particles, it follows that the densities of two substances under equal volumes will be proportional to their specific gravities. It follows also that if two substances have equal densities or specific gravities, their weights will vary with their volumes; and that the weights of bodies are to one another in a ratio compounded of their specific gravities and volumes.

Previously to describing the methods of finding the specific gravities of substances, it will be proper to explain the construction of the hydrostatical balance, which is the instrument employed for the purpose. The beam of this balance rests, as usual, on the lower circumference of a circular perforation in both sides of the fork which holds it, by a pin which is fixed in it perpendicularly to its length and depth, at a small distance above the common centre of gravity of the beam, scales, and weight. The fork is suspended from the middle of a horizontal bar, and this last is suspended from a spring at the top of the pillar which supports the machine. Care is taken that the two arms of the beam are symmetrical, and that the points from whence the scales are suspended are at equal distances from its centre of gravity. Now let the substance which is to be weighed be put in one of the scale dishes, and the number of grains necessary to keep it in equilibrio be put in the other. If the weight of the substance should be an exact number of grains, that weight is determined, but if not, and it were required to ascertain the weight within one-hundredth part of a grain (for example), the following contrivance may be adopted. Suspend in a vertical position, from the lower part of the scale containing the substance to be weighed, a brass wire, whose volume and weight have been previously determined, and let part of the length of this wire enter into water which is contained in a vessel underneath the scale. The scales with this wire thus attached to one of them being previously put in equilibrio when the surface of the water is at a certain mark on the wire, let the substance to be weighed be introduced into the scale above the wire, and let weights be placed in the opposite scale till one grain more would be found too great: then gently raising the whole balance till, by the increase of the weight on the side of the scale containing the substance, in consequence of a greater portion of the wire being out of the water, an equilibrium takes place. The wire being graduated so that 100 divisions correspond to a weight equal to one grain, the number of graduations on it between the surface of the water and the fixed mark before mentioned will enable the experimenter to determine the number of hundredths of a grain by which the weight of the substance in the scale exceeds the number of grains already placed in the opposite scale.

If it be required to weigh a substance in water, or in any other liquid, that substance may be suspended in a vessel containing the liquid by a horse-hair attached below the scale opposite to that from whence the wire before mentioned was suspended; and its weight while immersed in the liquid may be found to the hundredth part of a grain, as in the former case. The reason why horse-hair is employed to suspend the substance in water is, that it has very nearly the same specific gravity as that fluid.

A solid body having greater specific gravity than water being thus weighed both in air and water, may have its specific gravity determined, that of the water being supposed to be known or assumed, by the following proportion:

The weight lost by immersion in water (that is, the weight of water equal in volume to the volume of the solid [HYDROSTATICS],
Is to the weight of the body in air,
As the specific gravity of the water is to that of the body.

The specific gravity of a fluid is found by weighing any one and the same solid body in air, in water, and also in the fluid, and observing the two differences of weight These differences are the weights of quantities of the two fluids which are equal in volume to the solid body; and they are to one another as the specific gravities of the two fluids: hence that specific gravity which was required may be found. [See also HYDOSTATICS, p. 403, col. 2.] It should be observed that the specific gravity of the solid must be greater than that of either of the fluids, in order that the solid may sink when immersed in them.

If the body whose specific gravity is to be found be a solid lighter than water, there must be annexed to it, before it is weighed, a mass of some material of known specific gravity, and such that the two bodies may together sink in the water. The compound mass, and the heavier body alone, must be weighed both in air and water; also the lighter body must be weighed in air. Let W be the weight of the compound mass in air, and W′ the weight of the same mass in water; also let $w$ be the weight of the heavier body in air, and $w'$ the weight of the same body in water: then W − W′ is the weight of water equal in volume to the compound body, and $w-w'$ is the weight of water equal in volume to the heavier body. The difference between W − W′ and $w-w'$ is the weight of water equal in volume to the lighter body; therefore, by hydrostatics, that difference is to the specific gravity of water as the weight of the lighter body is to its specific gravity.

When the body is soluble in water, it may be weighed in air, and also in some fluid whose specific gravity is known, and which is not capable of dissolving it; then its specific gravity may be found by the first of the above-mentioned rules, substituting the weight lost in the fluid for the weight lost in water.

If the solid body imbibes water without being dissolved in it, let it be weighed when perfectly dry, and call that weight W: again, find the weight of water displaced by the body when dry, and call it D; then D is to W as the specific gravity of water is to the specific gravity of the body in its actual state. But D − W is the weight of the water displaced by the solid part only of the body; therefore D − W is to W as the specific gravity of water is to the specific gravity of the solid part only of the body.

It must be observed that the true weight of any body, or that which the body would appear to have if weighed in vacuo, is greater than the weight which it is observed to have when weighed in air, by the weight of a volume of air equal to the difference between the volume of the body and that of the object by which the weight is determined. It should also be observed that the numbers expressing the specific gravities of substances are strictly correct only on the parallel of latitude passing through the place where the weight of the water under the unit of volume is determined; for the force of gravity, and consequently the weight of any substance under a given volume, increases in proceeding from the equator towards either pole of the earth.

In order to determine the specific gravity of the atmosphere, or of any gas whatever, the air or gas must be weighed in a globular vessel of glass, of sufficient magnitude to prevent the unavoidable errors of the operation from sensibly affecting the results.

By means of a good air-pump let the air be drawn from the vessel as much as possible, and suppose, for simplicity, that the exhaustion is complete: then let the orifice be closed, and the vessel weighed in air, suspending it for this purpose below one of the scales of the hydrostatical balance Afterwards, by opening the valve, let the atmospherical air fill the vessel, and let the latter be weighed when thus filled. If W and W′ be the weights thus determined, then W′−W is the weight of a volume of air equal to the interior capacity of the vessel. This capacity being supposed to be known, the specific gravity of the air at the time of the experiment may be found by proportion. In like manner having weighed the vessel after the atmospherical air has been removed from it by the air-pump, let the vessel be filled with any gas whose specific gravity is to be determined, and, in this state, let it be again weighed. Let W and $w$ be the two weights thus determined; then $w - W$ will be the weight of the gas.

It is usual, for the sake of greater accuracy, to find the specific gravity of any gas from the ratio that the weight of any volume of it bears to that of an equal volume of atmospherical air; and the latter being the same in all parts of the earth, when the atmosphere is in the same state with respect to density and temperature, the weight of a cubic foot of it becomes a convenient unit for the specific gravities of the gases. Therefore, $W' - W$ is to $w - W$ as unity (the assumed specific gravity of air) is to the specific gravity of the other gas.

But the atmosphere in which the operations are performed varies at different times, even during the same day, with respect to its temperature and to the weight of the column which presses on the earth, that is, it varies with the state of the thermometer and barometer: it also varies with respect to the quantity of aqueous vapour which it contains. The vessel in which the air to be weighed is contained varies moreover in volume with a change of temperature, from the expansion or contraction of the glass; and, on all these accounts, corrections must be made before the specific gravity of a gas can be completely determined. Corrections should also be made for the small quantity of atmospherical air which remains in the vessel after the exhaustion has been carried as far as the air-pump will permit.

For the formulæ by which the corrections should be made see Biot's 'Traité de Physique;' the following rules being however of frequent application, their insertion in this place may be advantageous. First, the temperature of any gas being constant, the density varies inversely as the volume, and the volume varies inversely as the pressure under which it exists (the latter is usually expressed by the number of inches in the height of the column of mercury, whose weight is equal to the pressure). Secondly, the temperature and the volume being constant, the weight varies as the pressure; and hence the density of a gas varies as its weight or as the pressure. Thirdly, when the temperature of a gas is not constant: let V represent the volume of a gas at a temperature expressed by 32° (Fahr.), and let E be the cubic expansion $\left(= \frac{1}{480}\right)$ of the volume produced by an increment of temperature expressed by one degree of the same scale. Then if $t$ and $t'$ express increments of heat in degrees above 32°, and $V'$, $V''$ be the required volumes of the gas at the temperatures $32° + t$ and $32° + t'$ respectively, we shall have $V' = V(1 + Et)$ and $V'' = V(1 + Et')$; consequently, by division, $V'' = V' \frac{1 + Et'}{1 + Et}$. Again, since the weights vary as the densities, or inversely as the volumes, if $W'$, $W''$ represent the weights under the volumes $V'$, $V''$: then $W'' = W' \frac{1 + Et}{1 + Et'}$.

## Tables of Specific Gravities.

### *Gases.*

Barometer 30 in. Fahrenheit's thermometer 60°.
The specific gravity of atmospherical air is represented by unity.

| | | |
|---|---|---|
| Hydrogen | 0·0694 | Thomson. |
| | 0·074 | Davy, Sir H. |
| Carbon, vapour of | 0·4166 | Gay-Lussac. |
| Carburetted hydrogen | 0·5555 | Thomson. |
| | 0·491 | Davy, Sir H. |
| Ammoniacal gas | 0·5902 | Thomson. |
| Aqueous vapour | 0·625 | Gay-Lussac. |
| Do. (in contact with water at 212° Fahr.) | 0·484 | Dalton. |
| Phosphorus, vapour of | 0·8333 | Thomson. |
| Phosphuretted hydrogen | 0·9027 | Do. |
| Hydrocyanic acid gas | 0·9375 | Do. |
| Azote | 0·9691 | Biot and Arago. |
| Nitrogen | 0·9722 | Thomson |
| Olefiant | 0·9722 | Do. |
| Carbonic oxide gas | 0·9722 | Do. |
| Atmospherical air | 1· | |
| Nitric oxide gas | 1·0416 | Thomson. |
| Nitrous gas (deutoxide of azote) | 1·094 | Davy, Sir H. |
| Oxygen | 1·1111 | Thomson. |
| Sulphur, vapour of | 1·1111 | Do. |
| Sulphuretted hydrogen | 1·1805 | Do. |
| Muriatic acid gas | 1·2847 | Do. |
| Carbonic acid gas | 1·5196 | Biot and Arago. |
| Nitrous oxide gas (laughing gas) | 1·5277 | Thomson. |
| | 1·614 | Davy, Sir H. |
| Alcohol, vapour of | 1·6004 | Berzelius and Dulong. |
| Quadro-carburetted hydrogen, vapour of | 1·9065 | Thomson. |
| Chlorocyanic vapour | 2·1520 | Do. |
| Sulphurous acid gas | 2·193 | Davy, Sir H. |
| Æther (muriatic) vapour of | 2·219 | Thomson. |
| Euchlorine gas | 2·409 | Davy, Sir H. |
| Nitrous acid gas | 2·427 | Do. |
| Chlorine | 2·5082 | Do. |
| Æther (chloric) vapour of | 3·475 | Thomson. |
| Nitric acid gas | 3·75 | Davy, Sir H. |
| Hydriodic acid gas | 4·34 | Thomson. |
| Turpentine (oil of), vapour | 5·013 | Do. |
| Iodine, vapour of | 8·678 | Gay-Lussac. |

The following tables are compiled from the works of Muschenbroek, Haüy, Kirwan, Lavoisier, Biot and Arago, Drs. Thomson, Young, and Ure; from the 'Philosophical Transactions,' and from other authentic sources. The table for the different kinds of wood is from the experiments of Muschenbroek, and from those of Mr. Couch of Plymouth, as quoted by Mr. P. Barlow.

### *Liquids.*

Barometer 30 in. Fahrenheit's thermometer 60°.
The specific gravity of water is represented by 1000.

| | |
|---|---|
| Quadro-carburetted hydrogen | 627 |
| Hydrocyanic acid | 706 |
| Naphtha | 708 |
| Æther, muriatic | 730 |
| Do., sulphuric | 734 |
| Do., ascetic | 866 |
| Do., nitric | 909 |
| Bicarburet of hydrogen | 850 |
| Alcohol, pure | 796 |
| Do., 10 parts in 100 being water | 822 |
| Do., 20 do. | 848 |
| Do., 30 do. | 871 |
| Do., 40 do. | 896 |
| Do., 50 do. | 917 |
| Do., 60 do. | 936 |
| Do., 70 do. | 956 |
| Do., 80 do. | 973 |
| Do., 90 do. | 987 |
| Water, at 212° Fahr. (distilled) | 956·2 |
| Do., at 100° do. | 994 |
| Do., at 60° do. | 1000 |
| Do., at do. do. | 999·2 |
| Do., at 50° do. | 1000·7 |
| Do., at 35° (maximum of density) | 1000·9 |
| Sea-water | 1026 |
| Cyder | 1018 |
| Beer, pale | 1023 |
| Do., brown | 1034 |
| Wine, Burgundy | 992 |
| Do., Bordeaux | 994 |
| Do., Port | 997 |
| Do., Canary | 1033 |
| Do., Madeira | 1038 |
| Oil of turpentine (essential) | 870 |
| Do. of lavender do. | 894 |
| Do. of olives do. | 915 |
| Do. of almonds do. | 917 |
| Do. of whale do. | 923 |
| Do. of poppies do. | 924 |
| Do. of anise-seed do. | 987 |
| Do. of cloves do. | 1036 |
| Do. of cinnamon do. | 1044 |
| Acid, muriatic | 1194 |

| | | |
|---|---|---|
| Acid, nitric | | 1217 |
| Do., hyposulphuric | | 1347 |
| Do.. boracic | | 1479 |
| Do., sulphuric (pure) | | 1848·5 |
| Do., do. | (10 parts in 100 being water) | 1811·5 |
| Do., do. | (20 do.) | 1712 |
| Do., do. | (30 do.) | 1486 |
| Do., do. | (50 do.) | 1388·4 |
| Do., do. | (highly concentrated) | 2125 |

*Gums, Animal Substances, &c.*

The specific gravity of water being 1000

| | |
|---|---|
| Indigo | 769 |
| Shoemakers' wax | 897 |
| Fat, beef | 923 |
| Do. mutton | 924 |
| Do. veal | 934 |
| Do. pork | 937 |
| Butter | 942 |
| Tallow | 942 |
| Spermaceti | 943 |
| Lard | 948 |
| Bees'-wax, yellow | 965 |
| Do., white | 969 |
| Camphor | 989 |
| Urine | 1011 |
| Blood, human (serum) | 1028 |
| Do. | 1054 |
| Do. (crassamentum) | 1126 |
| Milk, woman's | 1020·3 |
| Do., cow's | 1032·4 |
| Do., goat's | 1034·1 |
| Do., mare's | 1034·6 |
| Do., ass's | 1035·5 |
| Do., ewe's | 1040·9 |
| Elemi | 1018 |
| Copal, from Madagascar | 1060 |
| Do. from China | 1063 |
| Mastic | 1074 |
| Storax | 1110 |
| Gum, euphorbia | 1124 |
| Copal, opake | 1149 |
| Labdanum | 1186 |
| Gum, seraphic | 1201 |
| Dragon's-blood | 1205 |
| Gum, ammoniac | 1207 |
| Gamboge | 1222 |
| Guiacum | 1229 |
| Gum from Aleppo | 1235 |
| Calculus humanus | 240 to 1700 |
| Gum, scammony, from Smyrna | 1274 |
| Gum, tragacanth | 1316 |
| Assafœtida | 1328 |
| Opium | 1336 |
| Aloes, hepatic | 1359 |
| Myrrh | 1360 |
| Gum, bdellium | 1372 |
| Aloes, Socotrine | 1380 |
| Terra Japonica | 1398 |
| Honey | 1450 |
| Gum, arabic | 1452 |
| Juice of Acacia | 1515 |
| White sugar | 1606 |
| Bone of an ox | 1656 |
| Juice of liquorice | 1723 |
| Ivory | 1826 |

*Woods.*

The specific gravity of water being 1000.

| | | |
|---|---|---|
| Cork | | 240 |
| Poplar, common | | 383 |
| White Pine, from New Brunswick | (mean) | 402 |
| Do., from the United States | (do.) | 426 |
| Yellow Pine, from Canada | (do.) | 440 |
| Riga Fir, an inferior kind | (do.) | 479 |
| Northern Pine, from New York | (do.) | 482 |
| Sassafras | | 482 |
| Spruce Fir, from Canada | | 518 |
| Poplar, White Spanish | | 529 |
| Larch, from Scotland | | 530 |
| Red Pine, from Canada | | 536 |
| Juniper | | 556 |
| Pitch Pine, from Virginia | (mean) | 563 |
| Spruce Fir, from Halifax | (do.) | 567 |
| Cedar, from Spanish America | (do.) | 567 |
| Willow | | 585 |
| Elm, English | | 588 to 500 |
| Riga Fir, superior kind | (mean) | 598 |
| Lime or Linden-tree | | 604 |
| Cedar, from Palestine | | 613 |
| Pitch Pine, from Baltimore | (mean) | 632 |
| Poon Wood, from the East Indies | | 635 |
| Mahogany | | 637 to 1063 |
| Yellow Wood, from the Cape of Good Hope | | 643 |
| Cypress | | 644 |
| Pear-tree | | 646 |
| Teak | | 666 |
| Walnut-tree | | 671 |
| Elder | | 695 |
| Fir, from Scotland | | 696 |
| Orange-tree | | 705 |
| Cherry-tree | | 715 |
| Oak, English | | 743 to 760 |
| Cedar, from Canada | | 753 |
| Apple-tree | | 793 |
| Alder | | 800 |
| Beech | | 852 |
| Box, French | | 912 |
| Olive | | 927 |
| Logwood | | 931 |
| Coco | | 1040 |
| Bog Oak, from Ireland | | 1046 |
| Heart of Oak, 60 years old | | 1170 |
| Ebony | | 1177 |
| Do., Indian | | 1209 |
| Letter Wood, from Surinam | | 1286 |
| Cedar, Indian | | 1315 |
| Vine | | 1327 |
| Box, Dutch | | 1328 |
| Lignum Vitæ | | 1333 |
| Pomegranate-tree | | 1354 |

*Earths, Stones, &c.*

The specific gravity of water being 1000.

| | |
|---|---|
| Gunpowder (loose) | 836 |
| Amianthus (long) | 909 |
| Pumice-stone | 915 |
| Ambergris | 780 to 926 |
| Gunpowder (closely shaken) | 932 |
| Amber, yellow (transparent) | 1078 |
| Do. (opaque) | 1085 |
| Do. (green) | 1083 |
| Bitumen from Judæa | 1104 |
| Cannel coal | 1270 |
| Carbon (of compact earth) | 1329 |
| Slate coal (English) | 1250 to 1370 |
| Phosphorus | 1714 |
| Nitre | 1900 |
| Opal (common) | 1958 |
| Rotten-stone | 1981 |
| Sulphur (fused) | 1990 |
| Brick | 2000 |
| Sulphur (native) | 2033 |
| Stone (from Burford) | 2049 |
| Opal (precious) | 2114 |
| Stone (silicious, for grinding) | 2143 |
| Porcelain (Sèvres) | 2146 |
| Gypsum (opaque) | 2168 |
| Slate (black stone) | 2186 |
| Stone (from St. Cloud) | 2201 |
| Talc (black German) | 2246 |
| Nitre (quadrangular) | 2246 |
| Gypsum (transparent) | 2274 |
| Gypsum (cuneiform crystallised) | 2306 |
| Amianthus (short) | 2313 |
| Stalactite (transparent) | 2324 |
| Obsidian | 2348 |
| Jasper (green) | 2359 |
| Porcelain (china) | 2385 |
| Stone (paving) | 2416 to 2460 |
| Serpentine (opaque Italian) | 2430 |
| Stone (rag) | 2470 |
| Stalactite (opaque) | 2478 |
| Stone (mill) | 2484 |
| Do. (from Portland) | 2496 |
| Stone (from Bristol) | 2510 |
| Spar (transparent) | 2564 |

| | |
|---|---|
| Flint (Egyptian) | 2565 |
| Asbestos (ripe) | 2578 |
| Flint (black) | 2582 |
| Serpentine (semi-transparent) | 2586 |
| Pebble (stained) | 2587 |
| Calcedony (blue) | 2587 |
| Agate (oriental) | 2590 |
| Carnelian (stalactite) | 2591 |
| Serpentine (veined black and olive) | 2594 |
| Flint (white) | 2594 |
| Sardonyx (veined) | 2595 |
| Spar (white sparkling) | 2595 |
| Do. (pure) | 2603 |
| Calcedony (veined) | 2606 |
| Agate (speckled) | 2607 |
| Pebble (English) | 2609 |
| Flint (veined) | 2612 |
| Calcedony (common) | 2616 |
| Carnelian (veined) | 2623 |
| Agate (cloudy) | 2625 |
| Serpentine (opaque, red and black) | 2627 |
| Carnelian (pale) | 2630 |
| Agate (stained) | 2632 |
| Talc (earthy) | 2632 |
| Crystal (European, pure rock) | 2637 |
| Quartz (fragile) | 2640 |
| Glass (green) | 2642 |
| Quartz (brown, crystallized) | 2647 |
| Marble (French) | 2649 |
| Do. (Brocatelle) | 2650 |
| Quartz (milky) | 2652 |
| Crystal (from Madagascar) | 2653 |
| Do. (from Brazil) | 2653 |
| Do. (yellow) | 2654 |
| Do. (violet) | 2654 |
| Granite (red Egyptian) | 2654 |
| Quartz (crystallized) | 2655 |
| Talc (yellow) | 2655 |
| Jasper (red) | 2661 |
| Calcedony (transparent) | 2664 |
| Agate (veined) | 2667 |
| Marble (green Egyptian) | 2668 |
| Crystal (rose-coloured rock) | 2670 |
| Slate (common) | 2672 |
| Porphyry (green, common) | 2676 |
| Marble (from Siena) | 2678 |
| Argillite (or slate clay) | 2600 to 2688 |
| Jasper (brown) | 2691 |
| Alabaster (veined) | 2691 |
| Chrysolite (from Brazil) | 2692 |
| Spar (blue sparkling) | 2693 |
| Alabaster (from Piedmont) | 2693 |
| Marble (from Biscay) | 2695 |
| Alabaster (yellow) | 2699 |
| Marble (Castilian) | 2700 |
| Talc (white) | 2704 |
| Spar (green) | 2704 |
| Marble (African) | 2708 |
| Do. (Valencian) | 2710 |
| Jasper (yellow) | 2710 |
| Marble (Carrara, white) | 2717 |
| Talc (slaty) | 2718 |
| Stones (basaltes) | 2722 |
| Beryl (occidental) | 2723 |
| Gypsum (foliated) | 2725 |
| Porphyry (green, from Cordova) | 2728 |
| Alabaster (oriental, white) | 2730 |
| Glass (bottle) | 2733 |
| Jasper (cloudy) | 2735 |
| Marble (green, from Campania) | 2742 |
| Do. (Roman, violet) | 2755 |
| Alabaster (oriental, semi-transparent) | 2762 |
| Porphyry (red) | 2765 |
| Emerald (from Peru) | 2775 |
| Chalk (British) | 2657 to 2784 |
| Do. (Spanish) | 2790 |
| Talc (Muscovy) | 2792 |
| Marble (white Parian) | 2838 |
| Slate (new) | 2854 |
| Marble (violet, Italian) | 2858 |
| Basalts (from the Giant's Causeway) | 2864 |
| Alabaster (from Malaga) | 2876 |
| Hone (white, razor) | 2876 |
| Crystal (white rock, from Marmerosch) | 2888 |
| Glass (white) | 2892 |
| Talc (black) | 2900 |
| Arragonite | 2946 |
| Serpentine (fibrous) | 3000 |
| Lapis-lazuli | 2767 to 3054 |
| Schorl (tourmalin, from Ceylon) | 3054 |
| Asbestos (starry) | 3073 |
| Schorl (common) | 3092 to 3212 |
| Spar (green and white sparkling) | 3105 |
| Sapphire (Brazilian) | 3131 |
| Schorl (Brazilian emerald) | 3156 |
| Limestone (white fluor) | 3156 |
| Do. (green) | 3182 |
| Glass (Leith crystal) | 3189 |
| Do. (fluid) | 3329 |
| Schorl (black, hexahedral) | 3364 |
| Diamond (Brazilian) | 3444 |
| Do. (yellow) | 3519 |
| Do. (white oriental) | 3521 |
| Do. (green) | 3524 |
| Do. (blue) | 3525 |
| Do. (rose-coloured, oriental) | 3531 |
| Ruby (Brazilian) | 3531 |
| Topaz (Brazilian) | 3536 |
| Beryl (oriental) | 3549 |
| Diamond (orange-coloured) | 3550 |
| Topaz (white) | 3554 |
| Do. (Saxon) | 3564 |
| Hornblende (common) | 3600 to 3830 |
| Hyacinth (common) | 3687 |
| Spar (adamantine) | 3873 |
| Pyrites (ferruginous, cubic) | 3900 |
| Sapphire (oriental) | 3994 |
| Hyacinth | 4000 to 4620 |
| Garnet (from Syria) | 4000 |
| Girasol | 4000 |
| Topaz (oriental) | 4011 |
| Sapphire (from Puys) | 4077 |
| Pyrites (ferruginous, round) | 4101 |
| Garnet (from Bohemia) | 4189 |
| Vermillian | 4230 |
| Ruby (oriental) | 4283 |
| Lapis Hœmatites | |
| Barytes, Sulphate of | 4481 |
| Pyrites (coppery) | 4954 |
| Lapis Calaminaris | 5000 |

*Metals*

The specific gravity of water being 1000.

| | |
|---|---|
| Sodium | 865 |
| Potassium | 972 |
| Plumbago | 1987 to 2267 |
| Cobalt (blue, glass of) | 2441 |
| Copper (ore, soft) | 3572 |
| Iron-stone (from Lancashire) | 3573 to 3863 |
| Arsenic (glass of) | 3594 |
| White-lead | 4059 |
| Antimony (crude) | 4064 |
| Bismuth (ore in plumes) | 4371 |
| Copper (ore, white) | 4500 |
| Molybdena | 4738 |
| Manganese (striated) | 4756 |
| Loadstone | 4800 |
| Antimony (glass of) | 4946 |
| Iron (ore, lenticular) | 5012 |
| Copper (from Cornwall) | 5452 |
| Silver (ore, dark-red) | 5684 |
| Arsenic (molten) | 5763 |
| Lead (ore, saturnite) | 5925 |
| Tin (ore, white) | 6008 |
| Lead (ore, red) | 6027 |
| Tungsten | 6066 |
| Litharge | 6300 |
| Uranium | 6440 |
| Lead (ore, vitreous) | 6558 |
| Lead (ore, black) | 6745 |
| Zinc (in its common state) | 6862 |
| Tin (ore, black) | 6901 |
| Tin (ore, red) | 6935 |
| Wolfram | 7119 |
| Iron (cast at Rotherham) | 7157 |
| Zinc (compressed) | 7191 |

| | |
|---|---|
| Iron (cast at Carron) | 7248 |
| Tin (pure, Cornish, not hardened) | 7291 |
| Tin (do., hardened) | 7299 |
| Iron (ore, prismatic) | 7355 |
| Lead (ore, cubic) | 7587 |
| Iron (forged into bars) | 7600 to 7788 |
| Copper (native) | 7600 to 7800 |
| Nickel (molten) | 7807 |
| Cobalt (molten) | 7812 |
| Steel (tempered, not hardened) | 7816 |
| Steel (tempered and hardened) | 7818 |
| Brass (cast, common) | 7824 |
| Steel (neither tempered nor hardened) | 7833 |
| Brass (cast, not hammered) | 8396 |
| Mercury (precipitate, red) | 8399 |
| Brass (cast, wire-drawn) | 8544 |
| Copper (wire-drawn) | 8878 |
| Bismuth (native) | 9020 |
| Bismuth (molten) | 9823 |
| Silver (native, common) | 10,000 |
| Silver (Paris standard) | 10,175 |
| Mercury (brown cinnabar) | 10,218 |
| Silver (virgin, fine and not hammered) | 10,474 |
| Silver (do. hammered) | 10,511 |
| Mercury (precipitate per se) | 10,871 |
| Lead (molten) | 11,352 |
| Mercury (fluent) | 13,568 |
| Mercury (congealed) | 15,632 |
| Gold (not hammered) | 15,709 |
| Do. (hammered) | 15,775 |
| Do. (Parisian standard, 22 carats, not hammered) | 17,486 |
| Do. (hammered) | 17,589 |
| Do. (English standard, 22 carats, not hammered) | 18,888 |
| Do. (fine, 24 carats, not hammered) | 19,259 |
| Do. (hammered) | 19,362 |
| Platinum (purified, not hammered) | 19,500 |
| Do. (hammered) | 20,336 |
| Do. (wire drawn) | 21,041 |
| Do. (compressed by being rolled) | 22,069 |

SPECIFICATION. [PATENT.]

**SPECTACLES** are lenses so mounted in frames as to be conveniently held before the eyes to assist defective vision. Where side-pieces are added to the frame, to hold it in its proper position by pressing against the sides of the wearer's head, the instrument is denominated simply a pair of spectacles; but when no side-pieces are used, and the frame is held with the hand, the name hand-spectacles is applied.

It has been conceived, though with very little foundation, that spectacles were in use among the antients; but most authorities give the latter part of the thirteenth century as the period of their invention. Some writers attribute the invention to Alexander Spina, a monk of Pisa, and suppose its date to have been about 1299 or 1300; but the mention of magnifying-glasses by Roger Bacon, who died some years before that time, justifies the supposition that something like what are now called spectacles were in use at least several years earlier. [BACON, ROGER, vol. iii., p. 244.]

The defects of sight, which it is the object of spectacles to counteract, and the manner in which they effect that object, have been explained under SIGHT, vol. xxi., p. 507. In addition to what is there stated, some remarks on the construction and choice of spectacles may be useful. In few cases, perhaps, are the effects of ignorance and prejudice productive of more serious consequences than in the injudicious selection of spectacles, or in the reluctance which sometimes defers their use until the eyes become, for the want of their necessary assistance, irreparably injured; and it is difficult to say whether the most harm is occasioned by the absurd empiricism of some pretending opticians, or by the ignorance which renders the purchaser liable to be imposed upon by the grossest fallacies, or prevents him from detecting the unfitness of the spectacles offered to him for his own particular case. Extensively as these useful instruments are employed, there can be no doubt that, were the subject more generally understood, the amount of advantage obtained from them would be greatly augmented and far more widely diffused. The eyes of an individual whose sight is much tried often receive the most serious injury from improper delay in the use of spectacles; while the sight of many persons is prematurely worn out by the use of glasses of too high a power. It is stated under SIGHT that, whether the glasses used be concave or convex, the lowest power that is available should be used; but in the case of convex or magnifying lenses this principle is too often lost sight of, and the temporary pleasure occasioned by the use of strong magnifiers is indulged at the expense of the visual organs, which will adapt themselves to circumstances of undue excitement, but will not so readily return to their natural state. The use of a single reading-glass instead of spectacles is also very injurious; since, by occasioning one eye to be more used than the other, the power and focal length of the two are rendered unequal. The unsteadiness of the glass is also a disadvantage. The defects of the single hand-glass are not removed by increasing its size so much that both eyes may see through it, because in that case the axis of each pencil of rays will be distorted by passing through the lens at points beside its centre. Hand-spectacles, which are made to fold up into nearly as small a space as a single glass, are better than reading-glasses; but, although steadied in some degree by resting upon the nose, they are by no means equal to spectacles well fitted to and supported by the head.

Varieties in the conformation of the eyes, and in the manner and degree in which they are affected by use, render it impossible to lay down any rule for the focal length of convex glasses for persons of a given age; yet a general idea of the necessary power may be obtained from an average of a great number of cases. The following table, extracted from Dr. Kitchener's 'Economy of the Eyes,' gives the average results of fifty years' experience of an eminent optician, and may prove useful, though it cannot be depended upon as an invariable rule, because, as the author remarks, 'no general rule has more exceptions.'

| Years of age. | Inches of focus. | Years of age. | Inches of focus. |
|---|---|---|---|
| 40 | 36 | 70 | 12 |
| 45 | 30 | 75 | 10 |
| 50 | 24 | 80 | 9 |
| 55 | 20 | 85 | 8 |
| 58 | 18 | 90 | 7 |
| 60 | 16 | 100 | 6 |
| 65 | 14 | | |

How little dependence is to be placed upon such deductions, in practice, may be perceived from facts recorded in the same volume, in which instances are given of very young persons who required magnifiers of six or eight inches focus, which are very rarely used except for couched eyes, while in other cases individuals of great age required no glasses at all, or glasses of very low power. The Rev. Mr. Romaine, for instance, was able, at the age of eighty-one, to read a very small print, and never used glasses. In some cases it is advisable to use different spectacles for night and day, to suit different degrees of light; and it is, generally speaking, well to increase the power of the glasses used as the sight becomes weaker from age. Even in this however caution must be exercised, lest, by over-stimulating the eye, its powers be too rapidly exhausted. It should always be borne in mind, both by young and old persons, and in changing spectacles as well as in first taking to them, that the legitimate object of convex spectacles is to restore the natural power (or rather the natural *focus*) of the eye, and not to enable the wearer to see objects larger or more distinctly than with the eye in a strong and healthy condition. Short-sightedness being still less dependent upon age, cannot be met by any rule even so well as the opposite defect.

The power or focus of the lenses is but one of many particulars to be attended to in the selection of spectacles; and even this must occasionally be different in the same pair of spectacles, because of one eye being, either from peculiar conformation, from accidental injury, or, which is very common, from the use of a single eye-glass, of different focus to the other. It is very essential that the frame shall fit comfortably to the head, and be of such form as to bring the centre of each lens exactly opposite to the centre of the eye it is intended to serve. The endless variations met with in the width between the eyes, the total width of the head, and the form of the nose, render it frequently difficult to suit an individual out of even a very large stock of ready-made spectacles. Errors in width, especially, are very common. In a case recently mentioned to the writer, a gentleman had purchased expensive spectacles from the shop of a first-rate optician, with which he was unable to see comfortably. The fact was, that though his head was very large, his eyes were unusually near together; but the spectacles with which he was supplied were adapted to a head of ordinary proportions, and had a bridge of considerable width, as shown in *Fig.* 1, which threw the centres of the lenses farther apart than the pupils of his eyes. His case was completely met by spectacles of the form of *Fig.* 2,

*Fig.* 1.

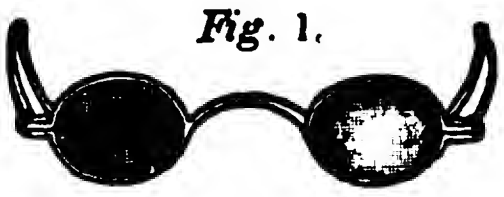
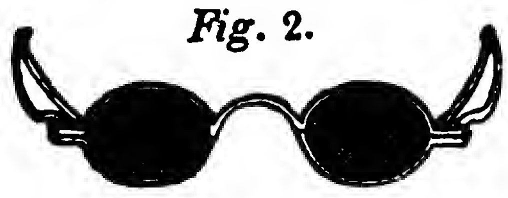


*Fig.* 2.



with a narrow bridge, but having the side-pieces so formed as to fit a wide head. The proper elevation of the glasses must be regulated by the form of the bridge, adjusted according to that of the nose. Convex spectacles, being used for viewing near objects, may generally be placed lower down upon the wearer's nose than those used by short-sighted persons, who are compelled to hold up their heads in an awkward manner, unless the glasses rest naturally in such a position as to enable him to see distant objects with an erect position of the head. Thus the bridge of concave spectacles must often be nearly straight, as in *Fig.* 3, or made in the form shown in *Fig.* 4, in which case the spec-

*Fig.* 3.

*Fig.* 4.

tacles may be put on either way, provided the glasses be of equal power. Some opticians recommend the use of large glasses, while others prefer small ones, on the principle that, as a very small portion only of the lens is available for perfect vision, it is useless and injurious to increase the size and weight, and at the same time to impede the access of air to the eyes. Small lenses may be inconvenient in some cases; but when spectacles are used for examining minute objects only, they are to be preferred, if not so small as to render the frames visible to the wearer. The oval form is usually preferred, because it allows most room for the motion of the eye in a lateral direction, without giving unnecessary weight, but semi-ellipses are sometimes used, when the wearer desires to look over or under, as well as through the lenses. Whatever may be the shape of the glass, the convexity or concavity is mostly spherical; but, to meet peculiar cases, lenses may be ground of unusual forms. An instance of this, in the spectacles of Professor Airy, has been mentioned under Sight, p. 508. Besides the circumstances that have been enumerated, it is important to attend carefully to the position of the lenses, as regards the angles they form with the axes of the eyes; because any irregularity in this particular must produce distortion, and prove injurious to the eyes. In some cases it may be necessary, in consequence of defects in the eyes, to place the two lenses not precisely in the same plane. Much has been written respecting the various qualities of glass used in spectacles, but it may be taken as a general rule that, except in cases where it is necessary to protect the eyes from an injurious glare of light, the most colourless material is to be preferred. The accurate figure of the lenses cannot be too strongly insisted on, and may be tested by holding the spectacles near to a printed book, and gradually moving them nearer to the eye; by doing which, if the glasses be not well-shaped, the letters will appear distorted. Veins or blebs in the glass are very injurious to the eye, and may be detected by holding the glass between the eye and the flame of a candle, and moving it backwards and forwards, until it appears full of light; when every such defect will be distinctly seen. Scratches are not quite so injurious, inasmuch as they do not produce distortion; yet they too should be carefully avoided. Their diminished liability to injury by scratching forms the principal recommendation of spectacle lenses formed of rock crystal; but some opticians consider their use injurious, owing to their tendency to irregular refraction of the rays of light. Respecting the material of the frames little need be said. If tortoise-shell frames be used, the front should be black, as the variegated colour might be hurtful to the eyes. Very light steel frames have been brought much into use of late years; but some persons prefer silver, although considerably heavier. Dr. Kitchener states that though the superior lightness and elasticity of a steel frame may for a time render it pleasanter than one of silver, the latter 'soon adapts itself exactly and comfortably to the head, and becomes infinitely easier and pleasanter than the springy steel.' It is almost needless to add, that spectacle-frames with double-jointed sides are far preferable to those with a single joint, though the latter are often used by females, to avoid interference with their head-dress.

Several deviations from the ordinary mode of constructing spectacles may be alluded to. The *periscopic* spectacles of Dr. Wollaston were contrived in order to allow considerable latitude of motion to the eyes without fatigue, by conforming the shape of the glasses to that of the eyes. This is effected by the use of lenses either of a meniscus or concavo-convex form; the concave side being in both cases turned towards the eye. *Fig.* 5 represents, in section, the form of the lens used in convex or magnifying spectacles of the periscopic construction; and *Fig.* 6 shows that of a con-

*Fig.* 5.

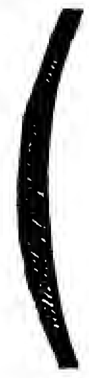
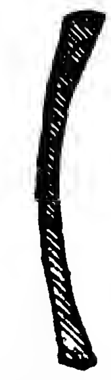


*Fig.* 6.



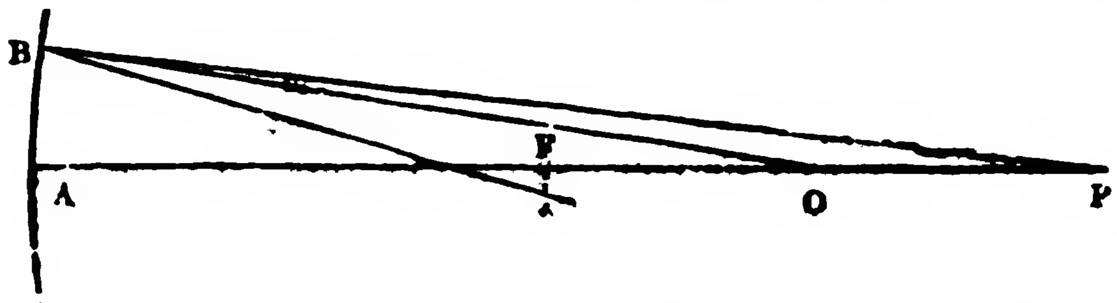
cave lens, suitable for short-sighted persons. In the former case the curve of least radius is that of the anterior, and in the latter, that of the posterior surface of the lens. Divided spectacles, each glass consisting of two half-lenses, are sometimes used; the upper half of each glass being occupied by a concave lens, or one of very slight convexity, for seeing distant objects, while the lower half has a strong magnifier, for examining things near the eye. Such spectacles have an awkward appearance, on account of the joint along the middle, and require some practice to avoid inconvenience to the wearer; but they have been used with advantage by artists and others requiring to look alternately at near and distant objects. The late Benjamin West, president of the Royal Academy, for many years used such divided glasses, the upper half being of thirty, and the lower of twelve inches focus; and in the latter years of his life used lenses of only eight inches focus in the lower part of his spectacles. Other plans have been tried for obtaining a similar advantage; such as having a second pair of glasses hinged to the frame, and capable of either turning up out of the way, or being placed immediately before the ordinary lenses, to modify their power; or having two distinct pairs of spectacles, capable of being used either separately or together. Spectacles with glazed wings are sometimes used for travelling in; the glasses, which may be plain, unless otherwise required, being of such a form as to shield the eyes from dust. A patent was obtained in 1826 by Mr. A. A. de la Court, for spectacles with a small mirror or reflector so attached to the sides of the frame as to enable the wearer to see objects either beside or behind him; in some cases the reflectors were to be used without ordinary glasses in front, their sole object being to enable an individual to see what is passing around him without turning his head.

From what has been stated above it is evident that much care and judgment are required in the choice of spectacles, and that it is a task which should not, where it is possible to avoid it, be delegated to another. Cheap as the best glasses now are, an ill-judged economy, or rather parsimony, in the purchase of articles of such importance, should be carefully guarded against; and, while so much ignorance and quackery is often met with, it is especially desirable that every one who stands in need of optical assistance should form a clear conception of the requisite qualities of a good pair of spectacles. It is advisable to try a pair of spectacles for some time before concluding the purchase, because the eyes become so excited by trying a number of glasses as to be unable, immediately, to select those best adapted for ordinary use. The use of the specious name *preservers* should be adverted to, since many are deluded into the notion that the spectacles sold under that name possess some peculiar property which enables them to arrest the progress of that natural change by which most individuals become presbyopic, or long-sighted, as they grow older; a notion which is utterly without foundation. The name is usually applied to convex glasses of thirty-six inches focus, or the *first sight;* but might with equal accuracy be given to any other sort; as the only spectacles to which the wearer can with propriety apply the name are those which, of whatever power they may be, are exactly suited to his particular case. Such spectacles, although they cannot stop the natural changes of the eye, may greatly diminish their inconvenience, and even retard their progress; and therefore may not unfitly be termed preservers; but few things can be more injurious than the use of spectacles of any kind before they are actually wanted, under the fallacious idea that they will maintain the sight unimpaired, notwithstanding the organic changes which accompany increasing years.

SPECTRUM. [Dispersion, vol. ix., p. 20.]

SPE'CULUM, a name frequently given to a mirror used for any scientific purpose, as in a reflecting telescope. For all that is general on this subject we refer to Telescope, intending here only to give the simpler mathematical description of a pencil of rays incident upon a mirror, so as to make this article a counterpart to Lens.

The convex mirror is comparatively of no importance, and the formulæ for it may be easily derived from those for the concave mirror, to which we proceed, referring, as in Lens, to Mr. Coddington's work 'On Reflexion and Refraction' for further information. Let a pencil of rays fall on the




spherical mirror AB from the point P, of which rays PB is one. Let PB be reflected into B$p$. It is supposed that P is in the radius OA, which is the axis of the mirror; O being the centre of the sphere. Let AO $= r$, AP $= u$, A$p = v$. The nearer B is taken to A, the more nearly does the point $p$ approach to a certain point F, at which the image of P is said to be formed: not that any rays are actually reflected to F, but because all the rays which are reflected from points near to A fall exceedingly near to F, which is the cusp, and brightest point of the Caustic. If AF $= w$, the position of F is determined by the equation—

$$\frac{1}{w} = \frac{2}{r} - \frac{1}{u} \ldots (1)$$

The point $p$ however is always nearer to A, or lies between F and A, and $p$F, or the longitudinal aberration, is thus found: let the length of the arc AB be $y$; then

$$pF = \frac{w^2}{r}\left(\frac{1}{r} - \frac{1}{u}\right)^2 y^2 \ldots (2)$$

very nearly, if $y$ be not very great. And for the lateral aberration F$t$, we have

$$Ft = \frac{w}{r}\left(\frac{1}{r} - \frac{1}{u}\right)^2 y^3 \ldots (3).$$

Again, there is for all the rays proceeding from P, after reflection, a circle through which they all pass, as in Lens (page 422). The distance of this circle of least aberration from the focus F towards A, is the following expression:—

$$\frac{3}{4}\,\frac{w^2 Y^2}{r}\left(\frac{1}{r} - \frac{1}{u}\right)^2 \ldots (4),$$

if Y be the whole semi-arc of the mirror: it is therefore three-fourths of the longitudinal aberration of the extreme ray. The diameter of this circle of least aberration is

$$\frac{1}{2}\,\frac{w Y^3}{r}\left(\frac{1}{r} - \frac{1}{u}\right)^2 \ldots (5),$$

or one-half the lateral aberration of the extreme ray.

When the rays fall parallel to each other on the mirror, $u$ is infinite, and we have $\frac{1}{2}r$ for the value of $w$, $\frac{y^2}{4r}$ for the longitudinal aberration, $\frac{y^3}{2r^2}$ for the lateral aberration, $\frac{3Y^2}{16r}$ for the distance of the circle of least aberration from the focus, and $\frac{Y^3}{4r}$ for its diameter.

When $u = r$, or the incident pencil is thrown from the centre, it is returned again to the centre, and there are no aberrations.

When $u$ is less than $r$, or P is between O and A, F then falls beyond O, and, as P approaches to the middle point of OA, recedes without limit. When $u = \frac{1}{2}r$, or P is at the middle point of OA, all the reflected rays are parallel to one another and to the axis of the mirror. And when $u$ is less than $\frac{1}{2}r$, $w$ becomes negative, or the focus is on the other side of the mirror, and the reflected rays diverge: but only the latitudinal aberration alters its sign.

The formulæ for a convex mirror may be found by making $r$ negative in those for a concave mirror. Hence $w$ is always negative, or the focus of every pencil is behind the mirror: the longitudinal aberrations change sign, but not the latitudinal ones: and as $w$ has also changed sign, the effect is that $p$ is always nearer to the mirror than F, as before.

The image in a convex mirror is always upright; and in a concave one always inverted, except when the object falls between the principal focus (or middle point of the radius) and the mirror.

SPECULUM METAL. The best composition for the metals of reflecting telescopes is a subject which has been much investigated; about 70 different mixtures were tried by the Rev. John Edwards, the particulars of which are stated in the 'Nautical Almanac' for the year 1787; he found copper 32, tin 15, brass 1, silver 1, arsenic 1, meaning of course, arsenious acid or white oxide, to form an alloy which was the whitest, hardest, most reflective, and took the highest polish.

The following composition is stated by the Rev. James Little (*Trans. Irish Academ.*, vol. x.) as being in every respect sufficient for the purpose, and inferior to none in whiteness, lustre, and exemption from tarnish: 32 parts of best bar-copper, 16½ parts of tin, 4 parts brass pin-wire, and 1¼ arsenic. He first added to the fused brass about an equal quantity of the tin, and put the mass cold into the melted copper, supplying afterwards the remainder of the tin, and then the arsenic; the copper, he states, was fluxed with black flux of two parts tartar and one of nitre.

Mr. Little states that he found silver, which enters into the composition of Mr. Edwards's metal, when used even in very small quantity, had an extraordinary property of rendering the metal so soft that he was deterred from employing it.

The following appearances are stated by Mr. Little to have served him as rules for determining the goodness of the compound metal:—'When the metal was melted, and before I poured it into the flask, I always took about the quantity of an ounce of it, with a small ladle, out of the crucible, and poured it on a cold flag; and observed the following appearances:—First, if the metal assumed, in cooling, a lively blue or purple colour, commonly intermixed with clouds or shades of green or yellow; and if, when broken, the face of the fracture exhibited a silvery whiteness, as bright and glistening as quicksilver, without any appearance of grain or inequality of texture, then the degree of saturation of the metal with the tin was complete and perfect. Secondly, if the surface of the metal became of a dun or mouse colour, and especially if of a brown or red, and when broken, the fracture exhibited a more yellow or tawny hue than that of quicksilver, then the quantity of tin in the composition was deficient, and it was necessary to add more. Thirdly, if the colour was a uniform dull blue, like lead, and, when broken, discovered a dull colour, with a coarse grain, like facets, the due saturation was exceeded, and there was an over-proportion of tin in the metal.'

From what is afterwards stated, it appears that Mr. Little on many occasions employed a glass flask, smoked with a candle made of resin mixed with tallow, as a mould for casting. He states that he supposes, with others, that if the speculum metal be granulated by pouring it, when first melted, into water, and then fused a second time, it will be less porous than at first.

SPEED, JOHN, born 1542, died 1629, an English historical writer of the reigns of Elizabeth and James I., was born at Farrington in Cheshire, but came early in life to London, where the rest of his days were spent. He was brought up to the business of a tailor, and seems to have supported himself by it during the greater part of his life for he does not appear as an author before the year 1608, when he was in the sixty-sixth year of his age. He was however, during that time, amassing treasures of curious historical knowledge, the possession of which brought him into the acquaintance of Sir Fulk Grevile, who drew him forth from his obscurity, and, it is supposed, afforded him the means of publishing the large works of which he is the author or editor. The first of these is a collection of maps of the English and Welsh counties, with plans of cities, and engravings of various antiquities, said to have been first published in 1608; but when formed into the work entitled 'The Theatre of the Empire of Great Britain,' bearing the date of 1611. In this work he owed much to the labours of Christopher Saxton and John Norden. There have been several editions of it. The other work of Speed's is a history or chronicle of England, entitled 'The History of Great Britain under the Conquests of the Romans, Saxons, Danes, and Normans,' originally published in 1611. In this work are engravings of coins, and also of the great seals of England, then for the first time published; but on the whole it is a compilation of no great merit. He was also the compiler of a set of Tables of Scripture Genealogy, comprising much of the genealogical information contained in the sacred books, exhibited in the form of pedigrees. A few other writings of small value are ascribed to him. He was buried in the church of St. Giles, Cripplegate, where a monument was raised to his memory.

SPELMAN, SIR HENRY, born 1562, died 1641, one of the most distinguished of the band of English antiquaries who lived in the reigns of James I. and his successor; the friend of Camden, Cotton, Selden, Dodsworth, Dewes, Dugdale, and others. He was a gentleman of antient family at Congham in Norfolk; educated at Walsingham in that county; from thence he removed to Trinity College, Cambridge, and at the age of eighteen was entered of Lincoln's Inn, with the design of studying the law. Instead however of proceeding to the practice of the law as a profession, he determined early in life to devote himself to historical and antiquarian research, the study of antient manuscripts and records, with a particular view to two objects, the elucidation of the history and antiquities of the county of Norfolk, and the investigation of the origin of the laws and institutions of the country. He did not keep himself wholly unconnected with public affairs, serving the office of sheriff of his county, and acting as a commissioner for determining disputed claims to lands and manors in Ireland. But in 1612 he withdrew from all public employment, and settled in London as the most favourable field in which to pursue his researches; and it was not till this time, when he was fifty years of age, that he began to bring before the public any of those works, the result of his long studies, which are the secure basis of his fame. The earliest of them is his treatise 'De non Temerandis Ecclesiis,' the object of which is to inculcate respect for the property belonging to the church. This involved him in controversies, in which he appears as the author of two tracts in defence of the principles of his work. In 1626 appeared the first part, which is all that he himself published, of a most valuable glossary of terms which occur in records and other antient historical writings. This work he entitled 'Glossarium Archaiologicum;' but it contains only as far as the letter L. The work was however completed from his manuscript after his death, partly by his son, but principally by Sir William Dugdale, under whose superintendence it was published. His other great work he left in like manner incomplete. This is his 'Concilia, Decreta, Leges, Constitutiones in Re Ecclesiastica Orbis Britannici,' of which the first volume was printed in 1639, and the second in 1664. Another posthumous work is his 'Villare Anglicanum,' 1656, a work of no great value. In 1698 there was printed at Oxford a folio volume entitled 'Reliquiæ Spelmannianæ,' or his posthumous work relating to the laws and antiquities of England. Among his manuscripts he left one which he entitled 'Archaismus Graphicus,' being a collection of the contrasts which he had observed in the old writings, with the explanation of them. This manuscript has been often transcribed, and is useful to those who have occasion to read early writings. He died at the house of his son-in-law Sir Ralph Whitfield, in the Barbican; and his body was interred, by the special order of Charles I., in Westminster Abbey, near the monument of Camden.

His son, Sir John Spelman, inherited the taste and a portion of the learning of his father. He is the author of a 'Critical Life of King Alfred,' Oxford, fol., 1678.

SPELTER. [ZINC.]

SPENCE, JOSEPH, was born at Kingsclere, Hampshire, April 25, 1699. His father was rector of Winnal, near Winchester, at which school Spence was educated, and became fellow of New College, Oxford, in the year 1722. In 1728, having entered into orders, he was chosen professor of poetry, and presented to the rectory of Birchanger, in Essex. At the close of the year 1730, he accompanied Charles, earl of Middlesex, afterwards duke of Dorset, on a tour through France and Italy, and returned in July, 1733, having been in his absence re-elected professor of poetry. His essay on Pope's translation of 'The Odyssey,' published some years before, had introduced him to the notice of that poet, with whom he became very intimate, and published at his request, in 1736, Sackville's tragedy of 'Gorboduc,' with a prefatory account of the author. In 1739 he made another tour to the Continent, with Henry, earl of Lincoln, afterwards duke of Newcastle, and returned to England in 1742. In the same year he was presented by his college to the rectory of Great Horwood, Bucks, and succeeded to the vacant professorship of modern history. In 1747 he published his 'Polymetis; or an Enquiry concerning the Agreement between the Works of the Roman Poets and the Remains of the Antient Artists, being an attempt to illustrate them mutually from each other:' the sale of which work was very profitable to him. In 1754 he was made a prebendary of Durham cathedral.

The latter years of Spence were passed in retirement in the country, where he indulged his favourite taste for gardening. He died August 20, 1768. Johnson ('Life of Pope') has observed of him with truth, that he was 'a man whose learning was not very great, and whose mind was not very powerful. His criticism however was commonly just; what he thought he thought rightly; and his remarks were recommended by his coolness and candour.' The 'Polymetis' has been considered worthy of some discussion by Lessing in his 'Laocoon,' who shows that the author has not distinguished with sufficient accuracy the boundaries of the several provinces of art, and has consequently attempted to make the range and power of the sculptor exactly commensurate with that of the poet in treatment and choice of subject. The design however of such a work is valuable, and, with the more exact knowledge and extensive views of modern archæology, might be successfully carried out.

Spence also collected an interesting volume of anecdotes, to which the biographers of Pope are much indebted for records of his conversations. It was published by Malone, and also by Singer in 1820, with a Life of the author, and many letters from distinguished contemporaries and friends. This correspondence exhibits Spence's private character in a very favourable light, and shows him to have been of an affectionate and benevolent disposition, and of simple manners. A few smaller publications are noticed in the above-mentioned biography. See also Nichols's 'Literary Anecdotes of the Eighteenth Century,' ii. 373-7.

SPENSER, EDMUND, the 'prince of poets,' as the inscription on his monument terms him, is usually ranked with Chaucer, Shakspere, and Milton. Like them, very little seems to be known of his personal history, and that little is extremely contradictory and obscure.

He was born in the year 1553, in East Smithfield, London. He appears to have been well connected, but as to this there is no certainty. The circumstance of some of his minor poems being addressed to Anne, daughter of Sir John Spenser, who married Lord Mounteagle, and at his decease Henry, lord Compton, and also her sister Elizabeth, wife of George Cary, who was created Lord Hunsdon in 1596, furnish some foundation for this opinion. Nothing is known of Spenser's parents. We find him entered as a sizar at Pembroke Hall, Cambridge, on the 20th May, 1569, in his sixteenth year. In 1572 he took the degree of A.B., and in 1576 that of A.M. He soon afterwards left Pembroke Hall, in consequence, it is stated, of an unsuccessful competition for a vacant fellowship with Launcelot Andrewes, bishop of Winchester. But some of his biographers state that no such competition ever occurred; others, that he left college immediately after taking his degree. On quitting Pembroke Hall, he went to reside with some friends in the north. During this retirement he wrote his first work, the 'Shepheardes Calendar,' and fell in love with his 'Rosalind,' who is by some supposed to have been a real personage. This work was first published in quarto in 1579, and dedicated to the 'ever-memorable' Sir Philip Sidney.

Dr. Birch, in his 'Life of Spenser,' asserts that the dedication of the 'Shepheardes Calendar' was Spenser's first and only introduction to Sir Philip Sidney. The common story of Sir Philip's ordering five pounds to be given to the author, who waited without, and gradually increasing the sum in proportion as his admiration was awakened, is treated with discredit by all Spenser's later biographers. Sidney appears to have warmly patronised the poet, for Spenser dates the letters to Gabriel Harvey from Leicester House, Sir Philip's ordinary residence, and many expressions indicative of warm attachment on the part of Spenser and friendship on that of Sidney, are contained in them. It is remarkable that some of Spenser's contemporaries seem to have believed, and the belief seems to have been general, that Sir Philip Sidney himself was the author of the 'Shepheardes Calendar.' The subject is briefly discussed in Mr. J. P. Collier's 'Poetical Decameron,' to which the reader is referred. The fact of the work being published anonymously, no doubt greatly aided the general belief in this report.

In 1580 the 'Foure Epistles' which passed between Spenser and Gabriel Harvey appeared. The subjects of these letters were an earthquake which happened at that time in London, and satirical poetry. Spenser is addressed under the name of 'Immerito.' Nash, in his 'Have with you to Saffron Walden,' 1596, speaks of these letters as 'ragged remnants.' This and other satirical cuts produced a tract from Harvey in the ensuing year, called 'The Trimming of Thomas Nash;' but Spenser's fame being by this time well established, Nash's satire may be considered as confining itself to Harvey's share in the letters.

In the latter part of the year 1580, Spenser was sent to Ireland as secretary to Lord Grey of Wilton, by the earl of Leicester, Sir Philip Sidney's uncle. His services in that capacity procured him, in 1586, a grant from the crown of 3028 acres of land forfeited by the earl of Desmond. Kilcolman, in the county of Cork, was the name of this estate.

In the same year (1586) he lost his kind friend and patron Sir Philip Sidney, a mournful event which produced 'Astrophel,' a pastoral elegy on Sir Philip. This work was not published until the year 1595.

During his residence at Kilcolman, the 'Faerie Queen' was most probably begun. In 1590 the first three books appeared. In 1591 'Colin Clout's come home again,' was published. This poem is dedicated to Sir Walter Raleigh, who appears to have become, after Sir Philip Sidney's death, Spenser's principal friend and patron, and who is generally believed to have introduced him to Queen Elizabeth. The well-known story of the queen rebuking Lord Burleigh for his parsimony, and desiring that Spenser should have 'reason for his rhyme,' has often been contradicted, and as often asserted. Mr. Collier, in his 'Annals of the Stage,' gives the following curious extract from Henslowe's 'Diary' in corroboration of it:—'May 4, 1602. When her majestie had given order that Mr. Spenser should have a reward for his poems, but Spenser could have nothing, he presented her with these verses:—

> 'It pleased your grace upon a tyme
> To graunt me reason for my ryme,
> But from that tyme until this season,
> I heard of neither ryme nor reason.'

Whether these lines produced any effect is uncertain, but Mr. Malone discovered, among the records deposited in the Rolls chapel, a grant of fifty pounds per annum from the queen to Spenser. It is not easy to reconcile his possession of this annuity with Ben Jonson's account of his death.

In 1591 were also published a collection of minor poems, entitled 'Complaints,' and the second part of the 'Faerie Queen.' The 'Complaints' comprise 'Mother Hubbard's Tale,' 'Tears of the Muses,' 'Virgil's Gnat,' 'Petrarch's Visions,' 'Bellaye's Visions,' and the printer of the edition of 1679 says that various other minor poems are 'either wholly lost or unkindly concealed from the publique by private hands,' an assertion of still earlier date. The title-page of the Second Part of the 'Faerie Queen' mentions that the work would be in twelve books. The six books which were wanting to complete the work are stated to have been lost in their passage from Ireland by the carelessness of Spenser's servant; but Fenton the poet denies this. Two 'Cantos of Mutability,' which were first published in the collection of 1609, appear to be all that remain to us of the missing six books.

In 1594 he married, but who the lady was is unknown. He alludes to the progress of his passion in the 'Amoretti,' but so obscure is this portion of his history, that it is uncertain whether this was a first or second marriage.

In 1596 he published four 'Hymns,' addressed to the countess of Cumberland and Warwick. In the same year he wrote his masterly 'View of Ireland,' published by Sir James Ware in 1633. His 'Prothalamion,' a nuptial poem, appeared about the same time.

The close of Spenser's career was lamentable. Tyrone's rebellion broke out in 1598. Spenser had been nominated sheriff of Cork a little time previously, by the queen; and to this circumstance, and not to his cupidity, as some writers have asserted, should the awful event detailed by Jonson to Drummond of Hawthornden be ascribed. Ben Jonson said that 'the Irish having robbed Spenser's goods and burnt his house and a little child new born, he and his wife escaped; and after he *died for lake of bread* in King Street, and refused twenty pieces sent to him by my lord of Essex, adding, "He was sorrie he had no time to spend them."'

Spenser died on the 16th of January, 1598-1599, in King Street, Westminster, though let us hope, for the honour of his numerous friends, not for *lake of bread*. He was buried, at his own request, near Chaucer, in Westminster Abbey, at the charge of the earl of Essex. Thirty years after, the countess of Dorset erected a monument to him, which, in 1778, was restored by the Fellows of Pembroke Hall.

Spenser left two sons, Sylvanus and Peregrine. Hugolin, the son of Peregrine, was restored to the estate in Ireland by Charles II.; but adhering to the cause of James II., he was outlawed, and the estate reverted to the crown. A William Spenser petitioned the House of Commons for its restoration about the year 1700, pleading his ancestry and services as a guide to the royal troops in Ireland; and also that Hugolin 'is very old and unmarried.' He obtained the grant of the estate through the interest of the earl of Halifax.

Pope observed of Spenser, 'There is something in Spenser that pleases us as strongly in one's old age as it did in one's youth. I read the "Faerie Queen" when I was about twelve, with a vast deal of delight.' Campbell calls Spenser 'The Rubens of English poetry.' Speaking of the 'Faerie Queen,' a writer in the 'Retrospective Review,' vol. ii., p. 143, remarks, 'The wonderful fertility of invention, the richness of imagination, the poetical prodigality of the "Faerie Queen" has our unfeigned admiration. The design, it is true, might have been more judiciously framed and the interest of the reader more deeply excited, but nothing can surpass the correctness of description, whether real or allegorical.' This judgment appears to be correct. With all its beauties, a continuous perusal of the poem is wearisome to many readers.

Of Spenser's minor poems it is unnecessary to say much. 'The Retrospective Review' unequivocally condemns them. The 'View of Ireland' will well repay perusal. The style is bold, and the handling of the subject very masterly. The 'Daphnoida,' usually printed with the 'Astrophel,' is a poem of much merit. Sir Philip Sidney, in his 'Defence of Poesie,' says he finds much good poetry in Spenser's works, but can hardly allow the use of the antiquated language. Warton's learned dissertation on the model of the 'Faerie Queen,' and the reasons for the adoption of an antiquated style, are well known.

There are a vast number of editions of Spenser's works. Lowndes, in his 'Manual,' enumerates thirty-two different editions of his works, and thirteen publications relative thereto. The first collection was that of—

1609, folio.
1679, folio; successive editions, edited
1715, by Hughes;
1751, with Life and notes, by Dr. Birch;
1758, by Church;
—— by Upton;
1805, by Todd, with notes and Life;
1806, by Dr. Aikin;
1825, with Essay on Life, by G. Robinson, Esq.;
Warton's 'Observations,' 1754; Jortin's 'Observations,' 1734.

Notices by contemporaries occur in the 'Skialetheia,' 1598, a satirical poem, in the very rare 'Eclogue upon the Death of the Right Honourable Sir Francis Walsingham,' by Watson, 1590; in a 'Discourse of English Poesie,' by Webbe, 1586; an Eclog,' addressed to him by Lodge, 1595; Notices, by Camden, in his 'Annals,' and by Sir James Ware, in 1633; and he is eulogised by almost every poet of the Elizabethan æra.

(Dr. Birch's *Life; Theatrum Poetarum; Biographia Poetica;* Collier's *Decameron;* and *Annals of the Stage. Biographia Britannica;* Ritson's *List of Poets;* Lowndes's *Bibliographer's Manual.*)

SPERANSKI, MICHAEL, was born in 1771, in the government of Vladimir. His father, a clergyman of influence, designed him for the church, and sent him to the ecclesiastical academy of St. Petersburg, after a course of preliminary studies in the seminary attached to the convent of Rozhdyêstvenski. Young Speranski however felt no inclination for theology, and devoted most of his time to the study of mathematics, in which he made such proficiency that at the age of twenty-one he was appointed to the professorship of mathematical and physical sciences attached to the academy. He retained this professorship until 1797, when, owing to ill health, he left his situation, retired to a village in the neighbourhood of St. Petersburg, and turned his attention to political science. During this period he formed the acquaintance of Count Kotchubey, who, upon the accession of Alexander, obtained for him the office of secretary to the Imperial council. In 1802 Speranski proceeded to organise the ministry of the interior under the direction of his patron. His plans were not completed till 1806, but were then adopted with the complete approbation of the emperor and his advisers. It was further determined that all the departments of government should be organised on the principle laid down by the young statesman, who had so completely gained the confidence of the government, that in 1808 he was named assistant-minister of justice and governor of Finnland. The latter situation comprised the chancellorship of the university of Abo; but before he proceeded to execute his intended improvements in the system of national education, he reorganised the egislative commission, which had resumed its labours in 1804. [RUSSIA, p. 265.] In the same year his plans for reforming the public schools were taken into consideration, and by his advice all the funds for public instruction received large additions. In the following year he had already obtained power enough to propose a new system of finance, an improved organization of the council of the empire, and a diminution of the power of the senate. All these measures were carried into execution, and Speranski, having thus brought all the chief branches of administration into the hands of the Imperial council, found himself in the capacity of its secretary, at the head of the affairs of the empire.

In the space of two years the whole system of government was changed; a new penal code was introduced; the law for the protection of commerce greatly improved; much of the paper money in circulation was replaced by a new coinage; and the whole method of taxation was remodelled. Speranski enjoyed in the highest degree the confidence of the emperor, who approved of all the changes proposed by him, and seems to have left everything in his hands. In 1809 Speranski had become a member of the privy council. The period between 1808 and 1812 was that of Speranski's greatest prosperity, and it is to these years of his almost unlimited power that some of the best institutions in Russia owe their origin. The nobility, who had lost many of their privileges under his reforming administration, insisted on his dismissal in 1812. The approaching invasion of Napoleon intimidated the emperor, who was in want of money, and felt that unanimity was indispensable in so critical a moment.

In the middle of March, 1812, Speranski was carried off to Nischnei Novgorod with the utmost precipitation, under the pretext that his life was in danger from the French. Six months after he was exiled to Perm, where, suffering from want and vexations of all kinds, he was obliged to apply to the government for a small pension, which was granted, and enabled him to live in retirement. Two years afterwards, a country-seat in the neighbourhood of St. Petersburg was restored to him; and he also obtained permission to live there. In 1817 he was unexpectedly appointed to the government of Pensa; and two years afterwards to that of Siberia. He devoted the first two years of his administration to a journey through the provinces which were entrusted to him, and he was thus led to project a new system of administration for Asiatic Russia. In 1821 he delivered his plan into the hands of the emperor Alexander, who received him with the greatest distinction, and restored him to his seat in the Imperial council of which his exile had deprived him. In 1825 the emperor Nicholas nominated him to the presidency of his chancery, and it was under his able direction that the celebrated 'Svod Zakônow' (or Corpus Juris), which contains the laws and ordinances from 1694 to 1833, was completed. About this time he published his work, 'Précis des Notions Historiques sur la Réformation du Corps des Lois Russes,' &c. (Petersb., 1833).

Speranski died in 1840, at the age of sixty-nine years. His manners were pleasing, and his aspect indicated genius and commanding power.

SPE'RGULA, from *spargo*, 'to scatter,' the name of a genus of plants belonging to the natural order Caryophylleæ. It is possessed of a 5-parted calyx, 5 undivided petals, 5 or 10 stamens, 5 styles, 8-celled, 5-valved, many-seeded capsule. This genus is found in fields and cultivated ground, especially on sandy soils, all over the world. It is divided into two sections, one of which possesses stipules; the other is without these organs. On this ground many writers have constituted new genera. Cambessedes placed the stipulate species in his genus *Spergularia*, whilst Reichenbach has placed the ex-stipulate species in a genus by themselves, under the name of *Spergella*. But the old name with the two sections is most generally adopted. *Spergula arvensis*, the corn-spurrey, or yarr, has its leaves in whorls, with minute membranaceous stipules at their base, the stalk of the fruit reflexed, and the seeds hispid, with a narrow border. It is a native of Europe, in gardens and fields, and in North America on the banks of the Columbia, and is common in Great Britain. Though not cultivated in England, this plant is of some importance on the Continent, and in the Netherlands and Germany is sown as fodder for animals. It is said to be well adapted for poor soils in which scarcely any thing else will grow. It may be sown and reaped in eight weeks, either in autumn or spring, and may be used as fodder either fresh or as hay. Cows and sheep are fond of it, and the milk of the former is said by Von Thaer to be enriched by it, and the mutton of the latter preferable to that of which sheep are fed on turnips. Hens also eat spurrey, and they are said to lay a greater number of eggs in consequence.

Three other species, the *S. nodosa*, knotted spurrey, *S. saginoides*, pearl-wort spurrey, and *S. subulata*, awl-shaped spurrey, are also natives of Great Britain, but are neither ornamental nor useful.

SPERMACETI, or CETA'CEUM, a fatty material, obtained from the Physeter macrocephalus, a species of whale, generally met with in the South Seas, but occasionally also on the coast of Greenland. This animal, called the cachalot, or white whale, is of immense size, frequently sixty or more feet in length, of which the head constitutes one-third. This part is the chief reservoir of the spermaceti, which however is found in several other parts of the body, mixed with the sperm oil. It is mostly lodged in two large cavities of the upper jaw, one above and the other below, divided from each other by the nostrils. These cavities are subdivided into numerous cells, of unequal size, by ligamentous or tendinous partitions; these partitions are of the same nature as those which separate the fat in other animals [ADIPOSE SUBSTANCE], but owing to the great size of the creature, of a larger and stronger kind. The purest spermaceti is contained in the largest and least ligamentous cells. The object of the great accumulation of spermaceti in the head is supposed to be to float that enormous mass. The part in which it is lodged is quite distinct from the cranium, containing the brain, which spermaceti was at one time supposed to be.

During the life of the animal the spermaceti is in a fluid state; and on the head being opened, has the appearance of an oily, clear, white liquid. On exposure to the air the spermaceti concretes and deposits from the oil. They are then separated, and put into different barrels. The head of a whale sixty-four feet in length has been found to yield twenty-four barrels of spermaceti, and from seventy to one hundred barrels of oil. When brought to England, the spermaceti has not a white shining silky appearance, but a yellowish colour, owing to the presence of some oil. To separate this it is filtered in bags, and the solid part, which remains, is then 'submitted to pressure in hair bags, placed in a hydraulic press. It is then melted in water, and the impurities skimmed off. It is then remelted in a weak solution of potass. It is then fused in a tub by the agency of steam, ladled into tin pans, and slowly allowed to concrete into large, white, translurent, crystalline masses.' (Pereira.) Even after all these processes it still retains a portion of oil, which can only be removed by boiling in alcohol, from which, on cooling, it is deposited in perfectly pure lamellated crystals. It is then called *cetine*. It is also soluble in æther, and volatile and fixed oils. It has a a white, pearly, or silky appearance, considerable tenacity, but may be broken into mica-like scales, with a smooth or fatty feel, slight fish-like odour, and mild mawkish taste. Its specific gravity is ·943; it melts at 112°, and when a lighted body is applied to it, it burns with a clear flame.

Sulphuric is the only acid which dissolves it. It is only partially dissolved by the fixed alkalis, and is with difficulty saponifiable. Hot caustic ammonia forms with it an emulsion, which is not decomposed on cooling.

Long exposure to the air renders it rancid; it may be again purified by washing in a warm ley of potass. It should be protected from air and light.

A hundred parts of spermaceti consist of sixty parts of margaric and oleic acids, forty parts of ethal, and 0·9 parts of a yellow extractiform substance. The ultimate composition of cetine seems to be—carbon, 81; hydrogen, 12; oxygen, 5.

Spermaceti possesses the properties common to fatty matters. It is bland and demulcent, with considerable nutritive qualities, when taken internally. It was formerly much used in colds and coughs, united with mucilage or syrup, to shield the throat from the irritation of the air, also in dysentery. Triturated with sugar-candy, and having warm milk added to it, it is a mild nutrient article, fit for children or old persons. It is however now chiefly employed externally as an ingredient in ointments and cerates. It is also largely used to form candles.

SPERMACOSE (σπέρμα, a seed), a genus of plants of the natural family of Rubiaceæ, so named from the seeds being terminated by two remarkable points. The genus is characterised by having the calyx 2-4-dentate Corol 4-lobed. Stigma bifid or entire. Capsule 2-celled, crowned with the limb of the calyx, which is sometimes obliterated. Seeds oval, oblong, marked in the inner side with a longitudinal furrow. The species are very common and abundant in tropical parts of the world; have usually quadrangular stems and branches, with small white or blue flowers. Some of the species, as *S. Poaya* and *ferruginea*, are useful, like other plants of the same family, in having roots which form substitutes for Ipecacuanha.

SPERMADICTYON, a genus of the natural family of Rubiaceæ, named from σπέρμα, seed, and δίκτυον, a net, from the manner in which the seeds cover the placenta. The genus is characterised by having the calyx tube ovate, 5-partile, persistent; corol densely pubescent; tube long, straight, 5-lobed. Stamens 5, included within the corol-tube. Stigma 5-cleft; capsule crowned by the calyx, contains 5 nuts. The species form shrubs with white and light blue very fragrant flowers, with leaves lance-shaped, shortly petioled; stipules short. They are natives of India, especially near mountains. *S. suaveolens*, the Hamiltonia of Roxburgh, ascends the Himalayas to elevations of 3000 feet, and has been cultivated in this country as a stove-plant.

SPERMESTES, Mr. Swainson's name for a subgenus of Fringillidæ.

SPERMOE'DIA, the name given by Fries to a certain altered form of the seeds of rye and other grasses, and to which the name *ergot* and *spurred* grain has been commonly applied. The bodies to which this name is given are solid elongated masses, growing from the inside of the ovary of grasses, rootless, of a firm mealy substance, with a concrete scaly or powdery crust. Fries says they have no proper fructification; but other authors state that the interior is composed of flocci and sporules firmly compacted into a solid homogeneous mass. The precise nature of thes grains, both on account of their peculiar medicinal effects and their poisonous quality when taken as food, have excited much attention amongst botanical observers. Willdenow supposed the ergot to be merely a diseased state of the grain, and stated that he could produce it at pleasure by excessive watering. General Field made some observations which led him to suppose that it originated from the puncture of insects. De Candolle and others more recently determined that the ergot was a distinct parasitic plant, developing itself from the ovary of grasses, and referred it to the genus *Sclerotium*. Fries, in his 'Systema Mucologicum,' considered the ergot to be a diseased state of the grain, and placed it in the doubtful genus Spermoedia. More recently this production has been carefully investigated by Mr. Edwin Quekett, who communicated the results of his observations to the Linnæan Society in November, 1838. From his examinations, it appears that the great mass of the ergot consists of the albuminous matter of the grain in a diseased state. The interior of these grains had been described as being filled by flocci and sporules compacted together; but on examination with the microscope, after the outside was scraped off, the interior was found to be composed of irregular cells filled with globules of a fatty oil. The cause of this changed state of the internal parts of the grain was found on the outside of the ergotized grain, where a number of very small oval or elliptical bodies were found, about 1-6000th of an inch in diameter, and containing within them a number of smaller granules. These were found to be the sporidia and sporules of a fungoid plant, which, attached to filaments, developed themselves early in the growth of the grain, and produced its diseased state. Mr. Quekett has since succeeded in obtaining ergotized rye by applying to healthy plants of rye water containing the sporules of this fungus diffused through it; thus affording additional proof that plants become diseased by imbibing the seeds or sporules of other plants from the soil in which they grow. For the plant as above described, Mr. Quekett proposes the name *Ergotætia abortans*. It belongs to the tribe *Mucedines* and suborder Concomycetes of the order Fungaceæ of Fries, thus occupying a different position to the *Sclerotium Clavus* of De Candolle or the *Spermoedia Clavus* of Fries. For the medical properties, &c., see Ergot.

SPERMO'PHAGA, Mr. Swainson's name for a subgenus of Fringillidæ.

SPERMO'PHILA, Mr. Swainson's name for a subgenus of Fringillidæ.

SPERMOSPI'ZA, Mr. G. R. Gray's name for a genus of Fringillidæ, belonging to the subfamily *Coccothraustinæ*, according to his arrangement.

SPESSART. [Germany.]

SPEUSIPPUS, the son of a sister of the philosopher Plato, was born in Attica, in the demus of Myrrhinus. He was a disciple of his uncle Plato, whose general principles he adopted in his philosophy; but he differed from his master, as he mixed up empiricism with the idealism of Plato, and consequently attributed more importance to the senses, and also combined with his system several Pythagorian principles. In some of his works, which are mentioned by Diogenes Laertius and Athenæus, he wrote about plants, animals, and natural objects, into which he inquired more deeply than Plato. (Sext. Empir., *adv. Math.*, vii. 145.) But on the whole he must be regarded as the continuator of the Platonic philosophy, and as the founder and the head of the old Academic school of philosophy, in which light he was always considered by the antients themselves. Among his disciples several females are mentioned. Some antient writers blame him for having taken money for his instruction, and for having indulged in sensual pleasures more than was becoming to a philosopher. A long list of his works, of which only few fragments are preserved, is given by Diogenes Laertius (iv. 1).

(Brandis, *De Perditis Aristot. Libris, de Ideis et Bonis*, p. 46, &c.; Ritter and Preller, *Historia Philosophiæ*, &c., p. 228, &c.)

SPEY, a river in Scotland, and one of the largest in Great Britain, as it runs rather more than 96 miles, and drains an area of 1300 square miles. A small lake, called Lake Spey, is its source. This lake is about 10 miles south of the southern extremity of Loch Ness, and is surrounded by the summits of the Coryaranik Mountains, a continuation of the Monadh Leadh Mountains, which traverse Scotland, between 57° and 57° 30,' in a north-east and south-west direction. The torrents which descend from the adjacent mountains supply the lake with water. The river issues from the eastern side of the lake and continues to run in that direction between high and naked mountains, and in a very narrow and uninhabited glen, for about 10 miles. It then enters, near Garvimore, a plain of moderate extent, which towards the north gradually rises to some moorlands, which extend to the base of the Monadh Leadh Mountains; whilst on the south, the plain, which gradually ascends, terminates on the high ground which lies between Loch Loggan and the Spey, and connects the Monadh Leadh Mountains with the mountains of Drumnasher, or the north-western portion of the Grampians. The greater part of the plain is occupied by the moorlands, but the lower part along the banks contains excellent pasture-ground. Loch Spey is about 1200 feet, and the plain between Garvimore and Laggan 1000 feet above the sea-level. A few miles below Laggan the river turns to the north-east, in which direction it continues to its mouth. It is joined from the south by the river Truim, which descends from the mountains of Drumnasher in a northern direction, and runs between mountains and elevated moorlands in a narrow and nearly uninhabited valley. This river may be considered as the southern branch of the Spey. After its confluence with the Truim, the Spey continues to flow in a fine valley, from one to two miles wide, whose surface is so little above the bed of the river, that the greater part of it is subject to frequent inundations, which circumstance, together with the severe climate, the effect of its elevation, prevents cultivation, but renders the country fit for pasture and meadow-land. On the south-east of this part of the valley, the country rises with a moderately gentle slope towards the Grampians, but being well drained, the surface is not swampy, and is chiefly covered with forest-trees. These are the forests of Kingussie and Abernethy, from which great quantities of timber have been taken in recent times, and floated down the river to Garmouth. Several small rivers traverse this country and join the Spey above Rothiemurches, but none of the valleys are wide enough to be inhabited, with the exception of that of the Fesshie, which is inhabited to the distance of about 6 miles from the banks of the Spey. Before the Fesshie joins the Spey, this river flows through Loch Inch, which is about 3 miles long and a mile wide, and surrounded by fine meadows. North of the walley of the river are moorlands, destitute of trees, and nearly a waste, which extend to the base of the Monadh. A little above Aviemore Inn, the high ground approaches the bed of the river on both sides, so as to have the appearance of a rent, through which the river flows. This narrow passage is called Craig Ellachy, and may be considered the termination of the *upper valley* of the Spey.

At Aviemore Inn begins the *central valley* of the Spey, commonly called *Strath Spey*, into which the valleys of three rivers, the Nethy, Avon, and Dulnain, open. The valley of the Spey is here much wider, being between three and four miles across. Some parts of it are also so low as to be subject to inundation, but others are beyond their reach, and there are several rising grounds in the level country which stand isolated. Several tracts in this part of the valley are under cultivation. The valley of the Nethy is separated from that of the Spey by woodlands. The Nethy runs about 12 miles. Its upper course lies in a narrow glen between high mountains connected with the Cairn Gorum mountain-knot, and is uninhabited, but about the middle of its course the valley grows wider, and contains good pasture-grounds.

The Avon rises in Loch Avon [AVON, vol. iii., p. 117; BEN, vol. iv., p. 209], and the upper part of its valley is too elevated for cultivation. The banks begin to be inhabited after it has terminated more than half its course; and though the valley by degrees widens to one mile and a half, it is intersected by numerous hills, and contains only narrow flats. On both sides of this valley high mountains continue nearly to the confluence of the Avon with the Spey. The Dulnain joins the Spey from the west, and the valley is separated from that of the principal river only by elevated moorlands, except towards the source of the river, where there is an offset of the Monadh Leadh Mountains between them. The first third part of its course is in a deep, narrow, and uninhabited glen; but about two miles above the church of Duthel, it expands into a plain of moderate extent, which rises with a gentle ascent to the south and north towards the higher ground which continues to the mouth of the river. The elevation of the valley renders the crops uncertain, and the rearing of cattle and sheep is preferred to agriculture. This central valley of the Spey terminates near Knokando, where the river begins to run eastward, as south of that place the hills with which the Monadh Leadh Mountains terminate approach to a short distance from the bed of the river on the north.

In its *Lower valley* the Spey runs east between Knokando and Abelour, and afterwards north. Its course here acquires rapidity, which entitles it to the epithet of the swiftest river in Great Britain. Above the church at Abelour it forms a waterfall 30 feet high; and the descent of the waters from the Boat of Bog to the sea, a distance of only three miles, is 60 feet. It is evident that the river here descends with rapidity from the elevated table-land on which its upper course lies. Along the eastern banks of this part of its course there is a high country, which rises into hills, mountain-summits, and flat moors, and approaches so near to the river, that in some places the level tracts are not a quarter of a mile in width. This elevated tract is intersected by the valley of the Livet, which opens into that of the Spey below Abelour. It is about 12 miles long, and not wide, but rather fertile, and contains excellent pasture. On the west of the Spey there are no mountains. The country is considerably elevated above the river; but it extends in wide moors, with a nearly level surface, which however rise towards the north-west, where they are interspersed with low sandy hills about the river Lossie. Between the moors there are some depressions, which run westward in the forms of valleys, and these are the only tracts which are inhabited and cultivated. One of these depressions, called the Plain of Rothes, extends between ranges of hills to the river Lossie; and it is conjectured that at some remote period the Spey took its course through this flat, and that the Lossie constituted its lower course. Near the mouth of the river the flat country extends for nine miles from south to north, and still more from east to west.

The Spey is not navigated, but great floats of timber are sent down from the forests of Kingussie and Abernethy to Garmouth. In order to prevent the timber from being shivered in passing the numerous rapids and cataracts in the lower course of the river, several canals have been cut along the banks. The Spey is the most irregular river in Great Britain: its variations as to quantity of water are extremely sudden.

(Sinclair's *Statistical Account of Scotland;* Sir T. Dick Lauder, *On the Great Floods, &c.;* and MacCulloch's *Highlands and Western Islands.*)

**SPEYER**, or **SPIRE**, is an antient city in the kingdom of Bavaria, situated in 49° 20′ N. lat. and in 9° 35′ E. long. It stands on the Speyerbach, where it falls into the Rhine, in a pleasant and fertile country. It is surrounded with walls and ditches, and has five gates. The population is probably under 10,000; though Hörschelmann, in 1834, makes it above 17,000; but Cannabich, in 1836, says 8000; the 'Conversations Lexicon,' in 1836, 8000; and the 'Weimar Almanack' for 1840, in a list of towns of more than 10,000 inhabitants, does not include Speyer. The majority of the inhabitants are Protestants; yet of the churches it is stated that 15 are Roman Catholic and only two Lutheran. The most remarkable is the venerable cathedral. The first cathedral was founded by King Dagobert. The present cathedral was founded by the emperor Conrad in 1030, and completed by Henry IV. in 1061. It was very richly adorned, and contained the mortal remains of eight emperors, three empresses, and two Imperial princesses; but their marble sepulchres, their statues, and silver coffins were desecrated and plundered by the French in 1689, and their bones scattered by order of Louvois. The sepulchres of Rudolph of Habsburg, Adolphus of Nassau, and Albert I. have been restored. The French also carried off the archives of the city and of the bishopric to Strasburg. In former times the diet of the German empire was frequently held at Speyer. One of the most important of these diets was that of 1529, when a protest made by the Reformers against certain proceedings of the emperors procured them the name of Protestants. The fine old town-hall is now the seat of the government of the circle, and the former Jesuits' college is now used as barracks for cavalry. The city has a gymnasium, a lyceum, an hospital, an orphan-house, and a botanic garden. In the old town-hall there is a pretty considerable collection of Roman and antient German antiquities found in the neighbouring country. There is no manufacture of any importance: the principal are snuff, sugar of lead, and wax; there are likewise some vinegar-breweries, and considerable cattle and corn markets. The inhabitants have some trade on the Rhine, and the transit trade is very profitable. (Stein; Hassel; Cannabich; Hörschelmann.)

**SPE'ZIA, THE PROVINCE OF**, called also 'Provincia di Levante,' forms the eastern extremity of the duchy of Genoa, which is annexed to the crown of Sardinia. It is bounded on the north by the high chain of the Apennines, which separates it from the duchy of Parma; on the east by the districts of Massa and Lunigiana, belonging to Modena and Tuscany; on the west by the Sardinian province of Chiavari; and on the south by the Mediterranean Sea. It is a mountainous region, lying along the slopes and among the offsets of the Apennines, and between them and the sea. The Magra, a mountain-stream, coming from Pontremoli, intersects the eastern part of the province from north to south, and is joined above the town of Sarzana by the Vara, another mountain-torrent, which flows from west to east, between the main chain of the Apennines and another and much lower ridge which runs parallel to it along the sea-coast. The new carriage-road from Genoa to Sarzana runs on this latter ridge, and partly along the banks of the Vara, until it reaches the Magra, below the confluence of the two rivers, opposite the town of Sarzana. The Magra is there forded when the water is low, or is crossed by a ferry in time of floods.

The finest part of the province is that which lies round the shores of the deep bay called Golfo della Spezia, which is one of the finest and safest bays in the Mediterranean, about five miles in length, and four in its greatest breadth, in which the largest fleet can ride at anchor in perfect safety. Napoleon, aware of its importance, built forts at the entrance of the bay and batteries along the shores; he formed docks, and intended to make the bay one of his great naval stations. The island of Palmaria lies on the western side of the entrance to the bay, and between it and the mainland is a narrow channel, on which the small town and fort of Porto Venere are built. On the opposite or eastern side of the gulf is the town of Lerici, with about 4000 inhabitants, which is a station for the feluccas and other coasting vessels which trade between Genoa and Leghorn. In the deepest recess of the gulf is the neatly built town of La Spezia, with about 7000 inhabitants. The town of Levanto, which is on the western coast towards Genoa, has 4000 inhabitants. (*Calendario Sardo.*)

The province of La Spezia is divided into three mandamenti, or districts, Levanto, La Spezia, and Sarzana. The last district, which lies along the banks of the Magra, forms part of the region formerly called Lunigiana, from the antient but long since ruined town of Luna, which was in the middle ages a county belonging to the feudal family of Malaspina, but is now divided among the states of Sardinia, Modena, and Tuscany. [MODENA, DUCHY OF.] The site of Luna is in a low plain now called La Marinella, on the left or eastern bank of the Magra, about one mile from its mouth, and four miles south-east of Sarzana. Scanty remains of an amphitheatre and other structures are seen above ground, but the excavations made of late years by order of the present king of Sardinia have brought to light marble pavements, columns, inscriptions, statues, bronzes, and other monuments, which have been illustrated by Carlo Promis, a Piedmontese, in his 'Memorie della Città di Luni.' The best part of these antiquities are now in the museum of Turin. Luna seems to have been originally built by the Etruscans; it was for a time in possession of the Ligurians, and was afterwards taken by the Romans. Livy (xxxiv. 8) mentions the harbour of Luna as the place where the consul M. Portius Cato embarked his troops, 195 B.C., for Spain, and two years later he relates how the Ligurians made a sudden irruption into the country of Luna and into the neighbouring territory of Pisa, devastating the whole maritime region. In the year 185 B.C. the consul M. Sempronius, advancing from Pisa into the highlands of the Apuani Ligures, devastated and burnt their country, and opened his way through their fastnesses and forests to the river Macra and the port of Luna. (Livy, xxxix. 32.) After the battle of Actium, a colony of veterans was sent to Luna. Under Augustus the trade of Luna was greatly increased in consequence of the demand for marble from the neighbouring quarries, which was shipped at that port for Rome [CARRARA], and the trade increased under the following emperors. Pliny (xxxvi. 4) speaks of the white marble of Luna as having superseded that of Paros for statuary. Inscriptions in honour of Trajan and his wife Plotina and his sister Marciana, of Hadrian, of Septimius Severus and Julia Domna, and of Flavia Plautilla, wife of Caracalla, have been found among the ruins of Luna. Rutilius Numatianus, in his 'Itinerary,' speaks in a highly poetical strain of the striking appearance of the marble buildings of Luna as seen from the sea. Luna became early a bishop's see, and there exist several letters written by Pope Gregory the Great to its bishop Venantius. The destruction of Luna was begun about the middle of the ninth century by the Saracens or Moors, who landed on that coast, and was completed in the early part of the eleventh century by another host of Moors from Sardinia, led by Musaït, sovereign of that island. Bishops of Luna however are mentioned till 1204, when, in consequence of the desolation of the place and the unhealthiness of the atmosphere, Pope Innocent III. transferred the see of Luna to the town of Sarzana.

Sarzana is a considerable town, situated on the left bank of the Magra, with the castle of Sarzanello built upon an eminence near the town. Sarzana has a handsome cathedral, an hospital, a theatre, and about 7600 inhabitants, including the territory of the commune. It is the birth-place of Pope Nicholas V., who was distinguished for his love of learning and of the arts. About five miles south-east of Sarzana, the small stream Parmignola forms the boundary between the Sardinian territory and the duchy of Massa, which belongs to Modena.

The population of the whole province of La Spezia is about 61,000. (Serristori, *Statistica dell' Italia.*) The country around the gulf of La Spezia, and about Sarzana and along the banks of the Magra, produces oil, wine, cotton, hemp, and silk; but the highlands of the Apennines in the interior are bleak and barren. A considerable proportion of the inhabitants are engaged in maritime trade.

**SPHACTE'RIA.** [NAVARINO.]

**SPHÆRALCE'A**, the name of a genus of plants belonging to the natural order Malvaceæ. It is characterised by a 3-leaved deciduous involucre; 5-cleft calyx; five obliquely emarginate petals; numerous stamens united together, the stamen-tube being longer than the petals; many-celled ovary, with three seeds in each cell; styles consolidated and stigmas capitate; a globose, umbilicated, downy capsule, with cells dehiscent at the back. The species are trees or shrubs with toothed or 3-5-lobed leaves. Flowers on peduncles, one or many-flowered, of a reddish or flesh colour. This genus was separated from Malva, which it greatly resembles, by Auguste St. Hilaire. With the exception of one, which is a native of the Cape of Good Hope, the species are all found in South America. They all of them bear elegant flowers, and will thrive well in gardens in this country. They require a light soil, and may readily be propagated by cuttings, which will strike root when placed under a hand-glass.

*S. Cisplatina*, the Cisplatine globe-mallow, has a slender shrubby stem, ovate 3-lobed toothed or crenate leaves, tomentose beneath; axillary racemose flowers. It is a native of Brazil, in the western part of the Cisplatine province. It is used medicinally in Brazil, in the same manner as marsh-mallows are in Europe. The decoction is given in inflammations of the bowels, and it is also employed as a fomentation in diseases of the chest.

**SPHÆRANTHUS**, a genus of plants of the natural family of Compositæ, so named from σφαῖρα, a 'globe,' and ἄνθος, 'a flower,' on account of the globular form of the heads of the flowers. The species are small herbs common in tropical parts of the Old World, with alternate decurrent leaves. Flowers tubular, external ones female, many-rowed, the central ones male with imperfect style. Receptacle naked. Pappus wanting. *S. mollis* is common in most parts of the plains of India, and has a strong aromatic odour, and is used by the natives in medicine, and is supposed by some of the hukeems to be the *Khamadroos* described in their works, which is no doubt the χαμαιδρυς of Dioscorides. *S. microcephalus* (indicus, L.) has also an aromatic odour, and is employed as a diuretic in Java, according to Dr. Horsfield, and as an anthelmintic in India, according to Rheede, and in fevers, according to others. These, as well as some other species, being bitter and aromatic, may no doubt be useful as tonics and stimulants.

SPHÆ'RIA (from σφαῖρα, a sphere), the name of a genus of plants belonging to the natural order Fungaceæ. This genus is known by possessing a rounded external receptacle, which opens at the top with a minute orifice. Within the receptacle, the sporidia, or seed-vessels, are found inclosed in tubes which are arranged in one or more rows. These tubes are called *asci*. The size of the rounded receptacles of these fungi varies from that of a millet-seed to that of a small marble. They are generally found upon decaying vegetable matter, and seem as if they were immersed in the substance on which they grow. Their most frequent position is on the bark of the stem and branches of decayed trees. They are however by no means confined to this situation, being frequently found on decaying leaves, on the stems of grasses, and on the surface of decaying wood. Some of them are found occupying the bark, leaves, &c. of plants that are still living, but in most instances this must be looked upon as indicative of a loss of vitality in the part of the plant thus attacked. One of the species, *Sphæria militaris*, is remarkable for growing from the dead bodies of caterpillars and other decaying animal matters. Another species, the *S. entomorhiza*, is also found in the same positions.

Although the plants of this genus are so simple in their structure, yet their receptacle, with its contents, presents so great variety in form, size, colour, &c., that upwards of 600 different species have been described. Of these, 201 have been recorded as British, by the Rev. M. J. Berkeley, in the 2nd vol. of Hooker's 'British Flora.' These plants are very generally diffused throughout the world in the temperate zones. So abundant are they, that scarcely a decaying stick can be taken up in autumn without presenting some form of them.

Like the great mass of the vast order of Fungi, the species of *Sphæria* have not been used as food or medicine, or cultivated as ornament. Their great use in the economy of nature appears to be, the appropriating those elements as materials of their growth, which, if left unconsumed, would become a source of deterioration to the atmosphere. As examples of this genus we shall select a few of the more common of the British species.

*S. Hypoxylon*, flat-horned Sphæria: receptacle of a black colour, of a corky consistence, single or branched, compressed, at first covered over with a mealy powder, then becoming naked, the stem villous. This is a very common species, and is found on sticks and stumps of trees. Unlike most of the species, it has a great tendency to sport, being sometimes exceedingly branched, sometimes palmate, and sometimes quite simple.

*S. stigma*, black-dotted Sphæria: effused, often nearly surrounding the branch, flat, even, at length becoming black, the orifices nearly plain. In the course of its growth, it pushes off the cuticle of the bark of the stick on which it grows; it is at first brown, and then becomes black. It is perhaps the most common of all the species.

*S. verrucæformis*, wart-like Sphæria: receptacles ovate with a short neck, plant of a black colour. Found on branches of the hazel and beech.

*S. quaternata*, quaternate Sphæria: receptacles generally grouped four together, naked; orifices collected together. It is found on beech-trees alone. Many other forms are found on only one kind of plant.

*S. sanguinea*, blood-coloured Sphæria: the receptacles scattered, very small, ovate; papillary of a blood-red colour. It is very common on all kinds of decaying wood and sticks, and is easily recognised by its red colour; there are however many other forms with a red colour, but not so common as this.

(For further information consult Fries's *Systema Mycologicum*; Hooker's *British Flora*; and Greville's *Scottish Cryptogamic Flora*.)

SPHÆROCA'RYA, a genus of plants of the natural family of Rhamnaceæ, so named from σφαῖρα, a 'sphere,' and κάρυον, a 'nut.' The species forms moderate-sized trees in Nepaul. The calyx is 5-parted. Petals are five, and alternate with the five stamens, which, like the petals, are inserted into the calyx, and with five fringed scales placed between the stamens, and opposite the calycina segments. Drupe pear-shaped, containing a smooth round nut. *S. edulis* is so called from its fruit being eaten and relished by the Nepaulese, though not very palatable to a European taste. This tree is a native of the forests of Nepaul, and has alternate, ovate, entire, exstipulate leaves, with axillary and terminal villous racemes of small greenish-coloured flowers, which are without odour.

SPHÆROCOCCUS, a genus of plants belonging to the natural order Algæ. It was formed by Stackhouse, and applied to the plants belonging to it on account of their globose fructification. A great number of species of this genus have been described, including amongst them some of the most useful of the sea-weed tribe. These species have been distributed by later botanists into the genera *Rhodomenia, Gigartina, Chondrus, Gelidium*, and *Phyllophora*, and the genus Sphærococcus has only one species, the *S. coronopifolius*.—The genus *Chondrus* affords the Carrageen moss, which is so much used as an article of diet. It is a species of *Gelidium*, with which the swallows build their nests in the Eastern Archipelago, and which are so highly valued as articles of food by the Chinese. [SEA-WEEDS.]

SPHÆROIDI'NA. [FORAMINIFERA.]

SPHÆRULA'CEA, M. de Blainville's name for his first family of *Cellulacea*, consisting of the genera *Miliola, Melonia, Saracenaria*, and *Textularia*. Lamarck uses the term to designate his fourth family of *Cephalopoda*, including the genera *Miliola, Gyrogona* (the seed of a plant), and *Melonia*. [FORAMINIFERA.]

SPHÆRULITE occurs in small botryoidal and spheroidal masses. Surface sometimes rough, at other times smooth.

No regular cleavage. Structure compact, fibrous. Fracture conchoidal. Hardness 7 to 7·5. Brittle. Colour grey, brown, red, yellow, of various shades. Opaque; translucent on the edges. Specific gravity 2·4 to 2·54.

Before the blow-pipe almost infusible, the edges becoming covered with a sort of enamel.

It is found embedded in pitchstone at Speithausen in Saxony; in pearlstone at Glashutte, near Schemnitz, Hungary, and also in Iceland and Scotland.

It yielded by analysis:—

| | |
|---|---|
| Silica | 79·12 |
| Alumina | 12·00 |
| Potash and soda | 3·58 |
| Magnesia | 1·10 |
| Oxide of iron | 2·45 |
| Water | 1·75 |
| | 100 |

SPHAGNUM, the name of a genus of plants belonging to the natural order of Mosses. It is known by the following characters:—receptacle pedunculated, its peduncle resembling a fruit-stalk; capsule sessile, entire, its lid deciduous, its mouth naked; calyptra irregularly torn. The plants of this genus are very widely diffused over the surface of the earth, perhaps more so than any other, hardly any limits being ascertained for their geographical distribution. They are aquatic plants, and constitute the great mass of our bogs in swampy and moory districts. All the species of this genus used to be included under the name of *Sphagnum palustre*; but later writers have multiplied the species to fourteen. Of these, Sir Wm. Hooker, in his 'Muscologia Britannica,' admits only four, and one or two even of these he thinks may be varieties.

*S. obtusifolium*; obtuse-leaved bog-moss: has tumid branches, with obtuse ovate leaves. It is found on the surface of watery turfy bogs throughout Europe. The dense masses of vegetation which it forms in these districts are generally filled with water, so that they will not bear the weight of a human being upon them; and from this cause many animals have lost their lives, being deceived by the apparent firmness this moss gives to a mass of water. When the bog-moss has grown long enough in a lake or bog, its decaying leaves and stems present a soil fitted for other plants, and in this situation the various species of Drosera, the Erica tetrali, the cranberry, and others, are frequently found. It is thus that these lowly bog-mosses become important agents in the economy of nature, as by their means immense masses of water are filled with decaying vegetable matter, which in the course of time permits of drainage and the application of manure, and thus a stagnant lake is converted into a fruitful field. The other species of Sphagnum are the same in habit as the foregoing. *S. acutifolium*, narrow-leaved bog-moss, has attenuated branches and ovato-lanceolate leaves; and is very abundant, especially in bogs in mountainous situations. *S. cuspidatum*, the long-leaved floating bog-moss, seems to be a variety of the last, having peculiar characters from growing constantly under water its leaves are looser and narrower than those of the narrow-leaved bog-moss. It seldom bears fruit. Its stems are sometimes four feet long, and its leaves three-quarters of an inch broad.

The economical uses of the bog-moss are several. The Society of Arts gave a reward to Mr. W. Curtis, for having pointed out the advantages to be derived from using these mosses for packing young trees for exportation. In Iceland and Lapland, and amongst the North American Indians, they are used for lining cradles. The peculiar spongy character of the cellular tissue of which they are composed renders them exceedingly well adapted for those purposes of use in which the non-conduction of heat or the absorption of moisture is desirable. It is on this account that they are used in cold countries for lining clothes, especially the large boots worn by reindeer drivers. The bog-moss also forms an excellent material for bedding, absorbing the moisture of the body at the same time that it allows of the accumulation of warmth from its want of conducting power for heat. When these beds become hard and lumpy from being lain on, they are quickly restored to their original elasticity by being placed in water and then dried. In Lapland these mosses are used as wicks for lamps; and where they are in abundance, the farmer may avail himself of them as an excellent litter for cattle.

SPHE'CIDÆ, Leach (*Sphegides*, Latreille), a family of hymenopterous insects of the section Fossores, distinguished by the following characters:—hinder tarsi at least equal in length to the head and thorax; antennæ generally slender and formed of elongated joints, which are often arched and contorted, at least in the females; prothorax forming a kind of neck, very distinctly separated from the mesothorax, and contracted in front. The base of the abdomen constricted into a long petiole; mandibles internally toothed. The following are the principal genera contained in this family:—

*Pepsis* (Fab.). Here the labrum is distinct; the antennæ, at least those of the males, are nearly straight, composed of joints closely applied to each other; maxillary palpi scarcely longer than the labial, prominent, and with the joints unequal; all the cubital cells perfect; the first recurrent nervure inserted near the anterior extremity of the second of these cells. The males have the tibiæ and the first joint of the posterior tarsi compressed.

All the known species of *Pepsis* are exotic, and they abound most in South America and in the West Indian islands; they are usually of large size, and have dark-coloured wings.

*Ceropales*. In this genus the labrum and antennæ resemble those of *Pepsis*, but the maxillary palpi are much longer than the labial, pendant and unequal jointed.

*Pompilus* (Fab.). This genus is placed by Latreille in the *Sphegidæ*, but, according to Leach, it forms the type of a distinct family (*Pompilidæ*), characterized by having a transverse prothorax, at least as broad again as long, with its posterior margin acute. The abdomen obovoid, without any contraction, in the shape of a long petiole, at its base.* The antennæ are setaceous and long; the superior wings have one marginal cell, nearly semicircular, and three submarginal cells, the first as long or longer than the two following; the second receiving about its centre the first recurrent nervure; the third, which is either triangular or subquadrate, receives the second; a fourth submarginal cell is sometimes traceable.

Several species of this genus are found in England; they usually make burrows in the sand for nidification, but some are said to make their nests in wood. The perfect insect provides its cell with spiders, these constituting the food of the larvæ.

*Ammophila* (Kirby). Abdomen with the petiole long; superior wings with one oval marginal cell, and three submarginal cells; the first as long or longer than the two following, the second receiving both the recurrent nervures, the third very small and narrow towards the marginal; legs long, the anterior tarsi slightly ciliated.

These insects, observes Mr. Shuckard, on the authority of St. Fargeau, construct their burrows in sand alone, and supply their larvæ with Arachnidæ and the larvæ of Lepidoptera, and select by preference those of the Noctuæ, sometimes as large as themselves. They sting them towards the middle of the body, which renders them torpid, but does not kill them, and prevents their motion. The *Ammophila* then extending itself in its whole length upon the larva, seizes it with its mandibles near the head, and supports the remainder of the body with its legs. But thus encumbered it can no longer fly; it therefore proceeds slowly, dragging it along. Should it perceive any obstacle in the path, such as a stone or tuft of plants, it quits its load an instant, and springs lightly forward to reconnoitre and explore its way, but returns immediately to resume its burden.

A female has been observed by St. Fargeau, thus loaded, to clear a wall eight or ten feet high, but not without much ingenious contrivance. The caterpillar fell several times to the ground, when the *Ammophila* placed it upon a projecting stone to rest itself and recruit its strength; but it renewed its task with extraordinary perseverance, and succeeded in accomplishing it.

In the genera *Sphex*, *Pronæus*, and *Chlorion*, the mandibles and labrum are comparatively short, and more or less curved at the point.

*Pronæus*.—Here the second cubital or submarginal cell receives the two recurrent nervures.

In *Sphex* the superior wings have one long and narrow marginal cell, which is rounded at the apex, and three submarginal cells, the first as long as the two following; the second quadrate, receiving the first recurrent nervure towards its extremity; the third forming a truncated triangle with its posterior margins slightly rounded, and receiving the second recurrent nervure in its middle: a rudimentary fourth cell is sometimes observable. One species has been found in England, but appears to be extremely rare.

The genus *Chlorion* has the first recurrent nervure inserted under the first cubital cell, and the second beneath the third cubital.

The genus *Dolichurus*, Latr., has the maxillary palpi much longer than the labial, and nearly setaceous; the mandibles are dentated.

The remaining genera of this family have no teeth to the mandibles: they are, *Ampulex*, *Podium*, and *Pelopæus*. The first of these genera resembles *Chlorion* as regards the insertion of the recurrent nervures in the superior wings, and in the genera *Podium* and *Pelopæus* the second cubital cell receives two recurrent nervures.

SPHE'GIDÆ. [SPHECIDÆ.]

SPHE'NE. [TITANIUM.]

SPHENOCLE'A, a genus consisting of only a single species, which is remarkable as one of the few which botanists are puzzled in knowing in what natural order to place. Dr. Lindley, following Martius, has formed it into a suborder Sphenoeleaceæ, and attached it, with a doubt, to the natural family of Campanulaceæ; but he remarks that its exalbuminous seeds, the absence of collecting hairs from its styles and the round subsessile anthers, and the peculiar habit, distinguish it. Endlicher has essentially followed Martius and Lindley, but has imposed upon the genus the name Pongaticæ, from the name *Pongatium*, which is applied to it by some botanists, as being the earliest, having been formed by Jussieu from the Pongati of Rheede. The genus is characterised by having a superior 5-parted calyx with inflexed segments. Corol 5-parted, with the segments inflexed and somewhat auricled at the base, and which conceal the 5-sessile stamens. Ovary inferior. Style very short and 2-lobed. Capsule membranous, many-seeded, with a central fungous placenta, circumscissile. Seeds minute, embryo without albumen, straight, with the radicle next the hilum. The only known species, called *S. zeylanica*, is an annual, with alternate entire leaves, without stipules; found in marsh situations in all parts of India, as far as 30° N. lat. The Bengalee name *jeel-murich*, assigned to that plant, and signifying marsh-pepper, would indicate the possession of acrid properties.

SPHENOCLEA'CEÆ, a natural order of plants, consisting of only one species, belonging to the monopetalous subclass of Exogens. It was formed by Martius, and consists of a single genus, which at that time was called *Sphenoclea*, but now known as *Pongatium*. This plant is very like a Campanula in its structure, but it is distinguished from all Campanulaceæ by the absence of albumen in its seeds, and also the want of collecting hairs on its styles. It has also round subsessile anthers, and a habit different from that of plants allied to it in structure. [SPHENOCLEA.]

SPHENOID BONE. [SKELETON.]

SPHENO'PTERIS, a genus of fossil ferns, which are known by possessing twice or thrice pinnated leaves, the

* See Mr. Shuckard's 'Essay on the Indigenous Fossorial Hymenoptera.'

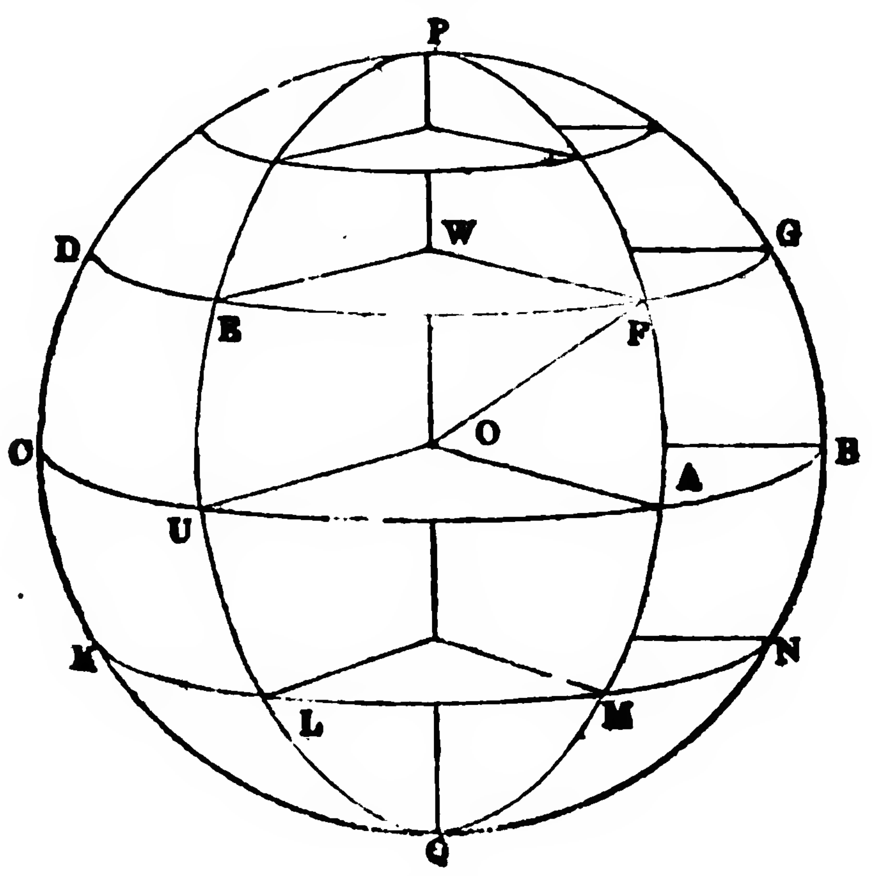
ultimate leaflets of which do not adhere to the rachis by their whole base, and are traversed by one or two principal veins in each lobe. They are all coal-measure plants, and are found in company with Sigillaria, Pecopteris, and other fossil genera. About twenty-six species of this genus are described as existing in the Fossil Flora of Great Britain.

**SPHENU'RUS**, Mr. Swainson's name for a subgenus of COLUMBIDÆ.

**SPHERE or GLOBE**, a solid body, the surface of which is everywhere equally distant from a given point or centre within it. This distance of each point from the centre is called the radius. In the article MENSURATION will be found the formulæ which connect the surface and solidity of a sphere with the radius: we shall here add that the weight of a sphere of pure water is found in ounces avoirdupois, by multiplying the cube of the number of inches in the radius by 2·4171; and in pounds avoirdupois by multiplying the cube of the number of feet in the radius by 261·05. These results multiplied by the specific gravity give the weight of a sphere of any other substance.

A section made by a sphere and plane is always a circle. When the cutting plane passes through the centre of the sphere, this proposition is obvious from the definition of a circle. When the plane does not pass through the centre, the assertion follows as soon as it is shown that a plane curve having all its points equidistant from a given point *not in the plane* is a circle. A section passing through the centre is called a *great* circle, and one which does not pass through the centre a *small* circle. These terms are incorrect, since a small circle may be in size as nearly as we please equal to a great circle: the words *greater* and *smaller* would be more correct.

The centre of a circular section is found by drawing a perpendicular from the centre of the sphere to the plane of the section. All sections whose planes are parallel have their centres on one straight line, namely, the perpendicular to the planes which passes through the centre of the sphere. The great circle in such a system (CUAB) is called the *primitive*, the common perpendicular (POQ) the *axis*, all the




small circles (DEFG, KLMN, &c.) *parallels*, the extremities of the axis (P and Q) *poles*, and all great circles passing through the axis and poles (PCQB, PUQ, PAQ, &c.) *secondaries*.

By the angle made by two great circles is always understood the angle made by their planes, which is also that made by their tangents at the point of intersection, and that made by the intersections of the two circles with the third circle to which both are secondary. It is also the angle made by the axes of the two circles. Thus the spherical angle EPF is the angle made by the planes PEQ and PFQ, or the angle made by tangents to the circles drawn through P, or the angle UOA.

The angle made by two straight lines drawn from the centre (as OA and OB) is often confounded with the arc (AB) which that angle marks out on the sphere. When this causes any confusion, which it will sometimes do at first, instead of each arc mentioned, read its angle: thus for the arc AB read the 'angle subtended by the arc AB' or AOB. Thus when we say that the angle made by two great circles is the arc intercepted between their poles, we mean not to equate the angle to the length of an arc, but to the angle which that arc subtends at the centre.

The following propositions are essential to the doctrine of the sphere in geography and astronomy; they may be easily proved, and will serve as exercises in the meaning of the preceding terms:—

1. If the poles of a first circle lie upon a second, the poles of the second will also lie upon the first.

2. If a sphere be made by the revolution of a semicircle round its diameter, the diameter will be an axis, the middle point of the semicircle will describe the primary, all other points will describe parallels, and every position of the generating circle will be a secondary.

3. If a point on a sphere be distant from each of two other points (not opposite) by a quadrant of a great circle, the first point must be a pole of the great circle which joins the second and third.

4. The arc of a parallel (as EF) is found from the corresponding arc of the primary (AU) by multiplying the latter by the cosine of the angle (FOA) which is subtended by the intercepted arc (AF) of the secondary.

5. The surface of the zone intercepted between any two parallels is the rectangle contained under the circumference of the primary and the perpendicular distance between the parallels.

6. The surface of a lune contained between two great circles is such a proportion of the whole surface of the sphere as the angle contained between the two great circles is of four right angles.

7. The part of a lune contained within any zone made by two of its parallels (as EFUA) is such a proportion of the whole zone as the angle of the circles forming the lune is of four right angles.

We are now to show the method of CO-ORDINATES by which points in the sphere are ascertained, and their relative positions described. Take any great circle CUAB, and choose any point U as an origin, and either direction to be that in which arcs are measured. Say for instance that UA, in preference to UC, shall be the direction in which arcs are measured. The position of any point in this great circle is then ascertained simply by determining its distance from U, since there is a tacit understanding as to the direction in which that distance shall be measured. If we give a name to that distance, be it longitude, right ascension, or any other, the point whose right ascension (if it be right ascension) is 80° means the point which is at 80° distance from U in the direction UA. Again, if we wish to describe any other point, not in the great circle chosen, as F: through F draw a secondary to the great circle (PFAQ), then the point F will be known as soon as A is described, in the manner just laid down, and also as soon as the arc AF is given, and the pole towards which it is measured. These two coordinates, UA and AF, when described in magnitude and direction, form a complete description of the position of the point F on the sphere; and the angles subtended by UA and AF are generally used instead of UA and AF.

For the first steps of the application of spherical geometry to astronomy see the next article.

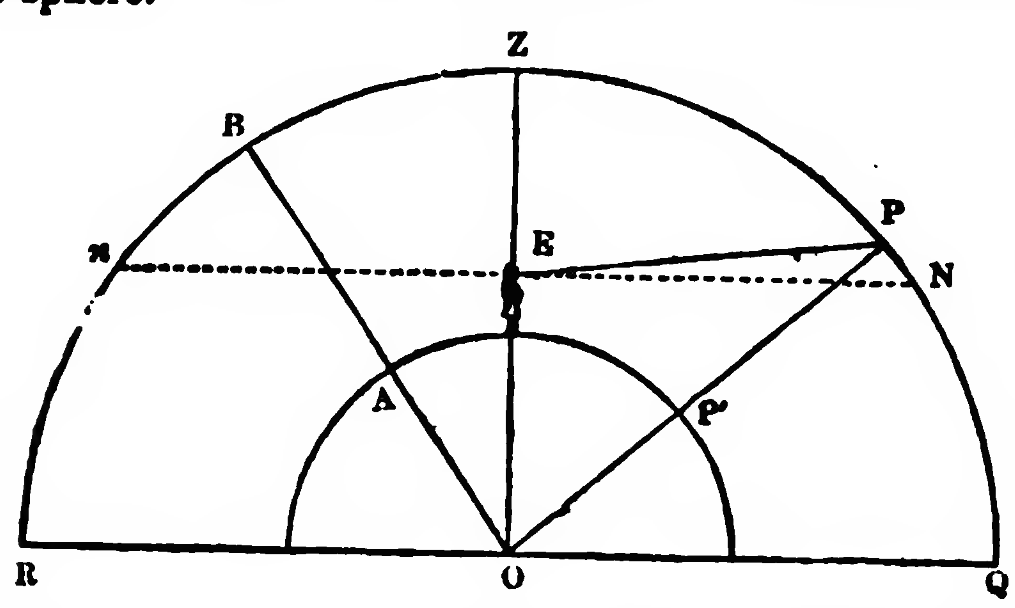
**SPHERE, DOCTRINE OF THE.** This phrase is generally used to signify the application of the simple geometrical notions in the article SPHERE to geography and astronomy. It comes between spherical trigonometry and those two sciences, being merely the explanation of the circumstances under which the former is to be applied to the latter, and the nomenclature which is employed to facilitate explanation.

In geography the end is almost gained when a distinct notion is acquired of the meaning of the terms terrestrial latitude and terrestrial longitude, generally abbreviated into latitude and longitude. These are only names given to a pair of spherical co-ordinates as described in SPHERE, the axis of rotation of the earth furnishing the means of prescribing the necessary data. The earth revolves round an axis, say PQ (see the diagram in SPHERE), and the great circle perpendicular to that axis is the *equator* (CUAB). An arbitrary point U is chosen as an origin; and P being the pole which is called north, UA is the east direction and UC the west. The English choose the point U in such a way that the secondary PU passes through the Observatory at Greenwich: the French pay the same compliment to their Observatory at Paris, and so on. The co-ordinate UA (or its angle) is called longitude, east or west according as it falls; and the co-ordinate AF (or its angle) is called latitude, north or south according to the pole towards which it is directed. Thus the place F (PU passing through

Greenwich) would be described as in longitude UA east of Greenwich, and FA of north latitude; but if the fundamental secondary, PU, be moved any number of degrees to the east, every east longitude must be diminished, and every west longitude increased as much; and all places which the secondary passes over in the transfer, must have the names of the directions of their longitudes changed, and take for their new longitudes the excesses of the angle of transfer over their former longitudes. Again, longitude might be measured all the way round in one direction: thus D, instead of being described as in UC of west longitude, might be considered as in $360° - UC$ of east longitude.

There are few problems of much interest connected with geography merely; and it must be remembered that the common terrestrial globe, with its brazen secondary to the equator (called a meridian, very incorrectly, except as meaning that it *may be made* a meridian to any place), its ecliptic, and figured horizon, is almost as much a representative of the sphere of the heavens as of the earth; and the most useful problems are those in which the sphere is used conjointly in these capacities. But, merely to show what we asserted at first, that the description and nomenclature which are called the doctrine of the sphere are nothing but the connecting link of geography, &c. and spherical trigonometry, let us ask the following question:—Given a table of latitudes and longitudes, required the distance between two places mentioned? Let D and M be the places (see diagram in SPHERE), then PD is the colatitude of D, or $90° -$ lat. of D, and PM (on account of M's south latitude) is $90° +$ lat. of M; while the spherical angle, DPM (which is the angle of the arc AC), is, on account of the longitudes being of different names, the sum of the longitudes of D and M. Hence, if D and M be joined by the arc of a great circle, we have given (from the tables) two sides and the angle included, in the spherical triangle DPM. From these data the third side, DM, can be found, in degrees, &c.: convert this into miles, at the rate of 69 miles to a degree (which is accurate enough for the purpose), and the result will be the distance required.

We now make the passage from the terrestrial to the celestial sphere. The latter is a fiction, derived from the impossibility of distinguishing the distances of the heavenly bodies, on which account they all seem at the same distances, on a sphere so great that the earth, its centre, is but a point in comparison. But it must be remembered that the appearances of the heavenly bodies conform themselves to this fiction, so that the development of the consequences of the latter amounts to an explanation of the phenomena of the heavens. And first, the rotation of the earth from west to east gives to the sphere of the heavens an apparent motion from east to west, round an axis which is obtained by lengthening the axis of the earth. The point of the heavens which answers, for the moment, to the spectator's position on the earth, is that point which is directly over his head, or his *zenith*. And since the spectator is not exactly at the centre of the celestial sphere, we give the following diagram, illustrative of the manner in which the effect of this misplacement is destroyed by the largeness of the sphere.




The eye of the spectator is at E, and his zenith-line is OZ. The smaller circle is a section of the earth, and the larger of the sphere of the heavens. The figure is drawn of dimensions so false, that the sphere of the heavens is represented about as well as a common orrery represents the solar system. The HORIZON is the small circle drawn perpendicular to OZ through N*n*; the altitude of the pole of the heavens (P′ being that of the earth) is the angle NEP. Now suppose the earth and the spectator to diminish until they cannot be distinguished from the point O, the sphere of the heavens remaining the same. All angles at O remain unaltered: the altitude of the pole of the heavens becomes QOP, equal to the angle AOE, the latitude of the spectator, and the horizon of the latter coincides with the great circle drawn through RQ perpendicular to OZ. The great circle, QPZR, passing through the pole and the zenith, is the *meridian;* the secondary to the horizon perpendicular to the meridian is the ***prime vertical.*** We here exhibit a skeleton of the sphere, showing

*n*MZPN, half the meridian; NE*n*, the horizon (N, E, *n*, its north, east, and south points); ZE, the prime vertical; a portion of PO, the axis; EM, the equator, perpendicular to the axis.

We now give three positions of the sphere, differing only in the manner of projecting the figure. Each one represents the state of the heavens some two or three hours before noon in an October morning, in a latitude somewhat greater than our own. The first figure is projected on the plane of the meridian; that is, the meridian is the circle which bounds the view of the sphere. The second is projected on the prime vertical; the third, on the horizon.

shows the time which is yet to elapse before noon. As to the time of the year, observe that the sun was at the autumnal equinox ♈ on the 21st of September, since which time it has moved over TS, independently of the diurnal rotation of the sphere. We see then what is meant by saying that the diagram represents some morning in October. The use of the globe is thus explained, as far as setting it for any hour and day is concerned. The pole P must first be elevated until the elevation is equal to the latitude of the place, the sun must then be put in its proper place in the ecliptic for the time of the year, and its hour-angle must then be made to represent the time which is wanted of noon, or has elapsed since noon. All this on the globe is done without attending to the distinction of sidereal and solar time, which need hardly be attended to when no greater degree of accuracy is wanted than can be obtained on a globe. We now refer the reader to works on the use of the globes, and shall conclude this article by a few indications of the mode of applying spherical trigonometry.

To find the time of sunrise, observe that in the spherical triangle PKN, right-angled at N, we have PK given, being 90°+ the sun's declination, and also PN, the latitude of the place of observation. Hence the angle KPN can be found, which being turned into sidereal time, gives a good approximation to the time of sunrise, refraction and the sun's proper motion being neglected.

Given SL the sun's altitude, and the latitude of the place; required the time of day. In the triangle SZP, we now know ZS the sun's co-altitude, SP which is 90°+declination, and ZP the co-latitude of the place. Hence the angle SPZ can be found, and thence the time from noon. If S, instead of the sun, were a known star, the question would be solved in the same way, except that the sun's hour-angle is no longer SPZ, but that angle increased or diminished by the difference of the right ascensions of the sun and star.

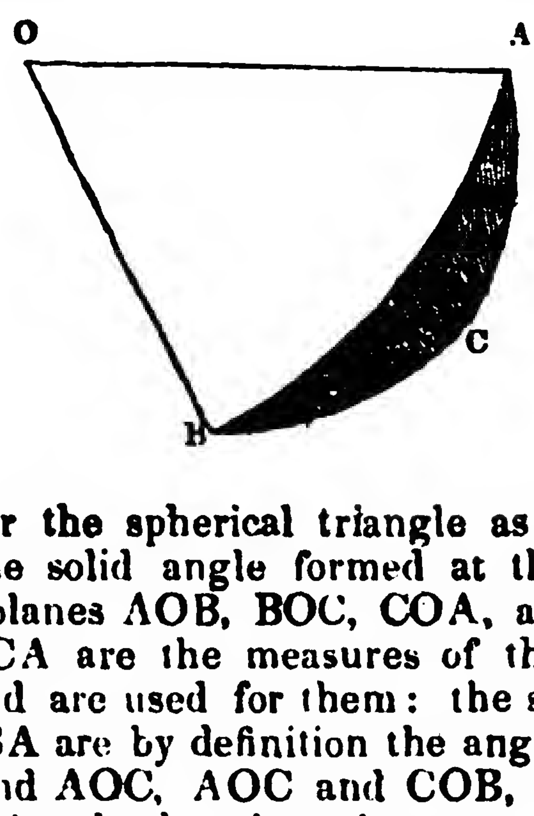
Two known stars, W and S, are observed to be in the same circle of altitude SWL at a given place; required the time of day. Here PW and PS, the co-declinations of the stars, are known, and also the angle WPS, which is the difference of their right ascensions; hence in the triangle SWP the angle SWP can be found, and thence its supplement, the angle ZWP. Then, in the triangle WZP, we know the angle ZWP, PW the co-declination of the star W, and ZP the co-latitude of the place: whence the angle WPZ can be found; and thence, by comparison of W with the sun, the time of day.

For the actual applications we must refer to mathematical works on astronomy.

SPHERICAL EXCESS. [SPHERICAL TRIGONOMETRY, &c.]

SPHERICAL TRIGONOMETRY, SPHERICAL TRIANGLE, SPHERICS. We shall confine ourselves in the present article to such a collection of the properties of a spherical triangle as may be useful for reference, referring for demonstration to the treatise on the subject in the 'Library of Useful Knowledge,' and to that on Geometry; adding to the former nothing but a shorter mode of obtaining Napier's Analogies.

By a spherical triangle is meant that portion of the sphere which is cut off by three arcs of great circles, each of which cuts the other two, as ABC. It is now usual how-




ever to consider the spherical triangle as a sort of representative of the solid angle formed at the centre of the sphere by the planes AOB, BOC, COA, as follows:—The arcs AB, BC, CA are the measures of the angles AOB, BOC, COA, and are used for them: the spherical angles BAC, ACB, CBA are by definition the angles made by the planes BOA and AOC, AOC and COB, COB and BOA. The spherical triangle then has six parts corresponding in name to the six parts of a plane triangle; but a *side* of it means the angle made by two straight *lines* of a solid angle, while an *angle* of it refers to the angle made by two *planes* of the solid angle.

Throughout this article we shall designate the angles by A, B, C, the sides opposite to them by $a$, $b$, $c$; the half sum of the sides by $s$. And by A′, B′, C′, $a'$, $b'$, $c'$, we mean the supplements of A, B, &c., so that $A + A' = 180°$, $a + a' = 180°$, &c.

Three circles divide the sphere into eight spherical triangles. Of these four are equal and opposite to the other four, with which they agree in every respect but one [SYMMETRICAL] with which we have nothing here to do. Of the four which are distinct, if ABC be one, there are three others thus related to it: the first has for its sides $a$, $b'$, $c'$, and for its angles A, B′, C′; the second has $a'$, $b$, $c'$ for sides, and A′, B, C′ for angles; the third has $a'$, $b'$, $c$ for sides, and A′, B′, C for angles. Hence every spherical triangle has another, with one side and its opposite angle remaining unchanged, and all the other parts changed into their supplements.

Again, if the three circles be taken which have A, B, and C for their poles, the intersections of these new circles are themselves the poles of AB, BC, and CA; and of the eight new triangles thus formed, each one has all its *angles* supplemental to the *sides* of its corresponding triangle in the first set, and all its *sides* supplemental to the *angles*. Thus there exists a triangle which has the sides A′, B′, C′, and the angles $a'$, $b'$, $c'$; which is called the supplemental triangle of that which has $a$, $b$, $c$ for sides, and A, B, C for angles. Hence, if in any general formula sides be changed into supplements of angles, and angles into supplements of sides, the result is also a general formula.

Any two sides of a spherical triangle are together greater than the third, and the sum of the three sides is not so great as 360°. Any two angles of a spherical triangle are together less than the third angle increased by 180°, and the sum of the three angles is more than two, and less than six, right angles. And the greater side of a spherical triangle is opposite to the greater angle; and the sum of two sides is greater than, equal to, or less than, 180°, according as the sum of the opposite angles is greater than, equal to, or less than, 180°.

The formulæ for the solution of a spherical right-angled triangle are six in number. Let C be the right angle, and let $c$ be called the *hypothenuse*, as distinguished from $a$ and $b$, which are still called *sides*. [CIRCULAR PARTS.]

1, 2. The cosine of the hypothenuse is equal to the product of the cosines of the sides, and of the cotangents of the angles:

$$\cos c = \cos a \cos b; \quad \cos c = \cot A \cot B.$$

3. The sine of a *side* is the sine of the hypothenuse into the sine of the *opposite* angle:

$$\sin a = \sin c \sin A; \quad \sin b = \sin c \sin B.$$

4. The tangent of a side is the tangent of the hypothenuse into the cosine of the included angle:

$$\tan a = \tan c \cos B; \quad \tan b = \tan c \cos A.$$

5. The tangent of a side is the tangent of its opposite angle into the side of the other side:

$$\tan a = \tan A \sin b; \quad \tan b = \tan B \sin a.$$

6. The cosine of an angle is the cosine of its opposite side into the side of the other angle:

$$\cos A = \cos a \sin B; \quad \cos B = \cos b \sin A.$$

These formulæ are sufficient for every case. Name any two out of the five $a$, $b$, $c$, A, B (C being a right angle), and in the preceding six formulæ, by repetition ten, will be found those two combined with each of the other three. Thus having given a side $a$ and its adjacent angle B, we find the other parts from

$$\tan b = \tan B \sin a, \quad \tan c = \frac{\tan a}{\cos B}, \quad \cos A = \cos a \sin B$$

These formulæ should be committed to memory: the abbreviation, so called, described in CIRCULAR PARTS, is only an expeditious mode of wasting time.

When all the angles are oblique, the principal formulæ are as follows (in most cases we give only one, these for other sides, &c. being easily supplied):—

1. $\dfrac{\sin A}{\sin a} = \dfrac{\sin B}{\sin b} = \dfrac{\sin C}{\sin c}$;

or the sines of sides are to one another as the sines of their opposite angles.

2. $\cos c = \cos a \cos b + \sin a \sin b \cos C$

3. $\cos \frac{C}{2} = \sqrt{\frac{\sin s \ \sin (s-c)}{\sin a \ \sin b}}$

$\sin \frac{C}{2} = \sqrt{\frac{\sin (s-a) \ \sin (s-b)}{\sin a \ \sin b}}$.

4. $\tan \frac{C}{2} = \sqrt{\frac{\sin (s-a) \ \sin (s-b)}{\sin s \ \sin (s-c)}} = \frac{M}{\sin (s-c)}$;

where $M = \sqrt{} (\sin (s-a) \sin (s-b) \sin (s-c) \div \sin s)$.

5 $\tan \frac{A+B}{2} = \cot \frac{C}{2} \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}(a+b)}$

$\tan \frac{A-B}{2} = \cot \frac{C}{2} \frac{\sin \frac{1}{2}(a-b)}{\sin \frac{1}{2}(a+b)}$.

6. $\cot a \sin c = \cos c \cos B + \sin B \cot A$.

7. $\tan \theta = \sin \frac{1}{2} C \sqrt{\sin a \ \sin b} \div \sin \frac{1}{2}(a-b)$,
gives $\sin \frac{1}{2} c = \sin \frac{1}{2}(a-b) \div \cos \theta$.

8. $\sin \theta = \sin \frac{1}{2} C \sqrt{\sin a \ \sin b} \div \cos \frac{1}{2}(a-b)$,
gives $\cos \frac{1}{2} c = \cos \frac{1}{2}(a-b) \cos \theta$.

The formulæ (5) which are called Napier's Analogies, may be demonstrated more easily than in the usual way, as follows. First—

$$\tan (\tfrac{1}{2} A \pm \tfrac{1}{2} B) \ . \ \tan \tfrac{1}{2} C = \frac{\tan \frac{1}{2} A \tan \frac{1}{2} C \pm \tan \frac{1}{2} B \tan \frac{1}{2} C}{1 \qquad \mp \tan \frac{1}{2} A \tan \frac{1}{2} B}$$

from (4) $\quad \tan \frac{1}{2} A \ \tan \frac{1}{2} B = \frac{\sin (s-c)}{\sin s}$, &c.

$$\tan (\tfrac{1}{2} A \pm \tan \tfrac{1}{2} B) \ . \ \tan \tfrac{1}{2} C = \frac{\sin (s-b) \pm \sin (s-a)}{\sin s \quad \mp \sin (s-c)}$$

[Trigonometry.] $\quad \tan (\frac{1}{2} A + \frac{1}{2} B) \ . \ \tan \frac{1}{2} C =$

$$\frac{2 \sin \frac{1}{2} c}{2 \sin \frac{1}{2} c} \ \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}(a+b)}$$

since $2s-a-b=c$. Hence the first of (5) easily follows, and the second in a similar manner.

The formula (6) is not easily remembered, except by the following:—Write the sides in any successive pairs, as $ab$, $bc$, $ca$, or $ac$, $cb$, $ba$: change the last three into the corresponding angles giving $ab$, $b$C, CA, or $ac$, $c$B, BA; remembering the formula cos ÷ sin = cot, make the middle terms cosines, those on the right and left sines, and those on the extreme right and left cotangents. We have then—

$$\cot a \sin b = \cos b \cos C + \sin C \cot A,$$

which is a case of the formula in question.

We now proceed to the different cases of triangles, observing that these may be taken in pairs, owing to the property of the supplemental triangle. Thus suppose it granted that we can solve the case of finding the three angles when the sides are given, it follows that we can solve that of finding the three sides from the three angles. For if A, B, and C be given, find the *angles* of the triangle whose sides are A′, B′, and C′. If $a'$, $b'$, and $c'$ be these angles, then $a$, $b$, $c$ are the sides of the original triangle. Nor is it worth while to separate the several cases, since it generally happens that out of each pair one is of much more frequent occurrence than the other.

*Case* 1. Given the three sides, to find the three angles. If one angle only be wanted, one of the formulæ (3) answers as well as anything. If all three angles be wanted, the shortest way is to calculate M from

$$M = \sqrt{} \{\sin (s-a) \ \sin (s-b) \ \sin (s-c) \div \sin s\}$$

and then the angles from

$$\tan \tfrac{1}{2} A = \frac{M}{\sin (s-a)}, \ \tan \tfrac{1}{2} B = \frac{M}{\sin (s-b)}$$

$$\tan \tfrac{1}{2} C = \frac{M}{\sin (s-c)}$$

*Supplement.*—Given the three angles, to find the three sides. Make the supplements of the given angles sides, calculate the three angles, and the supplements of the last three angles will be the sides required.

*Case* 2. Given two sides ($a$ and $b$), and the included angle C, to find the remaining parts. If all the parts be wanted, calculate $\frac{1}{2}$ (A+B) and $\frac{1}{2}$ (A−B) from (5), and then find A and B by addition and subtraction: lastly, find $c$ from one of—

$$\sin c = \sin b \frac{\sin C}{\sin B}, \ \sin c = \sin a \frac{\sin C}{\sin A};$$

or from both, which will be a verification. But if the remaining side only be wanted, use the formula (7) or (8), which gives this third side at once, by means of the subsidiary angle $\theta$. Or from the extremity of the shorter side given (say $a$), let fall a perpendicular arc $z$ on $b$, dividing $b$ into $x$ and $y$. Then—

$$\tan x = \tan a \cos C, \quad \sin z = \sin a \sin C$$
$$y = b - x, \quad \cos c = \cos z \cos y.$$

*Supplement.*—Given a side ($c$) and the two adjacent angles (A and B); required the remaining parts. Make A′ and B′ the sides of a triangle, and $c'$ the included angle; find C′ the remaining side, and $a'$ and $b'$ the remaining angles. Then C is the remaining angle of the original triangle, and $a$ and $b$ are the remaining sides. To find the remaining sides alone, the following formula may be used:

$$\tan \frac{a+b}{2} = \tan \frac{c}{2} \ \frac{\cos \frac{1}{2}(A-B)}{\cos \frac{1}{2}(A+B)},$$

$$\tan \frac{a-b}{2} = \tan \frac{c}{2} \ \frac{\sin \frac{1}{2}(A-B)}{\sin \frac{1}{2}(A+B)}$$

*Case* 3.—Given two sides ($a$ and $b$) first both less than a right angle, and an angle opposite to one of them (A); required the remaining parts. This case may afford no solution at all, or may give two solutions; it is therefore sometimes called the ambiguous case. The formula (6) may be used in the manner pointed out in Subsidiary Angle; but we should recommend a person who is not well practised in the subject to prefer the following simple method:—From the extremity of $b$ which is *not* adjacent to the given angle, drop a perpendicular $z$ on the side $c$, and let $x$ be the segment adjacent to A. Let $a^{\wedge}z$ and $b^{\wedge}z$ be the angles made by $a$ and $b$ with $z$. And first calculate $\sin b \sin A$; if this be greater than unity, the triangle does not exist; if it be equal to unity, the triangle is right angled at B, and may be treated as a right-angled triangle. But if $\sin b \sin A$ be less than unity, find $z$ from $\sin z = \sin b \sin A$, and $x$ and B from

$$\tan x = \tan b \cos A, \ \sin B = \sin A \frac{\sin b}{\sin a}.$$

There are two values of B, supplements of each other, both of which are possible answers. Let B be the one which is less than a right angle, and B′ that which is greater.

First, when A is acute and $a$ less than $b$. Calculate $y$ from $\cos y = \cos a \div \cos z$, and $b^{\wedge}z$ and $a^{\wedge}z$ from

$$\cot b^{\wedge}z = \cos b \tan A, \ \cos a^{\wedge}z = \frac{\tan z}{\tan a}$$

There are two triangles which satisfy the data: in the first, $c = x - y$, B′ is the angle opposite to $b$, and $C = b^{\wedge}z - a^{\wedge}z$; in the second, $c = x + y$, B is the angle opposite to $b$ and $C = b^{\wedge}z + a^{\wedge}z$.

Secondly, when A is acute and $a$ equal to or greater than $b$. Calculate exactly as in the last case, but there is only one triangle which satisfies the data, namely, the second of the preceding.

Thirdly, when A is obtuse, in which case there is no triangle, unless $a$ be greater than $b$. Calculate (using A as more convenient)

$$\sin z = \sin b \sin A', \ \tan x = \tan b \cos A, \ \sin B = \sin A' \frac{\sin b}{\sin a}$$

Use the value of B, which is less than a right angle; calculate $b^{\wedge}z$ and $a^{\wedge}z$ from

$$\cot b^{\wedge}z = \cos b \tan A', \ \cos a^{\wedge}z = \frac{\tan z}{\tan a}$$

Then $c = y - x$, and $C = a^{\wedge}z - b^{\wedge}z$.

In the case in which one or both of the sides are greater than a right angle, which rarely, if ever, occurs, it is best to have recourse to one of the adjacent triangles described at the beginning of this article, and to use it in the same manner as the supplementary triangle has been used. It is not however necessary to dwell on this point.

*Supplement.*—Given two angles (A and B) and a side opposite to one of them ($a$); required the remaining parts. Let A′ and B′ be the sides of a triangle, and $a'$ the angle opposite to A′. Find C′ the remaining side, and $b'$ and $c'$ the remaining angles; then C is the remaining angle of the original triangle, and $b$ and $c$ the remaining sides.

All the cases would need some subdivision to adapt them to calculation, if it were really often required to solve triangles with very large sides and angles. But in application, possess active properties, the Maryland worm-seed is that which is principally used in medicine.

*S. Anthelmia*, annual Worm-grass, is an herbaceous annual, with branched nearly square stems; ovate or oblong-acute leaves, with short petioles; floral leaves four in a whorl; funnel-shaped corolla, and enclosed stamens. It is a native of Guiana, Trinidad, and Brazil. It possesses powerful narcotic properties, and is used in the same manner as the last. This species is often cultivated: it has small pale-red flowers.

SPIGE'LIA MARYLA'NDICA (*Lonicera Marylandica*, Linn.), Carolina pink, perennial worm-grass, or worm-seed; a perennial herbaceous plant, native of the southern states of the American Union, abundant in rich soils about the borders of woods. It is from six inches to two feet high, leaves opposite, sessile, ovate, and acuminate. The root has a short caudex, from which issue numerous fibres; all which parts are of a yellowish colour when first dug up, but become black on drying. It is collected by the Creek and Cherokee Indians, and sold to the white traders, who pack it in casks, or make it up into bales, weighing from three hundred to three hundred and fifty pounds. The little care bestowed in packing it generally causes the stalks to be damp and mouldy before reaching the consumer. That contained in casks is generally in the best condition. The odour of the fresh plant is disagreeable, the taste sweetish, slightly bitter, and nauseous. The leaves are less potent than the root, which part, according to Wackerroder's analysis, consists of woody fibre 82, a peculiar principle like tannin 10; bitter acrid extractive 4; and an acrid resin. Both the resin and extractive have emetic properties. Spigelia has slight narcotic powers, and in large doses causes vomiting and purging. In America the fresh plant has decided anthelmintic virtues, but is only useful against the Ascaris lumbricoides, or large round worm. In Europe it is little used, having lost much of its power by long keeping. Dr. Barton recommends it as a cure for the infantile remittent fever, which often terminates in hydrocephalus, or water in the head. In such a case it acts beneficially by removing the worms, the irritation of which, when propagated to the brain, gives rise to the more serious disease. But the expulsion of the worms by any other means, and the exhibition of any tonic and astringent, like the tannin of the Spigelia, will prevent their recurrence. [ANTHELMINTICS.]

Spigelia is given in powder, or as an infusion or decoction. It is usually combined with senna or some other purgative, but it is better to give it alone, and follow its administration by a dose of calomel and jalap.

The Spigelia Anthelmia, a native of Brazil, which is a much more potent plant, is sometimes mistaken and given for the other. It contains an alcaloid, which is volatile, somewhat like nicotina, the effects of which it also resembles, causing formidable narcotic symptoms, to which lemon-juice, sugar, or carbonate of potash is said to be an antidote.

SPIGELIA'CEÆ, a small natural order of plants belonging to the monopetalous subclass of Exogens. The order consists of herbaceous plants or under-shrubs, with opposite, entire, stipulate leaves, and flowers arranged in one-sided spikes. The calyx is inferior, regularly 5-parted; corolla regular, with five lobes, having a valvate æstivation; stamens 5, inserted in the corolla, all in the same line; pollen-grains 3-cornered, with globular angles; ovary superior 2-celled; fruit a capsule, 2-valved, many-seeded, valves turned inwards at the margin, and separating from the central placenta; embryo very small, lying in the midst of fleshy albumen, with the radicle next the hilum. This order was separated from Gentianaceæ by Von Martius, and is an instance of the great utility of making small orders of those genera which differ much in character from any of the larger orders. If these plants were left among any of the larger groups, they would only tend to weaken the characters of those groups; whilst by separating them, the larger groups are strengthened, and less difficulty is experienced in pointing out their affinities. The principal points of structure for which Spigeliaceæ have been separated from Gentianaceæ are the symmetry of the stamens, corolline, and calycine segments; the division of the valves of the capsule; and the presence of stipules. In this last point they approach Cinchonaceæ.

The order consists of two genera, Canala and Spigelia, the species of which are natives of America. [SPIGELIA.]

SPIGE'LIUS, ADRIAN, was born at Brussels in 1578. He studied philosophy and medicine at Louvain, and afterwards pursued the latter science at Padua, where he received his diploma of doctor. He practised first in his own country, and then in Moravia; but in 1616 he was invited, at the recommendation of his former preceptor Fabricius ab Aquapendente, to take the principal professorship of anatomy and surgery at Padua. He seems to have filled the post with great honour both to himself and to the university, for its reputation was greater in his time than even when Fabricius and Casserius were professors. He died in 1625, of a disease said to have been caused by an accidental wound in the hand, leaving several works which were published after his death by his son-in-law and by Bucretius. The most important of them was that 'On the Structure of the Human Body,' an excellent and well written system of anatomy, in ten books, in which however there is contained little that was unknown to his predecessors; even the lobe of the liver, which is called after his name, having been before described by Vesalius and others. Haller's judgment of Spigelius, that he commends himself chiefly by the purity of his style and by his practical annotations (*Biblioth. Anatom.*, i. 357) is probably correct; and may explain why, as a professor, he had more repute than his two predecessors, both of whom were certainly more learned anatomists. The whole works of Spigelius were published by Van der Linden, at Amsterdam, 1645, folio.

SPIKE is a form of the inflorescence of plants in which the flowers are arranged around a common axis, upon which they are directly seated, no flower-stalk intervening between the axis and the flower, as seen in the Plantago. When the flowers are destitute of calyx and corolla, the place of which is taken by bracts, and when the whole inflorescence falls off after flowering or ripening, it is called an *amentum* or *catkin*. Such an inflorescence occurs in the willow and hazel. 'If a spike consists of flowers destitute of calyx and corolla, the place of which is occupied by bracts, supported by other bracts which enclose no flowers; and when with such a formation the rachis, which is flexuose and toothed, does not fall off with the flowers, as in grasses, each part of the inflorescence so arranged is called a *spikelet* or *locusta*.' (Lindley.) The spadix is also a modification of the spike. [SPADIX.]

SPIKENARD is a substance which has enjoyed celebrity from the earliest period of the world's history, and has engaged the attention of numerous commentators on the works of the antients, as well as of some modern authors. It is interesting therefore not only as making us acquainted with one of the substances known to and esteemed by the Greeks and Romans, but it is important likewise as being mentioned in the Bible, since the Nard of Scripture is supposed to be the same substance as the Nardos of the antients, called also Nardostachys (ναρδόσταχυς), and hence Spikenard, the word *stachys* being rendered by the word Spike.

Reference has been made to this article from Nardus, as also from Schoenanthus and Juncus odoratus, in consequence, as stated, of the very different substances which seem to be referred to under these names being often confounded together by modern writers, though the descriptions are very distinct in the antient authors, and substances may be found in the present day which seem to answer to those descriptions, and which are found in the countries from which the former are said to have been obtained. In antient authors, such as Pliny, Dioscorides, Theophrastus, and Hippocrates, we have notices both of *Indian nard* and of another aromatic, which is commonly called *Calamus aromaticus*. [SWEET CALAMUS.] When such substances are merely mentioned in antient authors, it is difficult to identify them in modern times, as we have the assistance only of the name, sometimes of the properties, and a notice of the country where it is produced. These, though often lending us considerable assistance, are yet insufficient to prove that we have succeeded in identifying a substance. In the first place, it is necessary to be acquainted with the more remarkable natural products of the country which is said to have yielded those which were possessed of properties striking enough to be sought for at very early times from very distant countries. As the productions of nature remain uniform in properties, we may appropriately compare what we now find with antient descriptions Dioscorides is the most eligible author for such purposes, as he arranges his articles, gives a description, and often synonymes, compares them with other substances, and mentions the country whence the articles were obtained. He was followed by a series of authors, as Galen, Pliny, Oribasius, Ætius, Paulus of Ægina, to the time of the Arabs, who mention the same substances, besides Myrepsus and Actuarius, who were subsequent to some of them. The Arabs, from their position and communication with the East, had a practical knowledge of such articles as were produced in their own territories, or were obtained from India. The Christian physicians, who assisted them in making translations, must have been well acquainted not only with both the Greek and Arabic languages, but also with the substances which were described and used as medicines. That the Arabs were acquainted with Sanscrit works on medicine has been proved by Dr. Royle, in his 'Essay on the Antiquity of Hindoo Medicine.' That Hindu physicians were present at the court of the Caliph of Bagdad was proved by the late Professor Dietz, and recently again by Mr. Cureton and Professor Wilson, in the 'Journal of the Royal Asiatic Society.' Hence, by following the description of a substance through these various authors, we may trace it with a considerable degree of certainty to the countries where it is produced; and this plan we have adopted in the articles LYCIUM and PUTCHUK, which is *Costus* of the antients. Dioscorides, in the first chapter of his first book, treats of the various aromatic and stimulant substances which were known to the antients, and among these, of the various kinds of Nard. Of the first kind, called simply nardus (νάρδος), there are two varieties, the one Syrian, the other Indian; the former so called not because it comes from Syria, but because the mountains in which it is produced have one part turned towards Syria, and the other towards India. This may refer either to the Hindu Khosh, or to so many Indian products finding their way to Syria, by the way of the Red Sea and the Euphrates, from the earliest times. The other variety is called Gangitis, from the river Ganges, near which, while flowing round a mountain, it is produced, bearing many hairy spikes from one root. These are strong-smelling, but those growing in moist situations less so than those found on the mountains. One variety, he further says, is called Sanphariticon, from the name of a place. This first kind being called nardus, and distinguished into the Syrian and Indian varieties; the second kind he calls Celtic nard (νάρδος κελτική), and the third kind a mountain nard (νάρδος ὀρεινή). On consulting Avicenna, we are referred from narden to sunbul, pronounced sumbul, and in the Latin translation from nardum to spica, under which the Roman, the mountain, the Indian, and Syrian kinds are mentioned. This proves, as has been already stated by Sir William Jones, that sumbul, &c. was always considered by Arabian authors as synonymous with the nardos of the Greeks. In Persian works on Materia Medica, all translated from the Arabic, as, for instance, the 'Mukhzun al-adwieh,' or Magazine of Medicines, we have four different kinds of *sunbul:* 1, *Sunbul hindee;* 2. *Sunbul roomee*, called also *sumbul ukletee*, and *narden ukletee*, evidently the above Celtic nard, said also to be called *sunbul Italion*, that is, the nard which grows in Italy; 3, *Sunbul jibullee*, or mountain nard: hence it is evident that the kinds described by Dioscorides are alluded to, and in fact the accounts given are merely translat ons of his descriptions. The fourth kind of *Sunbul* appears to be a hyacinth or polyanthus. But the first is that with which alone we are at present concerned. The synonymes given to it are, Arabic, *sunbul al teeb*, or fragrant nard; Greek, *narden;* Latin, *nardoom*, and Hindee, *balchur* and *jatamasee*.

Having the Hindee and Sanscrit names of an Indian plant, the next step was to obtain it. This was first attempted by Sir William Jones, at a time when we had no access to the Himalayan mountains, and a wrong plant was sent him. Dr. Royle informs us that on making inquiries on the subject, when at Saharunpore, in 30° N. lat., about thirty miles from the foot of the Himalayas, he learnt that *jatamansi*, better known in India by the name *bal-chur*, was yearly brought down in considerable quantities from the mountains, such as Shalma Kedarkanta, near the Ganges and Jumna rivers, to the plains. Having obtained some of the fresh brought down roots, he planted them both in the East India Company's Botanic Garden, and in the mountains, in a nursery attached to it. The plant produced was found to belong to the natural family of Valerianeæ, and has been named Nardostachys Jatamansi by De Candolle, and formerly Patrinia Jatamansi by Mr. Don, from plants sent home by Dr. Wallich from Gossainthan, a mountain of Nepaul. Mr. Don obtained the additional corroboration that spikenard bought in a chemist's shop by this name exactly corresponded with the roots of the jatamansi. (Royle, *Illust. Himalayan Bot.*, p. 242.)

Hence there can be no doubt that the nardos described by Dioscorides is the jatamansi of the Hindus, and probably the same substance which has been mentioned by such writers as Hippocrates, and there is nothing improbable in its being the nard of Scripture, and it has been shown to be a plant belonging to the natural family of Valerianeæ. It is curious that the Celtic and mountain nards are also Valerians, the former being yielded by *Valeriana Celtica* and *Saliunca*, still exported from the mountains of Austria to Egypt, whence it has spread into both Africa and Asia, being valued for its fragrance, and hence employed in perfuming baths; and the other by *Valeriana tuberosa.* Dr. Royle mentions it as a curious coincidence, if not allowed to be a sign of accurate knowledge, that the Persians should translate the φυ of Dioscorides, which he also calls wild nard, foo of the Arabians, by the term *bekh i sunbul*, root of soonbul. The plant correctly ascertained by Sibthorp has been named by him *Valeriana Dioscoridis*.

Differences of opinion exist respecting the nature of the fragrance of the jatamansi. It may be sufficient to state, that it is highly esteemed in the East as a perfume, and is used to scent oils and unguents. At a late meeting of the Asiatic Society specimens of true jatamansi were sent round, and all were of opinion that it was a highly fragrant drug.

SPILSBY. [LINCOLNSHIRE.]

SPINA BI'FIDA, or cleft-spine, is a disease commencing in fœtal life, and which consists in an imperfection of the posterior part of the spinal canal. It is almost always accompanied by an excessive secretion of spinal fluid, and in these cases it may be regarded as a disease of the same kind affecting the spinal canal as that which, existing in the skull, constitutes hydrocephalus. The two are indeed not unfrequently coincident; and spina bifida is sometimes called hydrorachis.

The arch of each vertebra [SKELETON] is developed and ossified in two pieces which meet behind in the middle line at the base of the spinous process. This is also developed in two lateral portions which subsequently unite together and with the arch, so as to form the one piece of bone which we find in the adult closing in the back of the spinal canal. This development and union of the arches of the vertebræ goes on during an early period of fœtal life, while the spinal column is growing rapidly, and the fluid of the spinal canal and arachnoid sac is being constantly secreted. If this fluid be secreted in an unnaturally large quantity before any or a part of the arches of the vertebræ are completely ossified, it may exert such pressure upon them as to separate their component parts, and produce a permanent aperture in the back of the spinal canal, through which a sac containing the excess of fluid will protrude. Or if the development and ossification of any or all of the arches take place more slowly than it should, then a secretion of not more than the ordinary quantity of fluid may suffice to keep them permanently open. A cleft spine will thus be produced without the watery tumour; but the openness of the spine will generally in cases of this kind lead to the secretion of an unnatural quantity of the spinal fluid; for it seems a general law that, other things being equal, the quantity of fluid secreted in each part is inversely proportionate to the resistance offered by the walls of the cavity into which it is poured.

Spina bifida is almost always characterized by a tumour situated over the defective vertebræ, globular, elastic, and fluctuating, often attached by a narrowed base, and varying in size according to the extent of the fissure in the spinal canal. It is usually covered by healthy skin, and consists of the dura mater, and one or more of the other membranes of the spinal chord, protruded in a sac through the space between the separated arches, and filled by a clear serous fluid. On pressing such a tumour the patient may become insensible, or be convulsed; for the fluid within it communicating with that within or around the brain and spinal chord, the pressure made upon it is felt with equal force by the whole of those organs. The parts of the body below the tumour are often paralytic, not from the pressure of the fluid, for that is equally diffused, but from disease of the chord coincident with that of the arches.

Spina bifida is most common in the lumbar and sacral regions, in which the vertebral arches are latest completed: it is most rare in the neck, and is there also most dangerous, because of the great number of nerves which, by the coincident disease of the spinal chord, may be paralysed. It does not commonly interfere with the general health: but by the friction to which, when the tumours are large, the skin is subjected, and by the distention produced by the increasing secretion of fluid, the sac is liable to inflame and ulcerate, till, exposing the spinal chord, or its membranes, death is produced by their inflammation; or, the quantity of fluid secreted may be so great as to produce death by its pressure on the chord and brain, in a manner similar to that in which hydrocephalus often terminates.

In one of these modes, spina bifida, when accompanied by excessive secretion, almost always terminates fatally, though patients may survive with it for ten or even twenty years. Life may generally be prolonged by maintaining a gentle even pressure upon the tumour, so as to supply the necessary resistance to the effusion of more fluid. In a few cases a repeated evacuation of the fluid, and then firm pressure upon the sac, has been found successful; and lately, M. Tavignot has related some cases which he cured by slicing off the tumour, and instantly bringing together the edges of the mouth of the sac, and so holding them till they had united and formed a firm cicatrix.

That just described is by far the most common form of spina bifida; others more rare are those in which not the arches only, but the bodies of the vertebræ also are cleft, the two lateral portions in which each is developed being kept apart, so that a portion of the spinal canal is open in front towards the cavity of the abdomen. Some differences of character also depend on the seat of the fluid secreted: it is generally in the sac of the arachnoid, but sometimes is in the tissue of the pia mater, or in both it and the sac, or, yet more rarely, in the central canal of the spinal chord.

SPINA VENTO'SA is a term now obsolete, which was applied by old surgeons to abscesses in bone, accompanied with excessive swelling, and then to nearly all the diseases indiscriminately in which either bones or joints become enlarged.

SPINACH. [SPINACIA.]

SPINA'CIA (from *spina*, 'a thorn,' on account of its prickly fruit), the name of a genus of plants belonging to the natural order Chenopodiaceæ. This genus is diœcious, the male and female flowers being on different plants. The male flowers are composed of a calyx, with 5 deeply cloven, concave, oblong, obtuse segments, 5 stamens, with filaments longer than the calyx, with oblong double anthers. The female flowers have a monosepalous calyx, with four divisions, two of which are smaller and opposite; a superior ovary with four styles and simple stigmas. As the fruit ripens, the calyx hardens and adheres to it. The ovary contains a single seed. There are only two species, which are herbaceous plants, with alternate leaves, and axillary flowers of a green colour.

One of the species of this genus, the *S. oleracea*, the common Spinach, is well known on account of its use in the kitchen. It has an herbaceous stem one or two feet high, branched, and hollow; arrow-shaped leaves; male flowers in long spikes, abounding with pollen; female flowers on another plant, axillary, herbaceous, and small. The fruit is a small round nut, which is sometimes very prickly.

The common spinach has been cultivated in Europe from time immemorial, but its native region was not known till Olivier announced that he had found it wild in Persia. It does not appear to have been cultivated or known by the antients, and is first mentioned by Arabian physicians under the name of Hispanac, and appears to have been known to the Spaniards from a very early period.

There are two principal varieties cultivated in gardens, the prickly-fruited, with triangular, oblong, or sagittate leaves, and the smooth-fruited, with round or blunt leaves. The former is considered the hardiest, and is therefore employed for winter culture; the latter is used for summer crops. Of these varieties there are several subvarieties, varying in the size, thickness, and shape of their leaves.

For the winter crop the seed is sown at the beginning of August. A light, dry, rich soil should be preferred, and, if possible, in a sheltered situation. When the plants have put forth two pair of leaves, the ground should be hoed and the plants thinned. By October or November the outer leaves of the spinach are fit for use. In February, when fine weather occurs, the plants should be again attended to, cleaned, and thinned out, and in this way it may be made productive till April or May, by which time the summer sort will be ready. The first sowing of the round-leaved spinach or smooth-fruited should take place at the end of January in some sheltered border. This crop should be successively thinned out till the plants are eight or ten inches apart. Successive sowings may be made, in order to ensure a constant supply in February, March, and April, and, if desirable, these sowings may take place between rows of cabbages, &c.

Spinach is often sown in narrow drills, which is rather more troublesome at first, but this is made up for by the facility with which clearing, thinning, and gathering are afterwards accomplished.

For preserving seed, those plants which are of the most stocky growth should be selected. The winter crops run up soonest, but seed may be obtained from spring crops in July and August. The new seed is the best for sowing, although it will keep very well for a year. When the plants are saved for seed, the male plants, which are easily distinguished by their flowers, may after fertilization be drawn and thrown away.

Spinach is sometimes grown by the farmer, for the purpose of obtaining a crop of seed for the uses of the gardener. In the selection of land for this purpose, care should be taken that it is finely prepared by ploughing and harrowing in the early spring, and some well-rotted dung should be ploughed in where the soil is not of the best quality. When the Spinach has blossomed, the male plants should be drawn out, which serve at this time as excellent food for pigs, and might be given to other animals with advantage. There is much uncertainty about this kind of crop; sometimes however it turns out very advantageous.

SPINAL CHORD. [BRAIN; NERVOUS SYSTEM.]
SPINAL COLUMN. [SKELETON.]
SPINCTE'RULUS. [FORAMINIFERA.]

SPINE, in Botany, is applied to the sharp hard conical extremities of the branches of plants. The spine is seen in great perfection in the Gleditschia, sloe, white thorn, and other plants. It is not produced in all plants, and seems to arise from the want of perfect development of the growing point of the plant. That such is the case would appear to be proved by the fact, that when wild plants which bear spines, as the apple and pear, are introduced into orchards, where they have more nutrition, the growing point no longer remains in the state of a spine, but is developed into a branch with leaves. Occasionally spines bear leaves, and this is the case in the white thorn. Spines differ from prickles in being in connection with the wood of the stem, and in being composed of bark and wood, as the stem itself. The prickle consists of merely hardened cellular tissue, and can be removed from the wood with the bark.

SPINELL, *Spinell Ruby, Balas Ruby, Ceylanite, Candite, &c.*, occurs in loose and imbedded octohedral crystals. Primary form the cube. Cleavage easy, parallel to the faces of the octohedron of the black opaque variety; difficult in the other varieties. Fracture conchoidal. Hardness greater than that of quartz, but less than that of corundum. Colour red, blue, violet, green, yellow, brown, and black. The first is the most common. Streak white. Lustre vitreous. Transparent; translucent; opaque. Specific gravity 3·5 to 3·7.

Infusible by the blow-pipe; the red varieties are rendered black and become opaque by exposure to it, but on cooling, at first of a fine green by transmitted light, then nearly colourless, and at last become again red.

Spinell is found in Ceylon and Siam in isolated and rolled crystals in the beds of rivers. It is found embedded in carbonate of lime in North America and Sweden.

Several varieties have been analyzed: red transparent spinell, by Vauquelin; blue, by Berzelius; green and black, by Dr. Thomson.

| | Red. | Blue. | Green. | Black. |
|---|---|---|---|---|
| Silica . . . | — | 5·48 | 5·62 | 5·59 |
| Alumina . . | 82·47 | 72·25 | 73·30 | 61·78 |
| Magnesia . . | 8·78 | 14·63 | 13·63 | 17·86 |
| Protoxide of iron | — | 4·26 | 7·42 | 10·56 |
| Lime . . . . | — | — | trace | 2·81 |
| Chromic acid | 6·18 | — | — | — |
| | 97·43 | 96·62 | 99·97 | 98·6 |

SPINELLANE occurs crystallized. Primary form, the cube; usual form, the rhombic dodecahedron. Cleavage parallel to the faces of the dodecahedron. Fracture conchoidal, uneven. Hardness 5·5 to 6·0. Colour brown, grey, greyish black. Lustre vitreous. Translucent. Opaque. Specific gravity 2·28. It gelatinizes in acids.

It is found on the borders of Lake Laach, near Andernach on the Rhine. Analysis by Klaproth:—Silica, 43·0; Alumina, 29·5; Soda, 19·0; Lime, 1·5; Peroxide of iron, 1·0; Sulphuric acid, 2·0; Water, 2·5.

SPINET', a musical instrument of the harpsichord kind, but differing in shape and power, formerly much in use, though now entirely superseded by the piano-forte. The *Spinet* had but one string to each note, which was struck by a quilled jack, the latter acted on in the usual manner by a key. The tone was, of course, comparatively weak, but pleasing, and as the instrument was small in dimensions and cheap in price, it answered the purpose of those who did not find it convenient to purchase a harpsichord. The outline of its ordinary form was nearly that of a harp laid horizontally, supposing the clavier, or key-board, to be placed on the outside of the trunk, or sounding part, of the last-named instrument.

SPINNING. The art of spinning 'consists, philosophically speaking,' observes Dr. Ure, in his 'Philosophy of Manufactures,' 'in forming a flexible cylinder of greater or less diameter, and of indeterminate length, out of fine fibrils of vegetable or animal origin, arranged as equally as possible alongside and at the ends of each other, so that, when twisted together, they may form a uniform continuous thread.' Whatever be the substance operated upon by the spinner, whether cotton, wool, flax, or silk, it is necessary in the first place to lay the fibres or filaments parallel with each other, so as to form them into a soft continuous ribbon or cord, sometimes called a *sliver*. Excepting in the case of flax, this is done by a carding or combing process, the object of which is to disentangle and straighten the tangled filaments; and in all cases it is desirable to distribute their ends as equally as possible in the mass, in order to make the strength of the sliver uniform. If such a sliver or cord be firmly griped or compressed at two points rather farther apart than the average length of its component filaments, it may be extended or drawn out to a greater length; the filaments sliding upon each other. When two or more such cords have been extended in this way, until they will stretch no longer without separating or being pulled asunder, they may be laid parallel to each other, and combined by being slightly twisted together. The compound cord thus formed may be again extended by stretching or drawing; and the repetition of the processes of doubling, twisting, and stretching will enable the spinner to extend the length and diminish the thickness of the cord until it becomes a fine compact thread or yarn. In fact, the power of extension is almost unlimited, except by the imperfect performance of the process, which might occasion the fibres to be so laid that several should terminate at the same point, whereby the cohesion of the thread would be destroyed; or by the attainment of such a degree of twist that the fibres would sooner break than slide farther upon each other,—their mutual compression being sufficient to overcome their individual strength. This explanation will apply to most of the operations classed under the general name of spinning; but various modifications of the process are occasioned by the nature of the material to be spun, or the character of the apparatus employed.

It is needless to enter at length into the history of the art of spinning, an art which has been practised from the earliest times, and to the invention of which so many claims have been brought forward. The primitive modes of spinning by the spindle and distaff, and by the spinning-wheel, which are still extensively practised in the East, and not entirely superseded in some remote districts of Scotland,* only enable the spinner to produce a single thread; but with the almost automatic spinning-machinery which has been called into existence by the cotton manufacture, one individual may produce nearly two thousand threads at the same time. The history of the series of inventions by which this result has been gradually attained has been already given under ARKWRIGHT, SIR RICHARD, vol. ii., p. 344; COTTON SPINNING, vol. viii., p. 94; and COTTON MANUFACTURE, vol. viii., p. 98. As the application of spinning-machinery to other manufactures has arisen out of the improvements made in that of cotton, it is needless, after the information conveyed in those articles, to do more than add a few remarks respecting the principal variations necessary to adapt similar machinery to the spinning of wool, flax, and silk.

The principle of roller-spinning has been explained as above, vol. ii., p. 345. The soft cord or sliver is caused to pass between two pairs of rollers; the space between the two pairs being rather more than equal to the length of the fibres. The two pairs of rollers between which the sliver is compressed do not separate farther from each other in order to stretch it, but that effect is produced by making the second pair of rollers revolve faster than the first. It is necessary to arrange the distance between the two pairs of rollers with reference to the average length of the filaments of which the sliver is composed; because if the two pairs of rollers were too far apart, the soft cord would be liable to separate between them, and if they were too near, so that the opposite ends of a filament should be compressed between them at the same time, the sliver could not extend or lengthen by the sliding of the filaments, but the filaments themselves must break with the strain. Hence, in machinery for spinning wool, on account of the variable length of the filaments, the drawing-rollers are so mounted that they may be readily adjusted to different distances. In consequence of the greater elasticity of wool, the relative velocities of the two pairs of rollers are so arranged as to produce a greater degree of stretching or extension than is usual with cotton.

For spinning flax other modifications are necessary, owing to the greater length of its fibre, and its peculiar character. Instead of being curled and tangled together like those of cotton and wool, the fibres of flax are nearly straight and parallel, but so firmly connected together in bundles as to need splitting or separating by a kind of metallic comb, called a *heckle* or *hackle*. This operation has been usually performed by the hand, in the manner described in the article FLAX, vol. x., p. 305, and it has been found very difficult to apply machinery successfully to the process, as no machine can proportion the force exerted to the state of the flax with the same accuracy as an experienced hand. A material difference between the processes of heckling by hand and by machinery consists in the circumstance that in the former case the heckle is stationary, and the flax is moved through it, while in the latter the principal movement is in the heckle itself. Automatic heckles are placed between the pairs of rollers in machinery for drawing the slivers of flax. Machinery for spinning tow is similar, but has a different heckling apparatus, to allow of the rollers being nearer together, because of the comparative shortness of the fibres. As the fibres of flax have not the same tendency to mutual entanglement as those of wool and cotton, it is necessary to moisten them with water to make them adhere to each other during the process of spinning, and also to render them more pliable and easy to twist. Until recently, cold water was used for moistening the flax for machine-spinning; but the substitution of hot water for that purpose has been found a great improvement. By this alteration a much finer, smoother, and more uniform thread may be produced, and a given weight of flax may, it is stated, be spun to double the length that it formerly could. The inconvenience of the spray thrown about by the process of flax-spinning is very serious, although measures have been adopted to lessen its injurious effect upon the health of the spinners. Particular descriptions of the machinery used for spinning flax, with the flax-gill, or automatic heckle, may be found in Dr. Ure's 'Philosophy of Manufactures' and 'Dictionary of Arts,' &c. In the latter work it is stated that the first attempts at spinning flax and hemp by machinery went on the principle of cutting the filaments into short lengths, by which their cohesive strength was wasted. In such experiments tow was used with more success, because of its greater similarity to cotton. The first tolerable results in the spinning of flax by machinery were obtained about the year 1810, as we are informed in the same work, by the brothers Girard, at Paris; but the French have never carried the art to any great practical perfection. In this kingdom many ingenious inventions have been recently brought into operation; and at Leeds, Dundee, and Belfast, the machine-spinning of flax has been brought to a state of perfection little short of that of cotton. The great superiority of rope-yarns made by machinery over those made by hand has been alluded to under ROPE, vol. xx., p. 154.

The manufacture of yarns or threads of the best quality of silk is a process essentially different from the spinning of

* 'Ency. Brit.,' art. 'Spinning.'

cotton wool, or flax. Instead of combining a number of short fibres into a long thread, the silk-throwster receives the silk in the form of very long and exceedingly fine filaments, which merely need cleansing and twisting together until the requisite strength is attained. The twisting process is, in this case, called spinning. There is, however, besides the best portion of the silk, which is wound off from the cocoon, a quantity of loose or *floss* silk, which forms a soft tangled mass enveloping it. This, with the refuse of the superior part of the silk, under the general name of *waste*, is converted into yarns for coarse or inferior articles, by a process very similar to that of spinning other fibrous substances. This waste silk was formerly cut by a machine, to reduce its filaments into short lengths, and then treated much in the same way as cotton wool; but the process of manufacturing it into yarns has been recently much improved by the adoption of contrivances similar to those used in flax-spinning, by which the filaments are heckled or drawn out into a sliver without being cut. A detailed account of the art of spinning silk-waste is given in the article 'Silk Manufactures,' in the new edition of the 'Encyclopædia Britannica.' It is there observed that this art is still in its infancy; but its rapid progress in this country may be inferred from the fact that while, in 1814, the quantity of waste-silk imported into Great Britain was only 28,996 lbs., it amounted to 1,509,334 lbs. in 1836. In 1839, according to the table in the article SILK, p. 12, the quantity imported of this description was 1,042,490 lbs., and the quantity of raw silk of the ordinary character 3,746,248 lbs.

SPI'NOLA, AMBRO'SIO, MARQUIS OF, was born at Genoa in 1569. His family were originally from Spinola, a small town on the confines of the duchy of Milan and the Monferrat; but one of his ancestors removed to Genoa, where he amassed considerable wealth by engaging in mercantile speculations. On the death of his father, Ambrosio followed his pursuits, while his younger brother Frederic embraced the military profession. Having in 1598 entered the service of Philip III. of Spain, with six galleys equipped and armed at his own expense, Frederic was employed against the Dutch, over whom he gained several victories, ruining their trade, and capturing or sinking their ships. In 1601 Frederic was appointed admiral of the Spanish fleet on the coast of the Netherlands, and shortly after was invested with full powers to raise a body of troops to operate against the insurgents of Flanders. He then went to Genoa, and prevailed on his brother Ambrosio to take the command of the land forces, whilst he scoured the sea with his fleet. The army was to be raised in the duchy of M[illegible]n, and to consist of 9000 men, Italians and Spaniards, whom the two Spinolas were to arm and pay, after the manner of the old *condottieri*, to be afterwards reimbursed by the Spanish treasury. This circumstance, at a time when the conduct of wars depended so much upon the troops being regularly paid, contributed in a great degree to the success which afterwards rendered Spinola so celebrated. While the Spanish troops in Flanders were disorderly and mutinous, those under the command of Spinola were always a pattern of obedience and discipline. Ambrosio left Milan in May, 1602, and entered the Low Countries. He served at first under Mendoza, who sent him to the relief of Grave, besieged by Maurice; but he was defeated in an attempt to break through the enemy's lines, and Grave surrendered on the 20th of September, 1602. The ensuing year (May, 1603) his brother Frederic was killed in a naval engagement with the Dutch. Shortly after Spinola was appointed general-in-chief of the Spanish forces in the Netherlands. He began the campaign by an attempt to relieve the town of Sluys, which was besieged by the Prince of Nassau; but in this he failed, the place having capitulated on the 19th of August, 1604. The Archduke Albert of Austria, governor of the Netherlands, having employed him in the capture of Ostend, which had long been besieged by the Spaniards, it fell into his hands after it had sustained a siege of three years and two months. Although Spinola obtained possession of a mere heap of ruins, his reputation was at once established throughout Europe. After this he repaired to Madrid, where he was received by King Philip with the respect due to his talents, and appointed commander-in-chief of all the Italian and Spanish forces in the Netherlands. On his way back to the theatre of war, he passed through Paris, where he had an interview with Henry IV. This king having asked him what were his plans for the ensuing campaign, Spinola, who penetrated his motives, entered without hesitation into the detail of his projects, and of the military operations which he intended to perform. Taking for granted that Spinola wished to deceive him, Henry wrote to Maurice the very contrary of what he had been told; and when he saw that by performing exactly what he had stated, Spinola had deceived both him and his antagonist, he is said to have exclaimed, 'Others have deceived me by falsehood, but Spinola by telling the truth.' Maurice at length saw the artifice, and changed his plan of operations, but he was unable to gain any decisive advantage over his adversary, who dexterously availed himself of the fortresses and of the nature of the ground to keep him in check. A decisive naval action, in which the Dutch admiral Heemskerk destroyed the Spanish squadron near Gibraltar (1607), induced the cabinet of Madrid to propose an armistice, which was concluded between Spinola and Maurice for twelve years (1609). The war was renewed in 1621, owing to the disputed succession to the duchy of Cleves, and Spain, by her connection with the house of Austria, and the hope of recovering her lost dominion over Holland, entered into it. Spinola commanded the Spanish forces, and Maurice was again his opponent. The advantage however remained entirely with the former. Juliers was invested and taken, and the siege of Breda was commenced. Whilst trying to relieve this city, the Prince of Nassau [MAURICE] died of a fever occasioned by the noxious air of the marshy soil, and Spinola himself was reduced to a weak state of health, owing to the same cause; but after ten months' siege, Breda opened its gates (June, 1625). This was Spinola's last achievement, his health obliging him soon after to resign the command. In 1629 he was employed against the French in Italy, but he was unable to gain any decisive advantage, and he died soon after (1630), of vexation and disappointment caused by the complete disregard of his pecuniary claims by the court of Madrid. Spinola was doubtless one of the ablest generals of his time, being second only to his antagonist, Prince Maurice, in military talent.

(Watson's *Philip III.*, Lond., 1783, 4to., p. 86, *et seq.*; Bentivoglio, *De la Guerra di Fiandra*, Cologne, 1634, 4to.)

SPINO'ZA, BENEDICT, the son of a Portuguese Jew at Amsterdam, was born in that city, the 24th of November, 1632. He was christened Baruch, but on his renouncement of Judaism he always called himself Benedict. From his infancy he exhibited remarkable indications of mental acuteness, and his frail sickly constitution forced him to find solace in study. He became well versed in the Hebrew language, and learnt also Italian, Spanish, German, and Dutch. His early studies were principally the Bible and Talmud; and his penetration was so keen, and the logical tendency of his mind was so great, that he won the admiration of Morteira, the chief rabbin, who became his instructor. His studies however led him to speculate curiously on certain points which were received in the Jewish religion. The immortality of the soul, for example, he nowhere found confirmed in the Old Testament; on the contrary, the Old Testament is silent on that point, a matter which has called forth great discussion. Among the most celebrated of the treatises on this subject are Dr. William Sherlock's 'Discourse of the Immortality of the Soul and a Future State,' and Warburton's 'Divine Legation of Moses.' Spinoza made no secret of his opinions on this matter, and two of his young friends soon disseminated the report of his infidelity. Spinoza was in consequence summoned before the synagogue, where his judges, after deploring that one who had given such hopes should have wandered from the right path, informed him that he was summoned to give a profession of his faith. He was accused of having treated the law and religion of Moses with contempt, which he denied, but he maintained his opinions. Long discussions took place, in which Morteira, who was enraged at his disciple, used all his endeavours to get him excommunicated, in which he subsequently succeeded.

A physician called Vanden Ende, who was himself accused of scepticism, instructed Spinoza in Latin and Greek. Vanden Ende had also a daughter, not prepossessing in appearance, but well acquainted with Latin, and an excellent musician. Spinoza took lessons in Latin and love at the same time; and would have married her, had not a young merchant from Hamburg, with the more potent seductions of pearl necklaces, rings, and other articles, won her heart. Spinoza's Latin however was useful in his new philosophical studies, for which he had abandoned theology; and the works of Des Cartes falling into his hands, he read them with avidity. A new world was opened to him, and he always declared that to Des Cartes he owed whatever knowledge he had of philosophy. He had now quite freed himself from the shackles of Judaism, was reserved with the Jewish doctors, and absented himself from the synagogue. It has been asserted that he professed Christianity, and frequented the Calvinist and Lutheran churches, and that he embraced Mennonism, but this is erroneous. It is true that he held many conversations with learned Mennonites and other sectarians, but never declared himself for any one. (*Vie de Spinoza*, prefixed to Boulainvilliers's *Réfut. de Spinoza.*) His attacks on the Jewish doctrine so alarmed the rabbins, that they offered him a pension of a thousand florins if he would consent to comply outwardly with their ceremonies and from time to time present himself at their synagogue. 'Not if the pension were tenfold,' indignantly exclaimed Spinoza. With such a man there was only one remedy—excommunication; but before that was put in practice assassination was attempted. Coming one night from the theatre, he was attacked by a Jew, who stabbed him in the face. The wound was fortunately slight; but he saw the danger of staying in Amsterdam, and determined to leave it. The day of excommunication at length arrived. The people were assembled in the synagogue to assist in that extraordinary proceeding. A vast quantity of black wax candles were lighted, and the tabernacle wherein are deposited the books of the law of Moses was opened. From the elevated chair, the chanter chanted in lugubrious tones the dreadful words of execration, whilst another sounded the trumpet. The candles were then held over a large tub filled with blood, and melted into it drop by drop, during which the people, awed by this spectacle, and animated with religious horror, cried out Amen.

Spinoza however found an asylum with his friend Vanden Ende: and there he practised himself in the art of making glasses for telescopes, microscopes, &c., in which he soon excelled, and thereby procured an humble subsistence. But Morteira, who pursued him with unabated rancour, got him exiled from Amsterdam, and he retired to Rhynsburg near Leyden, where he followed his trade, devoting every spare hour to his studies. In 1664 he published his 'Abridgement of the Meditations of Des Cartes,' with an appendix in which he expressed opinions wholly inconsistent with those of Des Cartes. He then went to the Hague, where he remained the rest of his life. He lived as a perfect recluse, and with the most rigid economy. His time was spent in study, or in correspondence with the celebrated men of his day. He would frequently not leave his room for three or four days together. His habits were sober, quiet, and retired. The occupation of his life was philosophy; and the only relaxation he allowed himself was his pipe, a little conversation with the people in his house, or watching spiders fight—an amusement which would cause the tears to roll down his face with laughter. His doctrines excited the indignation of theologians, but his virtues endeared him to all who knew him personally. He died of consumption, in the forty-fifth year of his age, A.D. 1677.

His published works are: 'Renati Descartes Principiorum Philosophiæ, pars prima et secunda More Geometrico demonstratæ,' 1663; 'Cogitata Metaphysica,' 1664; Tractatus Theologico-Politicus,' 1670; and 'Opera Posthuma,' 1677. The last contain 'Ethica More Geometrico demonstrata; Politica; De Emendatione Intellectûs; Epistolæ et ad eas Responsiones; et Compend. Gram. Ling. Hebr.

The materials for this notice have been drawn from the *Vie de Spinoza* which precedes Boulainvilliers's *Refutation de Spinoza*, in which the Life by Colerus is incorporated, and augmented by many curious matters derived from a manuscript memoir by one of Spinoza's friends.

SPINOZISM. The system of Spinoza is generally identified with atheism, both in France and England, so that it has become a term of extreme odium; with what propriety will be seen from the exposition of his doctrines, which, from their celebrity, and from their having been so frequently misstated and misunderstood, it will be useful to give correctly. The only work of Spinoza which attracts the attention of metaphysicians is the 'Ethica,' which appeared among his posthumous works. 'No treatise,' says Mr. Hallam, 'is written in a more rigidly geometrical method. It rests on definitions and axioms, from which the propositions are derived in close, brief, and usually perspicuous demonstrations. The few explanations he has thought necessary are contained in scholia. Thus a fabric is erected astonishing and bewildering in its entire effect, yet so regularly constructed that the reader must pause and return on his steps to discover an error in the workmanship, while he cannot also but acknowledge the good faith and intimate persuasion of having attained the truth which the acute and deep-reflecting author everywhere displays.' (*Intro. to Lit. of Europe*, vol. iv., p. 243.) Spinoza is indeed the Euclid of metaphysicians; and however widely we may dissent from his doctrines, yet the rigid, close, and perspicuous reasoning, the elaborate construction of his system, and the obvious deduction of his consequences from axioms, recommend it to all thinkers as a great intellectual gymnastic.

The eight definitions and seven axioms which contain his whole system are the following:—

*Definitions.*—1. By cause of itself I understand that whose essence involves its existence; or that the nature of which can only be conceived as existent.

2. A thing finite is that which can be bounded (terminari potest) by another of the same nature; for instance, body is said to be finite, because it can always be conceived as larger. So thought (cogitatio) is limited by other thoughts. But body does not limit thought, nor thought limit body.

3. By substance I understand that which is in itself, and per se, conceived: that is, the conception of which does not require the conception of anything else as antecedent to it.

4. By attribute I understand that which the mind perceives as constituting the very essence of substance.

5. By modes I understand the accidents (affectiones) of substance by means of which it is conceived.

6. By God I understand the being absolutely infinite; that is, the substance consisting of infinite attributes, each of which expresses an infinite and eternal essence. Whatever expresses an essence, and involves no contradiction, may be predicated of an absolutely infinite being.

7. That thing is said to be free which exists by the sole necessity of its nature, and by itself alone is determined to action; but it is necessary, or rather constrained, when its existence is determined by something else, and its acting by certain and determinate causes.

8. By eternity I understand existence itself, as far as it is necessarily conceived to follow from the sole definition of an eternal thing. For such existence, as eternal truth, is conceived as the essence of a thing, and therefore is not to be explained by duration or time, though duration, beginning, and end may be conceived.

*Axioms.*—1. All things which are, exist in themselves or in others.

2. That which cannot be conceived per aliud, must be conceived per se.

3. From a given determinate cause the effect necessarily follows; and vice versâ, if no determinate cause be given, no effect can follow.

4. The knowledge of an effect depends on the knowledge of the cause, and includes it.

5. Things that have nothing in common with each other cannot be understood by means of each other; that is, the conception of one does not involve that of the other.

6. A true idea must agree with its original in nature—with its object (idea vera debet cum suo ideato convenire).

7. Whatever can be conceived as non-existent, does not in its essence involve existence.

These fundamental principles of his philosophy will to some appear truisms, to others absurd. But when their language (and we have adhered as closely as possible to Spinoza's barbarous but energetic and expressive Latin) is rightly understood, and their signification seized, which a very slight study of their development will assist, they will appear as some of the most curious positions of speculative philosophy.

Two substances, having different attributes, have nothing in common with each other; hence one cannot be the cause of the other, since one may be conceived without involving the conception of the other; but an effect cannot be conceived without involving a knowledge of the cause (per Axiom 4). This must be understood as meaning a complete conception of the effect, which necessarily depends on a complete conception of the cause, not that the relation of cause and effect itself depends on our conception of them. Two or more things cannot be distinguished except by the diversity of their attributes, or by that of their modes. For there is nothing out of ourselves except substances and their modes. But there cannot be two substances of the same attribute, since there would be no means of distinguishing them except their modes or affections; and every substance, being prior in order of time to its modes, may be considered independently of them; hence two such substances could not be distinguished at all. One substance therefore cannot be the cause of another, for they cannot have the same attribute, that is, anything in common with another. Every substance is therefore self-caused; that is, its existence is implied in its essence. It is also necessarily infinite, for it would otherwise be terminated by some other of the same nature and necessarily existing; but two substances cannot have the same attribute, and therefore cannot both possess necessary existence. The more existence anything possesses, the more attributes are to be ascribed to it. This follows from the definition of an attribute. The more attributes we ascribe to anything therefore, the more we are forced to believe in its existence; and from this is derived the existence of God. God, or a substance consisting of infinite attributes, each expressing an eternal and infinite power, necessarily exists, for such an essence involves existence. If anything does not exist, a cause must be given for its non-existence. If only twenty men exist, an extrinsic reason must be given for this number, since the definition of man does not involve it or any number.

There can be only one substance, God. Whatever is, is in God, and without God nothing can be conceived. For he is the sole substance, and modes cannot be conceived without substance; but besides modes and substance nothing exists. God is not corporeal, but body is a mode of God, and therefore uncreated. God is the cause of all things, and that immanently, but not transiently. He is the efficient cause of their essence as well as their existence, since otherwise their essence might be conceived without God, which is absurd. Thus all particular and concrete things are only the accidents or affections of God's attributes, or modes in which they are determinately expressed. God's power is the same as his essence; for he is the necessary cause both of himself and of all things, and it is as impossible for us to conceive him not to act as not to exist. God viewed in the attributes of his infinite substance is the same as nature, that is, to use his fine and subtle expression, the 'natura naturans;' but in another sense, nature, or 'natura naturata,' expresses only the modes under which the divine attributes appear. And intelligence considered in act, even though infinite, should be referred to 'natura naturata;' for intelligence in this sense is but a mode of thinking, which can only be conceived by means of our conception of thinking in the abstract, that is, by an attribute of God. The faculty of thinking, as distinguished from the act, as also those of desiring, loving, and the rest, have no existence. This is an anticipation of Hume's doctrine. [SCEPTICISM.] There is, says Spinoza, an infinite power of thinking, which, considered in its infinity, embraces all nature as its object, and of which the thoughts proceed according to the order of nature, being its correlative ideas. This agrees with Plato, who says a law of nature is an idea in its objective reality; that is, idea and law (in this sense) are correlations. This opinion is indeed as old as philosophy itself, and is found in every country. The universe is taken as the manifestation of the Deity; not, as many suppose, as the Deity himself; but, to use the words of Cousin, 'the Deity passing into activity, but not exhausted by the act.' (*Cours de Phil., Intro.*) It is owing to the abstract and subtle nature of Spinoza's method that his system has been so often misunderstood. The positions, for example, which we have set down, require patient meditation and an acquaintance with metaphysical language to be intelligible, and some of them are open to the grossest misinterpretations. Thus Spinoza is usually accused of atheism, while not only are his doctrines found in St. Paul, St. Augustin, and the Greek writers, but all the modern German philosophy, from Kant downwards, owns him as its master.

Spinoza does not confound God with the material universe; his words distinctly absolve him from such a charge: 'God is the identity of the natura naturans and the natura naturata' (natura naturans et natura naturata in identitate Deus est). God and nature are not two distinct entities, but one living whole. God is the 'idea immanens,' the true spiritual existence, the living principle which permeates the whole. The material universe is only one phasis of his infinite attributes, namely, extension; but Spinoza rigidly and universally teaches that the One Infinite Substance has two infinite attributes, extension and thought. Extension is visible thought, and thought is invisible extension. The use of the word substance, by which he signifies existence, the 'prima materia' of the schoolmen, has led to much misunderstanding, and his adversaries have replied as if he meant by substance what we express by matter and body. When Spinoza therefore says that God is the infinite substance, he does not mean the material universe, which is only one attribute of existence, namely, extension; he simply gives the Platonic expression (τὸ ὂν καὶ τὸ πᾶν), the unique conception of the All. When Spinoza asserts thought to be the other infinite attribute of substance, he follows Parmenides, of whom Ritter says, 'Thought appeared to him to exhibit merely one aspect of the All.' (*Geschichte der Philos.*, vol. i., p. 460.) It should be observed that the attribute of thought is not proved. He demonstrates the necessity for extension, by saying that we cannot conceive substance without conceiving it as extended; but as we can conceive substance without thought, we may demand a demonstration of the necessity of this attribute, which Spinoza has not given. In other words, from the definition of substance, extension follows as a necessary attribute; but in the definition of substance, there is no necessity involved for thought as an attribute.

God then, according to Spinoza, is the 'idea immanens,' the fundamental fact and reality of all existence, the only power, the only eternity. What we name the universe is only the visible aspect, the realised form of his existence. All concrete things change and perish; they are only modes of the infinite Being, who alone remains unchangeable. It is a gross error (the origin of which may be traced to the misconception of his word 'substance') to assert, as it often has been, and on which Bayle founds his refutation of Spinoza, that this system is pantheistic, in the common acceptation of the term, that it identifies all things with God, and consequently that every concrete thing is a part of God. Such a conception is purely material and superficial. Schelling has well refuted it: 'God is that which exists in itself, and is comprehended from itself alone; the finite is that which is necessarily in another, and can only be comprehended from that other. Things therefore are not only in degree, or through their limitations, different from God, but *toto genere*. Whatever their relation to God on other points, they are absolutely divided from him on this, that they exist in another, and he is self-existent or original. From this difference it is manifest that all individual finite things taken together cannot constitute God; since that which is in its nature *derived* cannot be one with its original, any more than the single points of a circumference taken together can constitute the circumference, which as a whole is of necessity prior to them in idea.' (*Philosophische Schriften*, p. 104.)

We have not space to go through the ideological and moral parts of Spinoza's 'Ethics,' as we have done the metaphysical, but a few of the more important propositions may be usefully quoted.

The mind does not know itself, except so far as it receives ideas of the affections of the body. But these ideas of sensation do not give an adequate knowledge of an external body, nor of the human body itself. The mind therefore has but an inadequate and confused notion of anything so long as it judges only by fortuitous perceptions; but it may attain it clear and distinct by internal reflection and comparison. This is the doctrine of Hobbes and Locke explicitly stated. No positive idea can be false; for there can be no such idea without God, and all ideas in God are true, that is, correspond with their object. Falsity therefore consists in that privation of truth which arises from inadequate ideas; an adequate idea being one which contains no incompatibility, without regard to the reality of its supposed correlative object. Error is imperfect truth. It seizes one aspect of the truth to the neglect of the rest.

All bodies agree in some things; and of these all men have adequate ideas; hence common notions which all possess, such as extension, duration, number. The human mind however can only form a certain number of distinct images at the same time; if this number be exceeded, they become confused: and as the mind perceives distinctly just so many images as can be formed in the body; when these are confused the mind also will perceive them confusedly, and will comprehend them under one attribute, as man, horse, dog, &c.; the mind perceiving a number of such images, but not their differences of stature, colours, &c. Thus are universal ideas formed: first, by singulars, which the senses represent confusedly and imperfectly; secondly, by signs, that is, by associating the remembrances of things with words, which Spinoza calls imagination; thirdly, by reason; and, fourthly, by intuitive knowledge. Knowledge of the first kind is the source of error; the second and third are necessarily true. It is important to distinguish images from words. Those who think ideas consist in images which they perceive, fancy that ideas of which they can form no image are arbitrary. They look at ideas as pictures on a tablet, and hence do not understand that an idea, as such, involves an affirmation or negation. And those who confound words with ideas fancy they can will something contrary to what they perceive, because they can affirm or deny it in words. But thought does not involve the conception of extension; and therefore an idea, or mode of thought, neither consists in images nor in words, the essence of which consists in corporeal motions not involving the conception of thought.

Men can have an adequate knowledge of the eternal and infinite being of God, but cannot imagine God as they can bodies; and hence have not that clear perception of his being which they have of that of bodies, and have perplexed themselves by associating the word God with sensible images, which it is hard to avoid. The existence of God can be conceived; indeed it is a necessary conception from which no mind can escape; but the manner of his existence can never be conceived. The source of error in this case is that men do not name things correctly; for they do not err in their own minds, but in this application; as men who cast up wrong see different numbers in their minds from those in the true result.

The mind has no free will, but is determined by a cause, which itself is determined by some other cause, and so on for ever. For the mind is only a mode of thinking, and therefore cannot be the free cause of its actions. Will and understanding are one and the same thing; and volitions are only affirmations or negations, each of which belongs to the essence of the idea affirmed or denied. This subtle opinion is also adopted by Malebranche, Cudworth, and Fichte.

Spinoza's moral system is as rigidly deduced from premises as his metaphysical. Most men who have written on moral subjects, he says, have treated man as something out of nature, as a kind of 'imperium in imperio,' rather than as a part of the general order. They have conceived him to enjoy a power of disturbing that order by his own determination, and ascribed his weakness and inconstancy not to the necessary laws of the system, but to some strange defect in himself, which they cease not to lament, deride, or execrate. But the acts of mankind, and the passions from which they proceed, are in reality but links in the series, and proceed in harmony with the common laws of universal nature. Men finding many things in themselves and in nature, serving as means to a certain good, which things they know to have not been provided by themselves, have believed that some one has provided them, arguing by analogy of the means which they in other instances employ themselves. Hence they have imagined a variety of gods, and these gods they suppose to consult the good of men in order to be worshipped by them, and have devised every means of superstitious devotion to ensure the favour of these divinities. Finding also in the midst of so many beneficial things in nature not a few of an opposite effect, they have ascribed them to the anger of the gods on account of the neglect of men to worship them. Nor has the experience of calamities falling alike on the pious and impious cured them of this belief; they choose rather to acknowledge their ignorance why good and evil are thus distributed, than give up their favourite theory. But all things occur by eternal necessity. Moreover were God to act for an end, he must desire something which he wants; for it is acknowledged by theologians that he acts for his own sake and not for the sake of things created.

Men having thought that all things were created for them, have invented names to distinguish that as good which tends to their benefit; and believing themselves free, have got the notions of right and wrong, praise and dispraise. And when they can easily apprehend the relations of things, they call them well ordered, if not, ill ordered; as if order were anything except in regard to our imagination of it.

We are said to act when anything takes place within us, or without us, for which we are an adequate cause; that is, when it may be explained by means of our own nature alone. We are acted upon when anything takes place within us which cannot wholly be explained by our own nature. Passions are the affections of the body, which increase or diminish its power of action, and they are also the ideas of those affections. Neither the body can determine the mind to thinking, nor can the mind determine the body to rest or motion. For all that takes place in body must be caused by God, considered under his attribute of extension, and all that takes place in mind must be caused by God, considered under his attribute of thought. The mind and the body are but one thing considered under different attributes; the order of action and passion in the body being the same in nature with that of action and passion in the mind. But men, though ignorant how far the natural powers of body reach, ascribe its operations to the determination of the mind, veiling their ignorance in specious words. For if they allege that the body cannot act without the mind, it may be answered that the mind cannot think till impelled by the body, nor are all the volitions of the mind anything else than its appetites, which are modified by the body.

All things endeavour to continue in their actual being, this endeavour being nothing else than their essence, which causes them to be, until some exterior cause destroys their being. The mind is conscious of its own endeavour to continue as it is, which is, in other words, the appetite that seeks self-preservation; what the mind is thus conscious of seeking, it judges to be good, and not inversely. Many things increase or diminish the power of action in the body, and all such things have a corresponding effect on the power of thinking in the mind. Thus it undergoes many changes, and passes through different stages of more or less perfect power of thinking. Joy is the name of a passion, in which the mind passes to a greater perfection or power of thinking; grief, one in which it passes to a less. From these two passions, and from desire, Spinoza deduces all the rest of the passions in a curious but questionable manner.

Such is the substance of Spinoza's celebrated system; a system which has excited so much odium as to have become synonymous with atheism. We have pointed out the source of this error; but we cannot refrain from adding the testimony of the pious Schleiermacher to his religious earnestness. 'Offer up with me,' he exclaims, 'with reverence a lock of hair to the manes of the holy but repudiated Spinoza! The great spirit of the world penetrated him; the Infinite was his beginning and his end; the universe his only and eternal love. He was filled with religion and religious feeling; and therefore is it that he stands alone, unapproachable, the master in his art, but elevated above the profane world, without adherents, and without even citizenship.' (*Rede über die Religion*, p. 47.) Göthe thus speaks 'The mind that wrought so powerfully on mine, and had so great an influence on the whole frame of my opinions, was Spinoza's. After I had looked round the world in vain for means of shaping my strange moral being, I fell at length on the 'Ethics' of this man. What I read in this work—what I thought I read in it—I can give no account of; enough that I found there a calm to my passions; it seemed to open to me a wide and free view over the sensuous and moral world But what particularly riveted me was the boundless disinterestedness that beamed forth from every sentence. The all-equalizing serenity of Spinoza contrasted with my all-agitating vehemence; his mathematical precision, with my poetical way of feeling and representing.' (*Dichtung und Wahrheit*, xiv.)

These testimonies from such unquestionable sources will not be without benefit in directing men to look calmly into Spinoza, and meditate upon him. The student will derive great help from Boulainvilliers's *Refutation de Spinoza*, Bruxelles, 1731, in which the doctrines are popularized and divested of their mathematical precision, which repels many readers; also from Jacobi's *Briefwechsel mit Mendelssohn*, Breslau, 1789; and from Hallam's *History of the Literature of Europe*, vol. iv., pp. 243-263.)

SPIRÆA, a genus of plants of the natural family Rosaceæ, tribe Spiraceæ. The name occurs in antient authors, and is supposed to be derived from σπειρα, a cord, in allusion to the fitness of the plants for twisting into garlands. The genus is diffused through the temperate parts of the northern hemisphere, and is characterised by having a 5-cleft permanent calyx; stamens 10 to 50, inserted in a torus with the 5 petals, which are inserted into the calyx; carpels sessile, solitary or several, rarely connected into a capsule; seeds 2-15, pendulous, very rarely ascending. The species, upwards of 50 in number, form small unarmed shrubs or perennial herbs; leaves usually simple, sometimes pinnately cut. Flowers white or reddish. They are found in Europe, North America, Siberia, China, and the Altai and Himalayan Mountains. Several form ornamental shrubs and herbs, which are found in our gardens, and are of easy cultivation. S. Ulmaria, or Meadow-Sweet, is found in our meadows, and S. Filependula on our downs, &c. Pigs are said to be fond of the tubers of the roots. Several of the species are astringent, and might be used in tanning. S. trifoliata is sometimes called Ipecacuanha de Virginia, being employed as an emetic.

SPIRAL, a name belonging properly to curves which wind round a point in successive convolutions. The easiest mode of representing such curves algebraically is by means of polar COORDINATES: hence, in many of the older English works, any curve referred to such coordinates is said to be considered as a spiral. Thus we have the circle considered as a spiral; the ellipse considered as a spiral, and so on. The rest of this article is intended only for those who have some knowledge of the mathematical part of the subject.

If $r$ be the radius vector of a curve, $\theta$ the angle which it makes with a given line, and $r = \phi(\theta)$ the equation of the curve, it is obvious that if $\phi\theta$ be a common trigonometrical function of sin $\theta$, cos $\theta$, &c., the curve will not have an unlimited number of convolutions. The whole of the curve from $\theta = 2\pi$ to $\theta = 4\pi$, will be merely a repetition of that from $\theta = 0$ to $\theta = 2\pi$. Thus, $r = \sin\theta$ is the equation of a circle of a unit diameter, tangent at the origin to the line from which $r$ sets out; the fifteenth half-revolution of the radius vector is only the fifteenth description of this circle. It is only then when the angle $\theta$ occurs independently of trigonometrical quantities, that any curve is represented which can properly be called a spiral. Thus, the spiral of Archimedes, or Conon, of which the equation is $r = a\theta$, has a convolution in which $r$ changes from 0 to $2\pi a$, while $\theta$ changes from 0 to $2\pi$; another, in which $r$ changes from $2\pi a$ to $4\pi a$, while $\theta$ changes from $2\pi$ to $4\pi$, and so on. The principal spirals to which distinct names have been given, are—

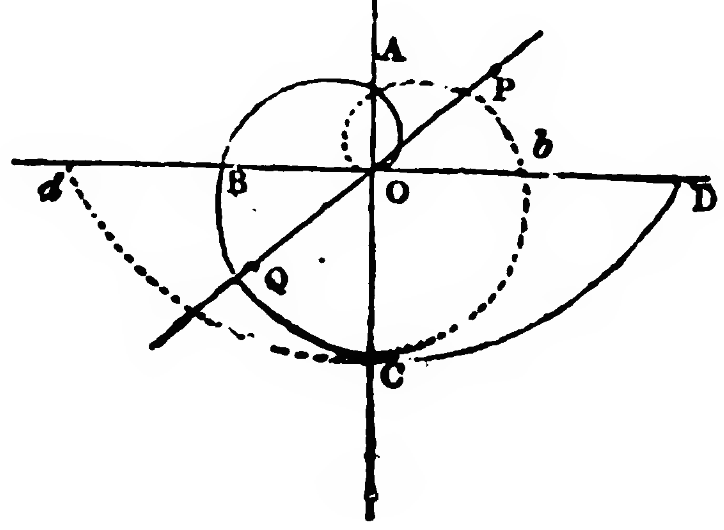
| | Equation. |
|---|---|
| 1. Spiral of Archimedes . | $r = a\theta$ |
| 2. Reciprocal Spiral . . | $r\theta = a$ |
| 3. Lituus . . . . . | $r^2\theta = a$ |
| 4. Logarithmic or Equiangular Spiral . . . . | $r = ab^{\theta}$ |

with some others of less note. The figures of these spirals are given in all books on the application of algebra to geometry.

It has hitherto been universal to consider spirals in a manner which has deprived these curves of half their convolutions: this has been done by refusing to entertain negative values of the radius. For example, in the spiral of Archimedes $r = a\theta$, $a$ being a positive quantity, the curve is supposed to have no convolutions when $\theta$ is negative, or when the radius revolves negatively. The consequence is, that the curve begins abruptly at the origin. It would be a matter of little importance to insist on the existence of the additional branches which belong to the negative radii, if it were not that the other mode of representing curves, by means of rectangular coordinates, always gives the additional branches: so that, if we refuse to receive the latter as coming from the polar equation, we have only the alternative of supposing that the mere transformation of coordinates destroys a part of the curve. In the spiral of Archimedes, for example, the rectangular and polar equations are—

$$y = x \tan \frac{\sqrt{(x^2 + y^2)}}{a}, \qquad r = a\theta.$$

The first, treated in the usual way, gives a curve of which




there is one succession of convolutions beginning with OABCD, and another beginning with OA*b*C*d*. But the second equation, which is only the first in a different form, does not yield any of the second set of convolutions, unless by means of the negative values of the radius vector answering to negative values of $\theta$.

The manner in which the negative value of $r$ is to be treated, is as follows:—Every line passing through the origin, as POQ, makes two angles with the positive side of the axis of $x$, POD, less than a right angle in the diagram, and QOD, between two and three right angles: the second of which may be considered as the common angle QOD, taken negatively. The bounding directions of these angles are different, OP and OQ: the rule is, whichever angle the straight line QOP is supposed to make with OD, let the bounding direction of that angle be the positive direction, and the other direction negative. Thus, when POD is the angle, OP is positive and OQ negative: when QOD is the angle, OQ is positive and OP negative. In this manner it will be found that the first three of the four spirals above enumerated have never been completely drawn. There is little need to insist much on the necessity of the extension here described: one more instance may suffice. Let the reader trace the curve whose equation is—

$$2y^2 = 1 - 4x - 2x^2 \pm \sqrt{1 - 8x},$$

derived from $r = 1 - 2\cos\theta$. The rectangular equation gives a curve of two loops, of which the polar equation will only yield one, unless negative values of $r$ be employed, in the manner above described. Nevertheless, if the process had been inverted, and the polar equation deduced from the rectangular, we should have found $r = \pm 1 - 2\cos\theta$ for the former; and the effect of the double sign is that the positive values of $r$ only, in the the two equations $r = 1 - 2\cos\theta$, and $r = -1 - 2\cos\theta$, will give the complete curve deduced from the rectangular equation. As far as this instance goes, it might seem as if the complete polar equation, as deduced from the rectangular, would give the whole curve by means of positive radii; though at the same time a single instance hardly proves anything. But even granting that the passage from the rectangular to the polar equation will always give forms enough to the latter to trace the whole curve from positive radii, it remains indisputable that the other transition, from the polar to the rectangular, requires the negative radii to be taken into account.

SPIRAL of ARCHIMEDES. [SPIRAL.]

SPIRAL STRUCTURE IN PLANTS. In the development of the tissues of plants two tendencies are observed, the one simply that of extension in a vertical direction, the other is that of curvation, mostly resulting in the production of a spire. The tendency to develop parts in a spiral direction, though much more prominent in the vegetable than the animal kingdom, is by no means confined to it. In a recent paper in the ninth volume of the *Annales des Sciences Naturelles*, Mandl has shown that all the tegumentary appendages of animals, as the scales, feathers, hair, &c., have a spiral arrangement, and that many of the internal organs are subject to the same law. The tendency to develop structures in a spiral form appears to be dependent on some of the higher laws regulating organic life; and in this view the subject has been investigated by recent botanists. Goethe, the German poet and philosopher, to whom botanists are indebted for the development of those theoretical views of the structure of plants on which is based the science of morphology, has investigated this subject. In his 'Essay on the Spiral Tendency of Vegetation,' published in 1831, he gives the following view. He supposes that there is a dependence of those properties which plants possess of resisting external agents, and of enduring for a length of time, upon those parts that are developed vertically, whilst the nutritive and reproductive functions are connected with spirally developed structures. In support of this generalization he adduces a number of facts. If a branch of an ash-tree is injured, so that the lower parts become over-nourished, it possesses a tendency to become spiral. When the leaves of the Italian poplar are injured by insects, the petioles become twisted. Spiral vessels exist in greatest numbers in the growing parts of plants, as the alburnum. They also exist in greater numbers in the higher plants, the lowest possessing none. A spiral arrangement of parts is also much less observable in the lower than in the higher groups of plants. The organs of nutrition and reproduction, the leaves and parts of the flower, have normally a spiral arrangement. Von Martius, Mohl, and others, have also written on the general theory of spiral structure. We shall confine ourselves to pointing out those plants and parts of plants that exhibit this structure.

Cellular tissue was at one time supposed to consist of plain simple cells, but the researches of later botanists have proved that the cells of this tissue are often furnished with fibres, which are twisted in a spiral manner. This spiral fibrous tissue is abundant in the roots of orchidaceous plants, in the seed-coats of many plants, and in the linings of the valves of almost all anthers. Spiral fibres, independent of any cells, and apparently surrounded by vegetable mucus, have been found in the testa of the seeds of Collomia linearis. In the seed-coats of the seeds of species of Blepharis and Acanthodium spiral fibres enclosed in membranous tubes are found in very great abundance. The organs called *elaters*, which are contained with the sporules in the conceptacles of Jungermannia, consist of spiral fibres surrounded by a tube. A structure also of this kind has been described as existing in a species of Trichia, but in general the fungi do not present any spiral structure in their parts. The elaters are analogous in structure to the vascular tissue, which is almost entirely composed of a tissue, which on account of its spiral structure has been called 'spiral vessels.' These vessels appear to be little more than fibrous cellular tissue elongated, the parietes of the cell forming an elongated tube, which is tapering at each extremity, and contains within it one, two, three, or more spiral fibres. This tissue is exceedingly abundant in exogenous and endogenous plants, but is not found in the lower families of Cryptogamia. It exists however in ferns, Lycopodiaceæ, and Equisetaceæ. It is only sparingly found in Coniferæ. These spiral fibres possess the power of moving when touched, which was attributed by Malpighi to irritability, but De Candolle attributes this to their hygrometrical properties.

From the tissues we pass on to the entire plant, where we frequently see the spiral tendency developed in the structure of stem and leaves. The part of the latter which exhibits this structure is the petiole, and in this organ all forms of the spire may be seen, from a single twist to the complicated spires observed in the organs called *cirrhi*. In most plants these cirrhi assist them in climbing, their structure adapting them to this purpose. The spires of the cirrhi twist in some from right to left, in others from left to right; and in the cirrhi of the genera Passiflora and Bryonia the direction changes several times in the course of the spire from right to left and from left to right.

In the structure of many of the Confervæ a spiral arrangement of the tissues is observed, especially of those which approach the animal kingdom in their movements, as the Oscillatoriæ. The setæ which support the conceptacle of Jungermannia, and which contain the spiral elaters before mentioned, possess in many instances a spiral structure. This is also occasionally developed in the same organ in mosses, a remarkable instance of which occurs in *Funaria hygrometrica*. In this moss the setæ are quite straight when young, but assume the spiral structure as they increase in age. In these setæ the spire turns in two directions; from the base about two-thirds up the stem it goes from right to left; it then becomes quite straight, and turns in the opposite direction from left to right. A curious property is possessed by these setæ when the capsules are ripe. If the upper part of the spiral is moistened, the capsule commences turning from right to left; but if the lower part only is moistened, it turns from left to right.

The entire stems of plants are frequently spiral, as is seen in the plants which are called climbers. These plants, by reason of the spiral arrangement of their tissues, twine around the nearest objects, whether organic or inorganic. In most of them the winding of the spire is to the left side, but in a few the turning is to the right. Amongst the former are the genera Cuscuta, Phaseolus, Dolichos, Passiflora, Banisteria, &c.; amongst the latter are the genera Humulus, Dioscorea, Lonicera, Polygonum, &c. This winding in a particular direction is not only confined to the species of a genus, but to the genera of an order; and Mohl, who has paid great attention to this subject, states that he knows of but one exception to this rule, which is the genus Abrus in the family of Leguminosæ, which twines to the left, whilst all the others twine to the right. The direction of the spires of the cirrhi is not so constant. Between the twining of the cirrhi and the stems of plants Mohl has pointed out an essential difference. The cirrhi are first developed longitudinally, and the spiral tendency proceeds from the point to the base; but in stems the first three or four internodes grow straight, and the next internode is developed very rapidly; and from this lower internode the spiral tendency is developed upwards. Sometimes a spiral direction is seen in the direction of trees that ordinarily grow straight; and Göthe records several instances of twisted trunks in the chesnut, the whitethorn, beech, and others. A remarkable instance of spiral structure connected with function is seen in the peduncle of the female flowers of Valisneria, which is a water-plant. The female flowers spring to the surface of the water in the summer, at the time the male flowers have perfected their pollen and scattered it upon the surface of the water. As soon as the pollen is conveyed to the female flower, its spiral stem becomes contracted, and its fruit is perfected at the bottom of the water.

Many theories have been proposed to account for the mere winding of the stem. Dutrochet supposes that it depends on the different relations of cellular and fibrous tissue to each other in plants during the action of endosmose. Mohl thinks that it arises from the irritability of the tissues of these plants, which, on the plant being placed in contact with certain external objects, is called into action, producing the peculiar development observed. This irritability is supposed only to exist on the sides and under surface of the twining part, and when called into action contracts and produces the twisting of the unaffected part. These explanations are not satisfactory. The spiral structure is too intimately connected with the essential existence of plants to be explained in all cases by a reference to immediate agents.

The most remarkable and important exhibition, in a practical point of view, of the spiral tendency in plants is the arrangement of the leaves upon the axis of the plant. If we take a branch of the willow, oak, pear, apple, or many others, and examine the leaves, we shall find they are arranged in such a manner, that if we were to draw a line from leaf to leaf up the stem, we should produce upon it a spiral which would in the case of any of these trees be of a different character from any of the others. In theoretical botany the spiral arrangement of the leaves which makes them alternate upon the stem is looked upon as their normal form, and those leaves which are opposite or verticillate are supposed to be produced by the suppression of an internodium. The spiral arrangement of the leaves on the stem has been made a matter of mathematical investigation by Braun and Schimper, and it is found that this arrangement is possessed of certain fixed mathematical properties. Of course the same observations are applicable to all those parts of the plant, as the bracts, sepals, petals, scales of the fruit, &c., which are considered modifications of the leaf. The fruit of the common pine may be taken as an illustration of these properties. If the cone of a pine or a spruce-fir be broken through the middle, three scales will be observed, 'which, at first sight, appear to be upon the same plane; but a more attentive examination shows that they really originate at different heights, and moreover, that they are not placed at equal distances from each other; so that we cannot consider them as a whorl, but only a portion of a very close spiral. But considering the external surface of the cone viewed as a whole, we find that the scales are disposed in oblique lines, which may be studied—1, As to their *composition* or the number of scales requisite to form one complete turn of the spire; 2, as to their *inclination*, or the angle, more or less open, which they form with their axis; 3, as to their total number, and their arrangement round the common axis, which constitutes their *co-ordination*. Finally, we may endeavour to ascertain whether the spires turn from right to left or *vice versâ*.' (Lindley.)

In the arrangement of the leaves several series of spires are discoverable, and between these there constantly exists a certain arithmetical relation which may be expressed by figures, and which results from the combination of the elements of which they are composed. All the spires depend upon the position of a fundamental series, from which the others are deviations. The nature of this series is expressed by a fraction, of which the numerator expresses the number of turns which make up one spire, whilst the denominator expresses the number of leaves, scales, &c. upon the spire. So that suppose we mark the seat of one leaf at the bottom 0, and go on following the leaves, we shall come at one directly over the first, and this completes the spire; of this leaf occurs after ten turns of the spiral, and there should be eighteen leaves upon the spire, the expression for this series would be $\frac{10}{18}$. By applying this rule very different figures may be obtained for various plants. The following are results obtained by Braun :—

$\frac{8}{21}$ is the expression for the leaves of Woad, Plantago lanceolata, and the bracts of Digitalis lanata. $\frac{13}{34}$ in Sempervivum arboreum, and the bracts of Plantago media. $\frac{3}{8}$ is a common form; it exists in the bay-tree, the holly, and Aconite. $\frac{2}{5}$ is the most common, representing the quincunx. It is seen in Mezereum, Lapsana communis, the potato, &c. $\frac{1}{2}$ is seen in the spikes of all grasses, in Asraum, the lime-tree, the vetch, and pea.

No application of this doctrine has at present been made, and these researches are only in their infancy. It seems in some genera to be a mode of distinguishing species. Thus the expressions for the following species of Pinus are P. pinaster $\frac{21}{55}$; P. sylvestris $\frac{13}{34}$; P. cembra $\frac{8}{21}$; P. larix $\frac{8}{21}$; P. micro carpa $\frac{2}{5}$.

For further information on the subject of this article the reader may consult Göthe, *Ueber die Spiral-Tendenz der Vegetation*; Meyen, *Pflanzen-Physiologie*, Band iii.; Lindley, *Introduction to Botany*; Henslow's *Botany*, in *Cab. Cyc.*; Virey, *Philosophie de l'Histoire Naturelle*.

SPIRATELLA. [HYALÆIDÆ, vol. xii., p. 372.]

SPIRAL VESSELS. [TISSUES, VEGETABLE.]

SPIRE (in German, *Spitze*, or *Thurm-spitze*; in French, *Flèche*, from its resemblance to the pointed tip of an arrow; but the Latin *spira* signifies a coil, or spiral line, and not an upright cone or pyramid). The term belongs to Gothic architecture, and is used to designate the tapering pyramidal mass erected on a tower by way of finish and ornament. That so little relative to spires is said in works on Gothic architecture is the more remarkable, because, in proportion to the number of examples, they exhibit more variety than almost any other separate feature in edifices in that style. Though the spire is a very striking feature in a building, it has nothing to recommend it on the score of direct utility. It is a mere external appendage to an edifice, since it does not, like the dome, contribute to any kind of effect whatever internally, a circumstance that seems to have been overlooked by Mr. A. W. Pugin, for else he would hardly have made it a reproach against the architect of St. Paul's, that the exterior dome of that fabric is merely for effect. Though the same objection might be made to the spire, we are far from urging it: mere utility is a low test of merit in architecture, and although this merit cannot be claimed for this feature in Gothic architecture, we hold the spire to be one of paramount value in it, inasmuch as that pyramidal figure concentrates all its principles and characteristics, rendering it most eminently the *Pointed* style. So considered, the spire may be said to be the keystone of the whole idea of such style; that which visibly completes it. It serves, moreover, to impart an air of graceful lightness to the whole of a building, and to correct—if we may so express it—what might else be excess of length as compared with the general height of a structure, by giving a corresponding degree of loftiness to one portion of it.

The origin of the spire, like that of the pointed arch, is merely matter of conjecture. The probability is that it arose out of the peaked roof usually given to campaniles and towers of a preceding period, which form was afterwards gradually improved upon and refined, till it eventually grew up into the slender tapering spire. According to such supposition, we would refer to the tower of Than church in Normandy, as an example exhibiting the rudiments of the spire, it being no more than a steep peaked roof or low pyramid, whose height does not exceed three-fourths of its base. A *peak* of this kind differs also from the spire both in being the same in plan as the tower on which it is placed, and in being immediately set upon it, whereas the spire is almost invariably an octagon or other polygon, and is surrounded at its base with a parapet. In Italy, where campaniles are usually detached square towers of very slender or lofty proportions, the spire is almost unknown, for such towers have seldom more than a mere pyramidal roof or peak, which, though it may be considered as the germ from which the Gothic spire was afterwards developed, is in itself of quite different character; yet, at the same time, that of each is best adapted to the respective style. There are some few instances of square spires; among them a very singular one at Egeln in Germany, where two such spires are set immediately together upon the same tower. But however slender in their proportions such spires may otherwise be, they have a certain heavy massiveness of form. When therefore greater loftiness and lightness were aimed at in this feature, the adoption of a polygonal plan for it became almost matter of course; for although in a geometrical drawing the general outline and proportions of a spire are the same whether it be square or octangular in plan, the perspective or actual appearance is widely different; because in the latter case the diagonal breadth of the square tower below is cut off, and each side or plane of which the spire is composed becomes a much more pointed triangle. Besides which, the polygonal spire produces a degree of contrast and variety highly favourable to general effect in the Pointed style.

A gradual and progressive transition from the mere peak or pyramidal roof to the slender tapering spire, cannot however be clearly traced. On the contrary, some of the earliest deviations from the simple pyramidal form appear to have produced uncouthness rather than lightness; for although much greater loftiness upon the whole was so occasioned, the appearance of it was reduced by the sides of the tower being made to terminate in gables cutting into, and therefore partly cutting off, the base of the pyramid or spire itself. Many of the earlier German edifices contain examples of this peculiarity—one almost confined to them; among others the cathedrals of Worms and Gelnhausen, the church at Andernach, and that of the Apostles at Cologne, exhibit many varieties of spires, or rather *spire-roofs*, springing up from gables at their base; and in some the gables are so large and rise up so high, that the appearance of spire is almost entirely lost. Such is the case with the pyramidal covering of the square tower at the west end of the church at Gelnhausen, of which the portion above the gable forms a mere capping. The same church offers other specimens of the kind, there being, besides the one mentioned, a spire over the intersection of the transept, one over the apsis at the east end, and two others over the towers adjoining it. All these are polygonal, but otherwise differ—except that those to the towers are similar to each other—both in dimensions and proportions; that over the apsis being not quite so high as it is broad, while that over the transept is one diameter and a half, and the two others three diameters in height. They are all gabled at the base, and their ridges correspond with the apices of the gables, so that the sides or faces of the spire alternate with those of the tower; which last circumstance is almost peculiar to the earliest German spires. Another distinction belonging to them is, that except gables or pediments, they have nothing at their base, neither parapet nor pinnacles of any kind, which would serve at once as a finish to the tower, and as enrichment to the lower part of the spire. This is so different from the usual mode, that in this country a spire set immediately upon a tower without any parapet, &c. at its base, is technically described by the term *Broach*. Many other distinctions are needed, and if no better can be found, we would suggest that of *Stump-spire* for one whose height does not exceed two diameters of its base.

There are indeed so many peculiarities in spires, that it is highly desirable to have descriptive terms for them. First, as regards its base, a spire may be said to be *Cluster-based*, when surrounded below with pinnacles connected with it, and from among which it seems to spring up; of which kind St. Mary's, Oxford, is a celebrated example. The

Hôtel-de-Ville, at Ypres, has a spire clustered with four exceedingly tall pinnacles or lesser spires. Where there are windows placed *against* a spire, rising *upright* like the dormers or lucarnes on a roof, the term *Lucarned* would express that character; we have therefore not scrupled to make use of it in the annexed table of spires, where it is applied, among others, to those of Lichfield cathedral, which have several tiers of such windows, and are described accordingly. *Crocketted* and *Banded* are terms requiring no explanation; but in regard to the first it may be remarked, that spires, otherwise quite plain, are sometimes ornamented with *crockets* along their edges; and with respect to *bands*, they are sometimes little more than string-mouldings, but in other cases broad and enriched surfaces. Many of the spires in Normandy are ornamented with such a number of bands, that they form alternating courses with the plain spaces between them. *Finialed* is a term which does not apply to any of our English spires; but that of St. Stephen's, Vienna, and some other continental spires, have an exceedingly large and rich finial, which ornament gives them a particular boldness of expression. The *Tabernacle-spire* also is one of which there is no example in this country, but of which the one just mentioned, and those of Strassburg, Ulm (as designed), Thann in Alsace, and many others, are specimens, the tower and spire being carried up from the ground in a succession of diminishing stages, all profusely adorned with pannelling, niches, canopies, pinnacles, and other tabernacle-work, in such a manner that it is barely possible to distinguish where the upright portion or tower terminates, and the spire itself begins, the latter seeming little more than the uppermost stage in continuation of the rest. Neither have we any instances of *Open-work* spires, or of such as, if not actually perforated, are yet entirely covered with tracery. That at Freyburg, and those at Burgos and Batalha, are all exceedingly rich specimens of the kind. The chapter-house of Burgos also has a series of very large pinnacles or small spires of tabernacle character. Cambrai and Esslingen on the Neckar afford other examples of open-work spires.

There are various other circumstances which, though they do not affect the spire itself, produce greater or less difference in regard to the character of the structure of which it is a component feature. Very much, for instance, depends upon its situation in the general plan: at Salisbury, Norwich, and Chichester, the spire is raised upon a tower at the intersection of the cross, or in the centre of the plan; whereas in most continental cathedrals and large churches there are two spires on the towers of the west front, though in some instances (Strassburg, Antwerp) only one has been erected. Several however have a single tower and spire in the centre of the west front (Ulm, Freyburg, Thann in Alsace), in which case the tower itself begins to diminish almost from the ground, and the whole becomes what we have described as of the *tabernacle* character. In most of our English churches (not cathedrals) the spire is placed upon a tower at the west end, as at Grantham, Louth, Bloxham, &c. If we except Peterborough, where they are very diminutive, the only English cathedral which has two western spires is Lichfield, which is further remarkable as having a central tower and spire also. Besides the richness and variety thus produced, the larger central spire serves to balance the whole composition, whereas else the body of the structure is apt to look low in comparison with the west end. At St. Stephen's, Vienna, the tower and spire are singularly placed on the south side of the edifice, it having been intended to balance them by a corresponding tower on the north side. At Gelnhausen, on the contrary, there is a group of spires, as already noticed, at the east end.

Although the building itself is by no means a tasteful example, the façade being in a rude and plain Norman design, the annexed view of St. Stephen's at Caen will assist in explaining some of the preceding observations.

We have here two western towers and spires, which last are not parapeted, but merely embased with turrets and pinnacles at their angles, rising up to a considerable height; consequently they answer to what we have denominated *cluster-based*, the turrets with their smaller *stump*-spires being clustered around the larger one. These spires are also *lucarned* below and *banded;* although in the cut those circumstances are rather indicated than expressed.

One circumstance plainly observable is that the whole façade is of narrow proportions, and the space between the towers very small. The spires themselves are short, both in proportion to their own diameters and to the height of the towers, which are carried up so high as to appear very lofty as compared with the rest of the structure.

Though so much depends upon circumstances of this kind, almost the only thing that is specified in the usual description of spires is the entire altitude from the ground, which single measurement, unaccompanied by others, gives no idea of the relative dimensions of the spire or how it is proportioned. Some of the loftiest spires, as they are popularly termed, are by no means lofty, being not above a third of the entire height, and not more than four of their own diameters. The spire of Strassburg, for instance, is only 110 feet out of 474, or less than one-third of the tower itself. At Antwerp again the spire is a mere *peak* crowning the uppermost stage of the tower, while the tower itself is twice as high as the roof of the church. If we compare Salisbury with Norwich, the spire of the latter cathedral will be found, though of less dimensions, much loftier in relation to the rest than the other, being in the ratio of 163 to 308 feet, while Salisbury is only 197 to 404. We have therefore drawn up a table of spires, showing the separate as well as united heights of the respective towers and spires; and although in some instances we have been unable to obtain those dimensions, the table supplies other information in regard to the examples mentioned in it, and will at least serve as a model for a more complete list of the kind. In addition to it we will here briefly enumerate some of the examples arranged according to the proportions of the spires, or their heights as measured by the diameters of their bases: *Six* diameters in height, or more than five, old St. Paul's; St. Stephen's, Vienna; Norwich; *Five*, or more than four, Salisbury, Bloxham, Marburg ($4\frac{1}{2}$); *Four*, St. Mary's, Oxford (nearly), Glasgow (do.), Ulm (do.), Bayeux (rather more), St. Stephen's, Caen; Freyburg (rather less); St. Peter's, Caen; *Three*, or more than two, St. Mary's, Stamford; Welford; Strassburg; Batalha: *Two*, Oxford cathedral; small western spires, St. Stephen's, Vienna: *One*, Worms, Gelnhausen.

*Table of Spires, English and Foreign.*

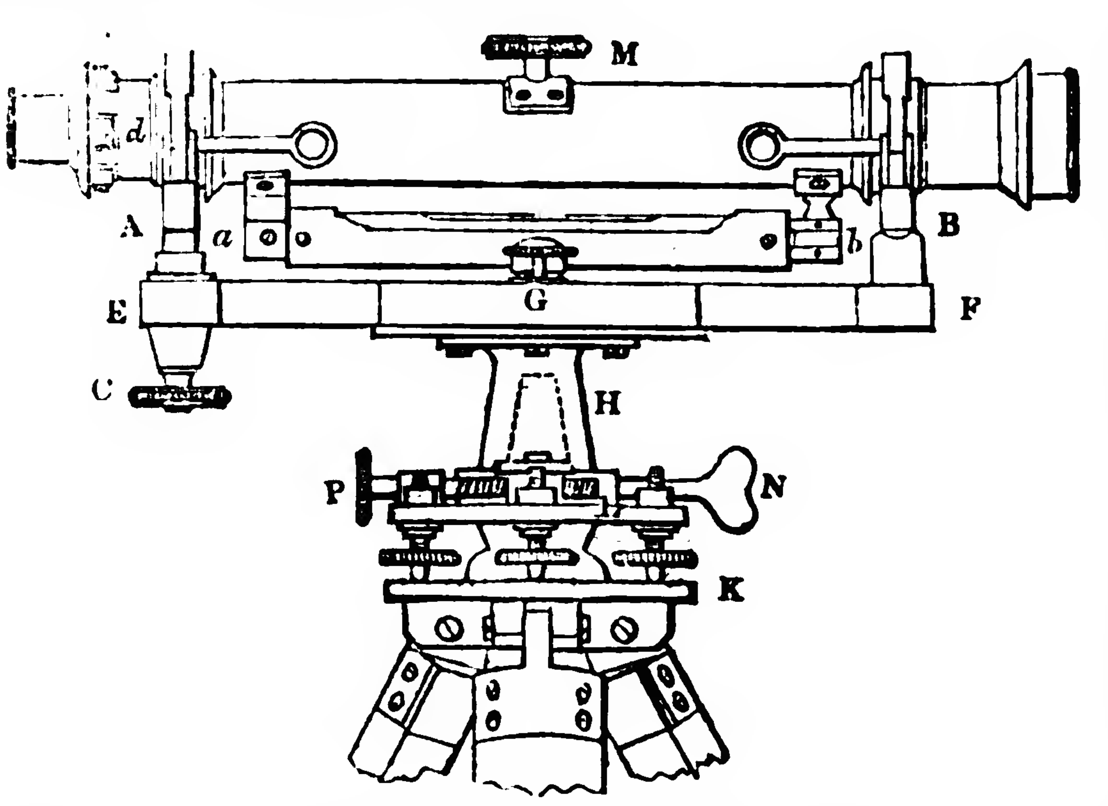
| | Tower. | Spire. | Total Height. | Remarks. |
|---|---|---|---|---|
| Old St. Paul's . . *feet* | 260 | 274 | 534 | Six diameters high. |
| Salisbury . . . . . .. | 207 | 197 | 404 | Date about 1350. Three enriched bands. Nearly five diameters. |
| Norwich . . . . . .. | 140 | 163 | 303 | Plain, rather more than five diameters high. |
| Lichfield . . . . . .. | 114 | 138 | 252 | Lucarned, 5 tiers of windows. Nearly 5 diameters high. |
| Do., two western . . .. | 89 | 103 | 192 | Lucarned, 4 tiers; $4\frac{1}{2}$ diameters high. |
| Chichester . . . . .. | .. | .. | 270 | Pinnacled and lucarned below; banded with one broad rich band; else quite plain. |
| Oxford Cathedral . .. | 94 | 52 | 146 | Date about 1220. |
| Oxford, St. Mary's . .. | 86 | 94 | 180 | Spire itself quite plain, lucarned with a canopied window below, on four sides. Embased by very rich canopied niches and pinnacles. |
| Lowth . . . . . . .. | 148 | 140 | 288 | Embased with lofty pinnacles and flying buttresses. Crocketted. 6 diameters. |
| Grantham (about) . .. | 140 | .. | 250 | Lucarned, crocketted, large crocketted pinnacles at base. Base of spire less than tower. |
| Newark . . . . . .. | .. | .. | .. | Short spire, spreading out at its base. Lucarned, with 4 tiers of windows. |
| Bloxham . . . . . .. | 101 | 94 | 195 | A very beautiful example. Spire 5 diameters high. Date about 1350 |
| St. Michael's, Coventry .. | 136 | 164 | 300 | This tower and spire a very fine example. |
| St. Mary's, Stamford .. | .. | .. | .. | Date about 1260. Base without parapet or pinnacles. Lucarned, 4 tiers. Spire $2\frac{1}{2}$ diameters. |
| Welford, Gloucester . .. | .. | .. | .. | An example of a spire on a low circular tower. Lucarned at its base with lofty gabled windows. Spire 3 diameters. |
| St. Chad's, Birmingham | 88 | 62 | 150 | Two west towers, only N.W. spire yet erected. (*Comp. to Almanac*, 1842.) |
| Cologne (as designed) .. | 330 | 200 | 530 | Two west spires enriched with tracery, and crowned by large finials. |
| Strassburg . . . . .. | 364 | 110 | 474 | Two west towers, only N.W. spire. |
| St. Stephen's, Vienna .. | 285 | 180 | 465 | On south side of church. Example of a tabernacle tower and spire. |
| Ulm (as designed) . .. | 320 | 171 | 491 | Tabernacle example. Tower and spire in centre of west front. |
| Freyburg . . . . . .. | 221 | 159 | 380 | Rich open-work spire. Tower and spire in centre of west front. |
| Marburg . . . . . .. | 184 | 88 | 272 | Two west towers and spires. Base of spire gabled. Spire $4\frac{1}{2}$ diameters. |
| Nürnberg, St. Laurence | 180 | 90 | 270 | Do. do. do. |
| Nürnberg, St. Sebaldus | 170 | 90 | 260 | Do. do. do. |
| Thann in Alsace . .. | .. | .. | .. | A tabernacle example, with rich tracery-work on spire. Spire about one-fourth of entire height. |
| Antwerp . . . . . .. | .. | .. | 366 | Two west towers, only N.W. spire. |
| Chartres . . . . . .. | .. | .. | .. | Two west spires, the N.W. one loftier and more enriched than the other. |
| Bayeux . . . . . .. | 142 | 104 | 246 | Two west spires. The north-west spire has 6 broad bands; the other plain. Diameter at base 27 feet. |
| Caen, St. Stephen's . .. | 155 | 107 | 262 | Lucarned at base and banded. |
| Caen, St. Peter's . . .. | 134 | 110 | 244 | Base of spire 24 feet. Spire has 9 bands, with small hexafoil, quatrefoil, and trefoil apertures between them. Crocketted. |
| Batalha . . . . . .. | 113 | 57 | 170 | Very rich open-work spire. Diameter at base 19 feet. |
| Burgos Cathedral . .. | .. | .. | .. | Two short or stump but very rich open-work spires, at west end. Date of spires 1442. |
| Glasgow . . . . . .. | 115 | 105 | 220 | Lucarned, banded, lower band richly moulded and quatrefoiled, and surmounted by fleurons. Diameter at base 27 feet. |
| Treis on the Moselle . .. | 111 | 128 | 239 | A new church, finished 1831. Lassaulx, architect. Spire, a *broach*, splayed off at base. Diameter, above splay, 16 feet; height about 8 diameters. |
| St. Marie Hilf, Münich .. | 220 | 60 | 280 | Church erected by Ohlmuller; completed 1839. Spire an open-work *helm* or broach. |

SPIRES. [SPEYER.]

SPIRIT, in Chemistry. This word, especially when employed by itself, is now almost exclusively applied to spirit of wine, or alcohol; formerly however the word spirit was given to most substances capable of being vaporized and condensed by distillation, and to some not obtained by distillation. It will be requisite merely to name a few of those compounds to show how extensively it was used and misapplied to substances of very different origin and composition: thus nitric acid was called spirit of nitre; hydrochloric acid, spirit of salt; sulphuric acid, spirit of sulphur; chloride of tin, spirit of Libavius; solution of ammonia, spirit of sal-ammoniac, and so forth.

SPIRIT-LEVEL, a tube of glass nearly filled with spirit of wine or distilled water, and hermetically sealed at both ends, so that when held with its axis in a horizontal position, the air which occupies the part not filled with the spirit or water places itself contiguously to the upper surface. The tube being supposed to be perfectly cylindrical, the exact horizontality of its axis is ascertained by the extremities of the air-bubble being at equal distances from the middle point in the length of the glass.

The spirit-tube is used in determining the relative heights of ground at two or more stations, and in order to render it available for this purpose, it is placed within a brass case having a long opening on the side which is to be uppermost, and is attached to a telescope; the telescope and tube are then fitted to a frame, or cradle, of brass, which is supported on three legs. In the interior of the telescope, at the common focus of the object-glass and eye-glasses, are fixed, generally, two wires, at right angles to each other, their intersection being in the line of collimation, or that which joins the centres of all the lenses.




The case containing the spirit-tube is made to turn on a joint at one extremity, as *a*, by the revolutions of a screw, *b*, at the opposite extremity; and the telescope rests, near each end, within two arms at the top of a small pillar, A or B, the pillar and its arms resembling the letter Y, and the interior sides of the arms being tangents to the tube of the telescope. One of these pillars is made capable of a small movement in a vertical direction by turning a screw, C, at its base, for the purpose of elevating or depressing one end of the telescope and spirit-tube; and in the more perfectly constructed instruments, both the pillars may be so moved. The pillars are at the extremities of a strong brass plate, EF, the under side of which is connected with the tripod-stand, which supports the whole instrument; and a compass-box, G, is attached immediately to the plate, as in the cut, or is raised above the telescope by means of four small pillars. A hollow conical socket, H, of brass is screwed to the under side of the plate, and is intended to receive a piece of bell-metal of a corresponding form, which constitutes the upper part of the stand. This piece serves as a vertical axis, upon which the telescope, the spirit-level, and the compass are to turn round horizontally: sometimes however the conical pivot projects from the under part of the plate, EF, and the socket is on the stand.

The three legs which are to support the instrument are firmly fixed to a circular plate, K, perforated at its centre, and having about the perforation a hollow spherical zone, resembling a small inverted cup. In the simpler kinds of spirit-levels a circular plate, L, of the same dimensions as the last, carries above it the pivot before mentioned; and from below it projects a stem, terminating in a ball, which fits the inverted cup or socket. By means of four screws which pass through one of these two plates (the upper plate in the cut), nearly at the extremities of two diameters at right angles to one another, the upper plate is made parallel to the horizon, and consequently the conical pivot which it carries is brought to a vertical position.

The above is a general description, which will serve nearly for every spirit-level at present in use, whatever be its form; and the following is the usual manner of performing the adjustments, preparatory to the instrument being employed on the ground:—

The telescope should, by a proper opening of the legs of the stand, be at first rendered as nearly level as can be estimated by the eye; then, being turned so as to lie vertically above the line joining two opposite screws in what are called the parallel plates (K and L), the spirit-tube is brought to a horizontal position by relaxing the screw nearest to its higher end, and tightening that which is opposite to it: the like operation is to be performed with the other pair of screws, after placing the telescope vertically above them. In order to render the spirit-tube parallel to the axis of the telescope, after the bubble of air has been made to occupy the middle place by the process just mentioned, let the telescope be reversed in the arms (the Ys, as they are called); then, if the bubble does not still occupy the middle, it must be made to do so by successive trials, endeavouring to correct half the error by means of the screw *b*, and the other half by the screw G.

The eye-piece of the telescope must be moved inwards or outwards till the wires in the field of view are distinctly seen; and the object-glass must also be moved by means of the pinion, M, till the station-staff, placed at any convenient distance (suppose 100 yards), is also distinctly seen. By a few trials, the distance between the eye and the object-glass may be made such that the intersection of the wires will appear to remain constantly at one point on the staff while the observer in looking through the telescope varies the position of his eye. It is necessary besides that the intersection of the wires should be precisely in the line of collimation, or the optical axis of the telescope: for this purpose the point of intersection should be directed to some well-defined mark at a considerable distance. The telescope must then be turned on its axis; and if the intersection remains constantly on the mark, that adjustment is complete; otherwise it must be rendered so by means of the screws, *c*, *d*, &c., on the telescope; those screws being placed at the extremities of two diameters at right angles to one another, on being turned they move the plate carrying the wires in the directions of those diameters. In order that the correction may be made, the apparent displacement of one of the wires, in consequence of the telescope being turned half round on its axis, should be observed, and the screws turned till half the displacement is corrected; the like observation and correction may then be made for the other wire: a few repetitions of each adjustment will probably be necessary before the error is wholly removed.

The level constructed by the late Mr. Troughton differs from that which has been above described in having the spirit-tube sunk partly in the telescope; and the latter, being incapable of a movement about its axis, does not admit of a separate adjustment for the intersection of the wires.

Mr. Gravat, who has within a few years made considerable improvements in the mechanism of these instruments, recommends the following method by which the error in the positions of the cross-wires and spirit-tube may be ascertained and corrected:—

Let three pickets be driven into the ground in a line and at equal distances from one another, and let the spirit-level be set up successively in the middle between the first and second, and between the second and third pickets; then, having by the screws of the instrument adjusted the spirit-tube so that the bubble of air may retain the same place while the telescope is turned round on the vertical axis, direct the object-end of the telescope successively to the station-staves held up on the different pickets, read the several heights, and take the differences between those on the first and second, and on the second and third staff. Now the staves being at equal distances from the instrument, it is obvious that any error which may have existed in the line of collimation, or from the spirit-tube not being parallel to that line, will be destroyed, and the differences between the readings on the staves are the differences in the levels of the heads of the pickets; but unless the adjustments are perfect, this will not be the case if the instrument be set up at any point which is unequally distant from all the pickets; therefore from such point direct the telescope to the staves, and take the differences of the readings as before. On comparing these differences with the former, a want of agreement will prove that the intersection of the wires is not in the optical axis; and the error may be corrected by means of the screws belonging to the wire plate. After the agreement has been obtained, should the bubble of air not stand in the middle of the tube, it may be brought to that position by the screw *b*, at one extremity of the case, and the instrument is then completely adjusted. (Simms, *Treatise on Mathematical Instruments.*)

The spirit-level is usually provided with a clamp, N, and a screw, P, by which, when the axis of the telescope has by hand been brought near the object, the coincidence may be accurately made by a slow and steady motion about the vertical axis.

The spirit-tube or level which is employed for the adjustment of transit telescopes or astronomical circles is contained in a case with feet or with loops at its extremities, in order that it may either rest above or be suspended below the horizontal axis of the instrument to be levelled; also the upper part of the case is furnished with a graduated scale, the divisions of which are numbered on each side of a zero point, this point being usually placed near each of the two extremities of the air-bubble when the tube is in a horizontal position. Having set up or suspended the spirit-tube, the two particular graduations at which the extremities of the air-bubble rest are marked; and half the sum, or half the difference of these numbers, according as the extremities of the bubble are in the same or in opposite directions from the two zero-points, being taken, gives the distance of the centre of the bubble from the middle between those points. The level being then reversed, the graduations at which the air-bubble rests are again marked, and half the sum or half the difference is taken as before. A mean of the two distances thus found is the true distance of the centre of the bubble from the middle point on the scale; and the screw which elevates or depresses one end of the axis of the telescope being then turned, till either extremity of the bubble has moved, in a direction contrary to that in which the centre of the bubble had moved from the middle of the scale, through a number of divisions equal to that mean distance, that axis will be brought to a horizontal position. This method is used in preference to that of successive trials, in order to avoid the trouble of making several reversions of the whole instrument.

The levelling-staff till lately in general use for finding the relative heights of ground is a rod consisting of two parts, each six feet long, which, by being made to slide on one another, will indicate differences of level nearly as great as twelve feet. The face of the rod is divided into feet, inches, and tenths, or into feet with centesimal subdivisions; and a vane, or cross-piece of wood, perforated through the middle, is moved up or down upon the rod by an assistant till a chamfered edge at the perforation is seen by the observer at the spirit-level to coincide with the horizontal wire in the telescope. The height from the ground to the chamfered edge of the vane must be read by the assistant; and it being out of the power of the observer to detect any mistake in the reading, it becomes very desirable that the graduations on the rod should be sufficiently distinct to allow the heights to be read at the spirit-level itself. The rod proposed by Mr. Gravat for this purpose is divided into hundredths of a foot by stripes which are alternately black and white, and are numbered at every foot in the usual way with figures great enough to be seen on looking through the telescope; the tenths of a foot are indicated by lines longer than the others. A similar staff has been proposed by Mr. Sopwith and Mr. W. P. Barlow; and the former gentleman, besides the number of every foot, has given a number to every first, third, fifth, and ninth decimal. Mr. Barlow's rod is also divided into centesimals of a foot; but the marks, instead of being stripes whose edges are parallel to one another, have the form of triangles: each tenth mark however is in the form of a lozenge, or double triangle, for the sake of greater distinctness.

SPIRIT-TRADE. [WINE AND SPIRIT TRADE.]

SPIRIT of WINE. [ALCOHOL.]

SPIROGLYPHUS, a genus framed for a species of *Serpula* of authors, which makes a groove for itself upon and in the surface of shells. [TUBICOLIDÆ.]

SPIROLI'NA. [FORAMINIFERA.]

SPIROLOCULI'NA. [FORAMINIFERA.]

SPIRO'RBIS, Lamarck's name for a genus of *Serpula* of authors; the white little shell is coiled round into a spiral disc-like form. Common on the shell of lobsters. [TUBICOLIDÆ.]

SPI'RULA. [SPIRULIDÆ.]

SPIRU'LIDÆ, Professor Owen's name for a family of polythalamous, decapodous, dibranchiate CEPHALOPODA, thus characterized by him:—

*Animal* corresponding in external form to the Decapodous type; internal organization unknown, presumed to be Dibranchiate. *Shell* partly internal; cylindrical, multilocular, discoïd; the whorls separated; septa transverse, concave next the outlet, and with regular intervals. *Siphon* marginal and internal, uninterrupted.

Genus SPIRULA, Lam.

The character of the family is also that of the single genus of which it is at present composed.

Example, *Spirula Australis*, Lam.

M. de Blainville, who, in the first volume of the *Nouvelles Annales du Museum* (1835), had given a detailed account of the anatomy of the shells of *Nautilus Pompilius* and *Spirula*, with coloured figures, has since published in the *Annales Françaises et Etrangères d'Anatomie et de Physiologie appliquées à la Médicine et à l'Histoire Naturelle*, his observations *Sur l'Animal de la Spirule, et sur l'usage du Siphon des Coquilles polythalames*. His account is founded on dead specimens, more or less complete, 'the remains, doubtless, of the voracity of fishes,' which he owed to the perseverance of MM. Leclancher and Robert, who collected them as they floated dead on the surface of the Atlantic, near the western coast of Africa.

In the last-named memoir, M. de Blainville refers to the former one as having placed beyond doubt, as it seems to him, the very complex composition of the siphon of the shell, 'que,' says he, 'j'ai montré être formé d'une suite de petits entonnoirs s'emboitant plus ou moins les uns dans les autres, de manière quelquefois à former *un tout solide*, mais aussi quelquefois ne se touchant pas, et alors les intervalles étant remplis par une partie membraneuse encroutée d'une couche calcaire, de telle sorte que, même dans ce dernier cas, la partie charnue provenant de l'animal ne peut jamais être à nu dans les loges qu'elle traverse.' He adds, that he had concluded from this anatomical disposition that this peculiarity of appearance in the siphon was nothing else than a mode of attachment of the animal to its shell, a sort of muscular insertion by a tubular prolongation, not continuing itself probably throughout the length of the siphon of the shell. 'Voyons,' he continues, 'si mes conjectures étaient fondées en étudiant aujourdhui ce que je possède de l'animal dont elle fait partie, c'est-à-dire, je le répète, le tronc dont la tête et les bras ont été arrachés.'

M. de Blainville describes the animal of the *Spirula*, limited by the mantle, as in the form of a long case, very regularly symmetrical, of an oval shape, slightly compressed at the sides, narrower and more circular forwards, and more elevated and more compressed backwards. The anterior extremity presents a sufficiently regularly trilobated aperture, there being one median lobe a little longer above, and two lower lateral lobes a little more pointed and separated by a median fissure below. This orifice is constituted by the borders of the mantle or of the sac of the Sepiaceans, the collar of the *Siphonobranchians* forming here a considerable case, in which the head and its appendages can enter and be completely sheltered, a little like the slugs (limaces) under their buckler. The trilobated form of this aperture recals, observes M. de Blainville, sufficiently well that which is at present known respecting that of many ammonites. The posterior extremity of the sac or mantle convex (renflée) and widened vertically (a disposition which is principally due to the shell solidly and vertically encased in the skin) presents, entirely, behind a sort of oblique flatness (aplatissement), at the middle of which is a terminal button, accompanied on the right and left by a small semicircular fin, attached by the right border, and very like that which exists in *Sepiola*. This mantle or case, in its anterior moiety at least, has, besides, an anatomical structure, which brings to remembrance what exists in the Calamaries, that is to say, it is formed of a contractile very thick lamina or derm constituting the principal part, offering on its surface a great number of lacunæ, forming a net; of a nacreous layer on which is the part coloured by small spots, violaceous, doubtless, during life, as in the *Sepiolæ*; and, lastly, of a sort of epidermic varnish or glazing, only the contractile part is perhaps still more solid, and capable of more resistance than it is in the calamaries. But in lieu of being sustained in the back by a cartilaginous or calcareous nearly straight lamina, it contains a shell, whose very much elongated and very regular spiral cone presenting its base open in front, is rolled up vertically backwards behind and below, in coils which are concentric, but disjoined, or not contiguous. This shell is no more really external in any of its points than the cartilage of the calamaries, or the bone of the cuttles. Only fastened on the back and belly in the circumference of a small elongated oval space by the dermomuscular layer, and, as it were, set in it, it forms a sort of hernia, and is not covered in those two places, except by the superficial parts of the skin, the nacreous and coloured layers. With regard to the rest of the spire, it is contained in a subdermic space, occupying the posterior part of the visceral mass, which is perfectly independent of it, being separated from it by a subcutaneous membrane, which is very delicate, but as distinct as in the sepiaceans. This space or lacuna is, nevertheless, traversed by a bridle equally dermic, which passes from one wall to the other, across the disjunction of the whorls.

Before he examines the relations of the shell with the membranous siphon proceeding from the animal, M. de Blainville turns his attention to the mode in which the visceral mass is disposed. Sufficiently considerable, especially at the period when the generative apparatus is in a state of turgescence, it occupies the whole bottom of the cavity of the mantle, prolonging itself more or less on each side of the subdermic envelope, which includes the shell, behind the excretory funnel, situated under the neck, as in the other sepiaceans, and between the two branchiæ, situated one on the right, and the other on the left, in the cavity of the mantle. This visceral mass, which is more or less rounded and convex in front, and, in general, bifurcated behind, is entirely enveloped in a very distinct but delicate and transparent peritoneum, prolonging itself with the organs of generation, or in the bifurcation of the case, resulting from the position of the shell. On dividing the mantle in the median line, as the figure which M. de Blainville will publish in his *Malacozaires* indicates, there appear—

1st. In front the very considerable funnel entirely closed, and advancing probably also under the cephalobrachial mass, to judge of it at least from the eye, left nearly in situ.

2nd. The branchiæ, long, narrow, triangular, directed on each side with the point forwards, free, and only retained by a very loose membranous bridle, except at their base, where the vascular peduncle is found.

3rd. Towards the middle of the lower surface of the visceral mass, the intestinal canal terminating in a small, free, floating appendage, widely open, absolutely as in the cuttles, and accompanied throughout its extent between the two masses of the generative apparatus, by the canal of the ink-bag, containing black matter, which M. de Blainville pressed out by a small orifice situated at the left of the anus.

4th. The principal part of the female organs of generation, viz. on one side (the right) a considerable ovary, and on the other, doubtless, an organ of digestion, forming both together the whole lower surface of the mass, and prolonging itself more or less backwards on each side of the envelope of the shell. The mass of eggs came forth a little below the fasciculi of the muscular attachment of the cephalic mass to the shell. They were few and very large, being a millemetre in length by three quarters of a millemetre in width. Their envelope was hard and friable; it contained an amber-coloured matter, nearly solid, and which was, M. de Blainville thinks, without doubt the vitellus; but he could not perceive any trace of a fœtus, in consequence of the early stage of development in which they were.

M. de Blainville reminds the reader that he has already adverted to the fact, that in all the individuals which he had observed, the cephalic mass and its appendages had been torn away at their point of junction with the body; but on one, the least mutilated, the end of the muscular sheath which traverses the œsophagus was preserved. Its anterior extremity, which goes to the head and its appendages, was truncated at the point of abstraction; but the posterior extremity was in tolerably good preservation; one might see that, narrowing as it proceeded, it attached itself to a fleshy lamina, which completed the bottom of the first chamber of the shell, forming a sort of hood or cap continued by means of its circumference with the envelope of the shell, and giving origin, at the bottom and towards the inferior border, to a tubiform prolongation penetrating into and attaching itself to the siphon of the first chamber, and then continuing itself without any adhesion, as M. de Blainville supposes, up to its origin towards the summit of the shell; from which he was able in fact to withdraw it without breaking it for a considerable length; so that it may be said that this is in a prolongation of the columellar or retractor muscle of the head and its appendages, and that the membranous siphon itself is only a part of this muscle.

The mantle, the envelope of the shell, and the mass of the viscera, afforded the following analysis:—

The shell, entirely free in the dermoid envelope which contains it, has not its terminal excavation augmented in depth by a rather considerable membranous border, as M. de Blainville had supposed in his anatomy of the shell; it is only lined by the membranous hood already described, at the circumference of which terminates anteriorly the fascia of the columellar muscle, and, behind, the subdermic membrane which forms the chamber of the shell. Placed in the back of the animal, this first chamber contains no viscus either in whole or in part; and very certainly the membranous siphon has no connexion except with the fleshy hood, and none whatever with the peritoneal cavity, at the anterior and lower part of which M. de Blainville states that he could easily recognise the heart receiving the branchial vessels, which are very long on account of the advanced position of the branchiæ.

M. de Blainville then observes that the very exact description, as he hopes, thus given of the principal parts of the body of the *Spirula*, and especially of that which forms the entire envelope containing the shell, will not permit him to admit here the theory proposed by Dr. Buckland, in his 'Bridgewater Treatise;' but if it be not applicable to the *Spirula*, continues M. de Blainville, may it not be applicable to the Nautilus, whose organization in fact offers considerable differences, not only in the cephalic appendages, but also in the respiratory funnel divided throughout its length like the branchial tube of the *Siphobranchiata*, and especially in the shell, which is completely external, and in the first chamber of which the animal is lodged, and can retire therein completely? This, says M. de Blainville, is what I cannot decide. At all events, it is sufficiently difficult to conceive that if the tubuliform prolongation which is lodged in the siphon of the shell of the *Spirula* is not hollow, it should be so in the *Nautilus*, and that if the pericardium or the peritoneum does not communicate with this pretended canal in the *Spirula*, it does communicate with it in the Nautilus; and this so much the more, inasmuch as it is at least an unusual thing that this species of *diverticulum* of the pericardium should thus continue in all the whorls to the summit: 'aussi,' continues M. de Blainville, 'attendrons nous avec quelque impatience que M. R. Owen ait pu éclaircir nos doutes au sujet du Nautile; jusque là nous pouvons au moins dire que la théorie de M. Buckland n'est pas applicable à la Spirule. Aussi en proposerons-nous une beaucoup plus simple et plus en harmonie avec ce que nous pouvons voir tous les jours chez les planorbes et les lymnées de nos marais.'

Whether Professor Owen will set to work to clear up these doubts we know not; but we venture to think that, if he does, he will be wasting time that might be much better employed. If M. de Blainville was unwilling to give credit to the Professor's positive affirmation that the hollow membranous tube traverses the siphon of *Nautilus*, and to the Professor's figure exhibiting it, he might have satisfied himself of its existence by examining the dried remains of it in any old recent Nautilus shells, which we never understood to be rare at Paris. The hollow tube is equally demonstrated by the condition of the fossil *Nautili*.

In the museum of the Royal College of Surgeons in London there is a preparation (No. 900 B, *Physiological Series*), made by Professor Owen, and described by him in the second volume of the admirable Catalogue published in 1834. This preparation exhibits the circulation and respiratory organs of the Pearly Nautilus (Nautilus Pompilius); and the description is given in this work. [NAUTILUS, vol. xvi., p. 112.] We have minutely examined the preparation, and can vouch for the accuracy of the description: no one at all versed in the subject can see the former without being satisfied that the prolongation of the mantle and membranous tube to form the siphon is tubular, and not solid. It goes through the pericardium, and consequently communicates by means of the valvular *foramina* at the base of the gills with the branchial chamber.*

Now supposing that M. de Blainville is correct in describing the siphon of *Spirula* to be solid, and upon that fact his argument against Dr. Buckland's theory mainly rests, we cannot allow the inference, which, from observation of a structure for the attachment of the shell to the body in the dibranchiate *Spirula*, with an internal small shell, concludes that the same structure ought therefore to exist in the tetrabranchiate Nautilus, with its great external shell, to be very sound. Nor is this the kind of argument for which we should have looked in the writings of so eminent a zoologist and comparative anatomist as M. de Blainville.

The following is the theory of M. de Blainville as far as regards *Spirula*:—

Admitting as beyond doubt that the chambers of the shell of *Spirula* are empty, or at most filled with an aëriform fluid, which appears to be proved *à priori*, because in fact one cannot conceive how the water could come there, the chambers being closed on all sides, and *à posteriori* because they are so, even when separated from the animal, which makes these shells constantly float on the surface of the sea, and equally or as well when they form a part of the whole, as M. de Blainville had satisfied himself by experiment on all the individuals brought home by MM. Leclancher and Robert; it seems to M. de Blainville that the re-entry and the contraction of the whole brachiocephalic mass into the case formed by the mantle, as well as the application of the fins against its walls, will be sufficient, by notably diminishing the volume of the animal without at all changing its mass, to counterbalance or even overcome the specific lightness of the air contained in the chambers of the shell, which will again gain the ascendency, when the volume of the animal shall return to its first disposition by the protrusion and expansion of its head and arms. It is certainly thus that the *Limnææ* and *Planorbes* [LIMNEANS], act in order to descend to the bottom of the water, for to rise again to its surface they must resort to creeping along solid immersed bodies. With regard to the *Spirulæ*, the kind of natatory bladder formed by the aëriferous chambers of their shell can without doubt elevate them to the surface without effort on their part, according to M. de Blainville, and he is even inclined to think that the size of the chambers is, so to speak, measured by the animal instinctively, so that the extent of the vacant space should always be in proportion to the mass of the animal, and floating must be the result, that is to say, there must be a specific gravity less than that of the ambient medium.

'Cette manière de voir, cette explication du fait, pour le dire en passant, ne démontrerait-elle pas mieux la sagesse du grand géomètre,' asks M. de Blainville, 'que tout ce que l'on a dit à ce sujet?'

To this question, we humbly answer, no. Supposing M. de Blainville's theory to be impregnable, the mechanism by which the Nautilus is *proved*—we write it advisedly—to ascend and descend, is no worse demonstration of the adaptation of means to an end, to say the least of it, than the mode proposed by M. de Blainville.

In fact, continues M. de Blainville, to enable the animal during its growth, that is to say, increasing in mass and volume, to preserve the faculty of floating at the surface in a fluid the density of which varies but little, and that by a hydrostatic disposition, without any effort on its own part, there would *really* be required a very singular combination, consisting in this—that the animal could create for itself a new bubble of air, and that in a determined proportion. This it seems to effect by advancing its muscle of attachment by a single effort (d'un seul coup) on a quantity of air measured, so to speak, and afterwards limiting this space by an impermeable septum (cloison).

On this supposition, says M. de Blainville, in conclusion, the normal disposition of *Spirula* would be to float constantly on the surface of the sea, like the *Janthinæ* [JANTHINA] and *Physsophoræ* [PHYSOGRADA, vol. xviii., p. 137], and equally by the means of an aëriferous float of calculated proportion. In this position it would execute the greatest parts of its functions and its acts; but in order to withdraw itself from danger, it would have the faculty of changing the relation or proportion of the volume to the mass, and of diving more or less; but perhaps without ever reaching the bottom.

*Geographical Distribution.*—Widely disseminated in the seas of warm climates. [SPONDYLIDÆ.]

* In the early part of the memoir, M. de Blainville says of Dr. Buckland's theory:—'Pour accepter cette nouvelle hypothèse, il faut admettre les points suivants, que M. Buckland considère, à ce qu'il paroît, comme prouvés: 1. La communication du péricarde avec le siphon. 2. L'existence du siphon membraneux creux et à découvert, dans les loges ou dans les intervalles des cloisons. 3. L'existence constante d'un liquide dans le péricarde. 4 La pesanteur spécifique de ce liquide, plus grande que celle de l'eau de mer. 5. La vacuité complete, si ce n'est d'air, des loges ou chambres de la coquille. Or, de ces différentes theses, il n'y a peut-être'—that *peut-être*, like our *if*, is a great peace-maker—'que la dernière qui soit complètement hors de doute.' We do not think that we shall be deemed presumptuous, if we add numbers 1 and 2; and we could say something of the others, but let them pass for the present.

SPI'SULA, Mr. J. E. Gray's name for a genus of *Conchifers*, founded on *Mactra fragilis*, and similar species. Ligament subexternal, marginal, not separate from the cartilage. Posterior lateral teeth double and single.

SPITZBERGEN is a group of islands situated nearer to the arctic pole than any other country on the globe. It lies between 76° 30′ and 80° 30′ N. lat., and between 9° and 22° E. long., and is surrounded by the Arctic Polar Sea, of which that portion which lies west of Spitzbergen is distinguished by the name of the Greenland Sea, because it extends to the eastern coasts of Greenland.

The group consists of three larger and numerous smaller islands which lie about the larger islands. The largest island is on the west, and extends from 76° 30′ to 80° N. lat.; it is properly called Spitzbergen, and its most eastern part is called New Friesland. To the east of New Friesland lies North-east Land, which extends from 79° 10′ to 80° 10′ N. lat., and is divided from the larger island by the Henloopen or Waygatz Strait, which is about 70 miles long, and varies in breadth from 4 to 11 miles. East of the main body of Spitzbergen, and south of New Friesland, is Edges Island, which extends from 77° 15′ to 78° 15′ N. lat., is separated from New Friesland by a strait called Walter Tymens fiord, or Alderman Freeman's inlet. This strait is somewhat more than 50 miles long, and less than 10 wide. Along the southern coast of Edges Island numerous small islands cover the sea to a distance of 15 miles from the shores, and this group goes by the name of the Thousand Islands. A considerable number of smaller islands are also dispersed over the sea which surrounds North-east Land on the north and east, in Henloopen Strait, and round the north-western coast of Spitzbergen. In other places along the coast the smaller islands are not numerous, but at the distance of 12 or 15 miles from the western coast of Spitzbergen is Charles Island or Forland, which is about 40 miles long, but only a few miles wide.

Nothing is known of these islands except those parts which are contiguous to the sea, and even the coast is imperfectly laid down in our maps, with the exception of the western coast, which for more than two centuries has been annually visited by many whaling vessels, and thus has gradually become well known, and has been partially surveyed

The west coast of Spitzbergen is mountainous. The mountains generally rise within three miles of the sea, but in several places they commence at the coast. Between the shore and the mountains is a low level tract, rarely more than three miles wide. It is commonly somewhat above the level of high-water mark, but in some places it is below, and only prevented from being covered by the sea by a natural bank of shingle of the height of 10 or 15 feet. The mountains, which fill the interior of the island, rise, according to an estimate, in general to between 3000 and 4000 feet above the sea-level. Many branches of them run westward, and come close to the shore, where the abrupt termination of the mountain-ridges projects beyond the regular line of the coast, and overhangs the ocean. Where these mountain-ridges occur at no great distances from one another, the intervening valleys, being of moderate extent, are filled with glaciers, which in several places constitute the very shores of the sea, forming a high perpendicular wall of ice from 100 to 400 feet high. The inland valleys, in all seasons, present a smooth and continuous bed of snow, in some places divided by considerable rivulets, but in others exhibiting an unbroken surface for many miles in extent.

The southern extremity of Spitzbergen is called Point Look-out, or South Cape: a low flat, about 40 square miles in surface, constitutes the termination of the coast. On the isthmus, which joins this flat tract to the main body rises a mountain-chain, which runs north, and soon attains a considerable elevation, as a large glacier or iceberg lies here along the sea-shore. North of 77° N. lat. is a wide bay, called Horn Sound, near the southern shores of which lies Mount Horn, or Hedge-hog Mount, which has several summits, chiefly in the form of spires, the highest of which is 4395 feet. Horn Sound has tolerable anchorage. A little to the northward of Horn Sound is a glacier of immense extent, occupying 11 miles of the sea-coast. The highest part of the precipitous front adjoining the sea is 400 feet, and it extends backward towards the summit of the mountain to about four times that elevation. Bell Sound, another wide bay, occurs between 77° 35′ and 77° 40′ N. lat., and within it are several anchoring-places. North of 78° is Ice Sound, where good anchorage is found at Green Harbour. That portion of Spitzbergen which is south of 78° 50′ N. lat. consists of groups of isolated mountains, partly disposed in chains, having conical, pyramidical, or ridged summits, sometimes round-backed, frequently terminating in points, and occasionally in acute peaks not unlike spires.

To the north of 78° 50′ N. lat. are English Bay, King's Bay, and Cross Bay, in which there is good anchorage. Near the head of King's Bay there are three piles of rocks of a regular form, called the Three Crowns, which resemble the *teocallis* of the antient Mexicans. They rest on the top of a mountain, and each commences with a square table or horizontal stratum of rock, on the top of which is another of similar form and height, but of smaller area; this is continued by a third and fourth, and so on, each succeeding stratum being less than that immediately below it, until it forms a pyramid of steps, almost as regular as if it were worked by art. North of Cross Bay the mountains are more disposed in chains than farther south. The principal ridge lies nearly north and south, and the main valley extends from the head of Cross Bay to the northern coast, a distance of 40 or 50 miles. An inferior chain of hills, six or nine miles from the coast, runs parallel to the shore, and from this chain several lateral ridges project into the sea, where they terminate in mural precipices. Between those lateral ridges are the Seven Icebergs, each of which is, on an average, about a mile in length, and near 200 feet high near the sea. The higher mountains terminate near 79° 35′ N. lat., and the lower coast, which extends hence to the north, is indented by many small inlets, surrounded by numerous small islands of considerable height. In this part there are several very good harbours and anchorages, both in the inlets and between the islands, as Magdalena Bay, the excellent harbours of Smeeresberg, Fair Haven, Vogel Sang, the Norways, Love Bay, Heckla Cove, in the bay of Treurenburg, on Waygatz Strait, and others.

The centre of Charles Island, which lies opposite the western coast of Spitzbergen, is occupied by a mountain-chain about 30 miles in length, rising on the west side from the sea, and on the east from a narrow strip of level ground only a few feet above the sea-level. The central part of this chain is perhaps the highest land near the sea. It rises from the water's edge by a continual ascent, at an angle at first of about 30°, and increasing to 45° and more, until it terminates in five distinct summits, of which the highest is 4500 and the lowest 4000 feet above the sea-level.

Along the north shores of Spitzbergen and North-east Land the country is neither so elevated nor are the hills so sharp-pointed as on the west coast. Some of the smaller islands which occur along these shores, and considerable tracts of the mainland, are comparatively level. They also contain much more earth and clay, and the vegetation is rather more vigorous. Along the east coast of North-east Land there is a continuous line of glaciers extending to the shore. We have very little information respecting the eastern and southern coasts of Spitzbergen, as well as those of New Friesland and Edges Island.

Extending to within 10° of the pole, the climate of Spitzbergen is intensely cold. The mean temperature of the three warmest months on the western coast does not exceed 34·50°, and even at that season this part of the island is occasionally subject to a cold of three, four, and more degrees below the freezing-point. In the northern parts the longest day is four months; but from the 22nd of October to the 22nd of February the sun does not rise above the horizon. This long night however is not quite dark, for the sun, even during its greatest south declination, approaches within 13¼° of the horizon, and causes a faint twilight for about one-fourth part of every twenty-four hours. If we add to this the aurora borealis, which sometimes exhibits a brilliancy approaching to a blaze of fire, the stars, which shine with unusual brightness, and the moon, which in her north declination appears for 12 or 14 days together without setting, we may conceive that during the long night there is generally sufficient light to enable a person to go abroad. The winter sets in at the end of September, or beginning of October, with winds from the north, north-north-west, or north-west, or with calms, hard frost, and snow. In the middle of October the frost is sometimes very intense, and it increases rapidly in November. But throughout the whole winter, when strong south winds occur, they are generally accompanied with mild weather, and sometimes with thaw. Storms in this season are so frequent that two-thirds of the weather may be said to be boisterous. The highest winds occur about the time of the equinoxes, and blow most frequently from the south. A great quantity of snow falls every winter, but it accumulates principally in the sheltered glens, lying on the level ground seldom more than five feet deep. Captain Parry however found that the climate of the northern coast is remarkably temperate in summer for the latitude, and very agreeable, but only so near the land, that of the adjacent sea being of a totally different character, owing to the almost continual fogs. In May and June the sea was almost entirely covered with large fields or floes of ice, but in August it was hardly possible to discover a single piece of ice, so great was the change which had been produced by the continual presence of the sun.

The number of species of plants which have been found in Spitzbergen hardly exceeds forty, but vegetation is very rapid. Most of the plants spring up, flower, and produce seed in the course of a month or six weeks. They are of a dwarf size, and the only plant which partakes of the nature of a tree is a *Salix herbacea*, which grows to the height of three or four inches. The islands do not produce vegetables suitable or sufficient for the nourishment of a single human being.

As only a small part of Spitzbergen has been visited, we know very little of its mineral productions. In some parts of King's Bay a very beautiful marble and coal of good quality are abundant.

The quadrupeds are—polar foxes, polar bears, and reindeer. The adjacent sea abounds in many species of whales and some other large fish, and for more than two centuries a very advantageous fishery has been carried on. There are also many morses or walrusses, and abundance of seals. Sea-fowl are exceedingly numerous: some of the rocks along the western coast are literally covered with them.

Spitzbergen was discovered in 1596, by Barentz, Hemskerke, and Ryp, in their endeavour to effect a north-east passage to the Indies. It was named by them Spitzbergen (pointed mountains) from the numerous peaks observed on the coast. In 1607 it was visited by Henry Hudson, and four years afterwards the English began to resort to it for the whale fishery. Some sailors were left on these shores by accident on several occasions, and they passed the winter there: in some instances they died of the scurvy, but in other cases they survived and returned home. In 1743 four Russians were left there for six years, and thus the fact was ascertained that human beings could pass the winter in Spitzbergen without injury to their health. Since that time the Russians have frequently visited these islands. They proceed from Archangel, Mezen, Onega, and Kola, in vessels of 60 to 160 tons, some of which are intended for the summer fishing and others for the winter. The former put to sea in the beginning of June, and return in September; the latter sail about a month later, winter in some of the harbours, and return home in August or September of the following year. They also kill a great number of morses, polar bears, and foxes, and bring home many skins of these animals.

(Scoreby's *Account of the Arctic Regions*; and Parry's *Narrative of an Attempt to reach the North Pole in Boats*.)

SPIZAËTUS, M. Vieillot's name for a genus of FALCONIDÆ, placed by Mr. Swainson under the subfamily *Buteoninæ* or *Buzzards*.

*Generic Character.*—Form aquiline, with the bill of a buzzard. Bill strong, high, curved from the base, with a prominent festoon. Orbits and lores covered with down and hairs. Wings short. Tarsi moderate, feathered. Inner toe, without the claw, shorter than the outer. Rasorial. (Sw.)

Mr. G. R. Gray arranges the genus under the subfamily *Aquilinæ* or *Eagles*.

SPIZELLA, the name given by the Prince of Canino to a genus of *Fringillinæ* or *Finches*.

SPLACHNUM, the name of a genus of cryptogamic plants belonging to the natural family of Mosses. The word is adopted from Dioscorides, who used both σπλάχνον and βρύον to designate the families of lichens and mosses. It is known by its terminal fruit-stalk; single peristome with 8 double teeth; capsule with an evident apophysis, and mitriform, glabrous, furrowless calyptra. They are generally annual plants, and remarkable amongst their tribe for their size and beauty as well as singularity. Seven of the species are British. The most common in England is the *Splachnum ampullaceum*, purple gland-moss, which is found growing chiefly on rotten cow-dung. The receptacles are obtuse, inversely conical, of a greenish-purple colour, and three times as thick as the capsule.

*S. sphæricum*, green globular gland-moss, has a green globular receptacle, with ovato-lanceolate, pointed, entire leaves, and a capillary fruit-stalk. It is a native of alpine situations in the north of Europe and Scotland, and is generally found on cow-dung. It occurs in green tufts, and has elegant slender wavy tawny fruit-stalks from one and a half to three or four inches high.

*S. rubrum*, red umbrella gland-moss, has an orbicular convex red receptacle, with partially toothed leaves. The fruit-stalks are six inches in length; the receptacle is very conspicuous, being half an inch wide, and having the form of an inverted cup, which is of a rich crimson colour and finely reticulated, making this moss one of the most remarkable and beautiful in the family. It is a native of Norway, Finland, Russia, and Siberia.

SPLEEN (Σπλήν, *Lien*, *Splen*). There are few parts of the human body on which more has been written than on the spleen, and none where the result has been more unsatisfactory. The purpose which it serves in the animal economy still remains entirely unknown; and the physiological part of this article must consist of a mere historical recapitulation of the various theories respecting its functions, which have successively been for a time adopted, and have then fallen into oblivion.

The spleen is an organ which is not found in any tribe below the class of fishes. Some animals have two, and this number has not unfrequently been found in man; for, as Haller says (*Elem. Physiol.*, t. vi., p. 388), everything connected with this organ is uncertain and variable. Its form is generally somewhat oval, being smooth and convex on the exterior, where it is in apposition with the diaphragm, and irregularly concave on the opposite side, which is unequally divided into two parts by a transverse slit for the transmission of its vessels. (Quain, *Elem. of Anat.*) It is for the most part placed in the left hypochondriac region, between the diaphragm and the stomach, and beneath the cartilages of the ribs. (Quain.) It varies so much in size, that it is almost impossible to say what are its normal proportions. (Bichat, *Anat. Descr.*) It is much enlarged by disease, as will be hereafter noticed; but in health, taking a general average, its greatest diameter may be said to measure about four inches, its breadth three, and its thickness from two to two and a half; its usual average weight is from eight to ten ounces. It is of a slight spongy consistence (ἀραιὸς καὶ σπογγοειδής, Hippocr. *De Morb. Mulier*, lib. i., tom. ii., p. 683, ed. Kühn), and is at all times easily torn; and in many cases it is found, soon after death, so soft as to be readily broken by a slight pressure, when it appears a grumous, dark, confused mass. Its colour is deeply red, with a tinge of blue, particularly round its margin. It has a peritonæal investment prolonged to it from the stomach, by which, as well as by vessels, it is connected with that organ; but it has also a smooth and fibrous tunic proper to itself, which is so firmly adherent to the serous investment above mentioned, that they cannot be separated except at its concave surface. (Quain.) No organ receives a greater number of blood-vessels in proportion to its size than the spleen; a fact noticed by all anatomists, and the more so because it secretes no fluid of any sort, at least none that has hitherto been discovered. (Bichat.) Almost all the blood that it receives is derived from the *splenic artery* (Haller, p. 400, 401): this is the largest branch of the cœliac axis, and near the spleen divides into several branches, some of which enter the fissure in that organ, and are distributed to its substance. These are called the *rami splenici;* they are five or six in number, and vary in length and size. (Quain.) They are the proper terminal branches of the artery, and by infinite ramifications form within the substance of the spleen a capillary system, which probably anastomoses in a direct manner with the capillaries of the veins (Bichat), as is proved by the facility with which injections pass from one to the other. The *splenic vein* is a vessel of very considerable size compared with the bulk of the organ; and it returns the blood not only from the spleen, but also from the pancreas, duodenum, the greater part of the stomach and omentum, the left colon, and part of the rectum. It commences by five or six branches, which issue separately from the fissure of the spleen, but soon join to form a single vessel. Its direction is then transverse from left to right, embedded in the substance of the pancreas, in company with the splenic artery, beneath which it is placed. On reaching the front of the spine it joins the *superior mesenteric vein* nearly at a right angle, from the conflux of which proceeds the *vena portæ*. (Quain.) The nerves of the spleen accompany the splenic artery, and are derived from the *solar plexus*, forming an interlacement called the *splenic plexus*, previous to their entrance into it. (Ibid.) They are small compared with the size of the organ; and accordingly the spleen has very little sensation, a fact which was noticed as early as the time of Aretæus. (See *De Caus. et Sign. Diuturn. Morb.*, lib. i., cap. 14, p. 111, ed. Kühn; Haller.) Its lymphatic vessels are very numerous; but as no appreciable product is elaborated by this apparatus, it has no excretory duct. (Quain.) The fibrous or proper coat of the spleen sends into its interior a multitude of cellular bands and fibres, which form by their intersections cells of various forms and sizes, and support the soft, pulpy, red tissue of the organ. In the red substance there are in many animals contained whitish round corpuscules, visible to the naked eye, which were first discovered by Malpighi, and of which the existence in the human spleen has been at one time admitted and at another denied. The corpuscules of the human spleen are described by Dupuytren and Assolant as greyish bodies, devoid of internal cavity, and measuring one-fifth of a line to one French line in diameter, and so soft as to take a liquid form when raised on the knife. Meckel describes them as roundish whitish bodies, one-sixth of a line to one line in diameter, most probably hollow, and at all events very soft and very vascular. In the human spleen the Malpighian corpuscules are distinguished with great difficulty. Müller mentions (*Elem. of Physiol.*, by Baly, vol. i., p. 618) having seen them in a spleen which had been macerated. They were very firm, and much smaller than the greyish soft points sometimes seen in cut surfaces of the spleen, which have been described under the name of *Malpighian corpuscules*, but which are in reality very different from them.

*Physiology.*—Of the functions of the spleen, as was before remarked, we still remain in perfect ignorance. The most antient opinion concerning its use in the animal economy is that which is found in the writings attributed to Hippocrates, and is connected with the famous doctrine of the four humours. 'The heart,' says the author of the fourth book *De Morb.* (tom. ii., p. 325, ed. Kühn), 'is the source of the blood (αἷμα), the head of the phlegm or pituita (φλέγμα), the spleen of the water (ὕδωρ), and the liver of the bile (χολή)'. This *water* was attracted by the spleen from the fluids received into the stomach (*ibid.*, p. 333; *De Morb. Mul.*, lib. i., tom. ii., p. 683), and thus the whole of this theory bore a striking resemblance to one of those that have been proposed in quite modern times. In another part of the Hippocratic collection (*De Loc. in Hom.*, tom. ii., p. 130), it is said that 'those persons whose spleen is large have their body meagre' (Conf. Gal., *De Natur. Facult.*, lib. ii., cap. 9, tom. ii., pp. 132, 133), an idea which is found also in Plato (*Timæus*, cap. 47, ed. Stallb.), and which gave rise to the well-known comparison of Trajan, who said that the imperial treasury was like the spleen, because when that was rich the people were impoverished. (Aurel. Vict., *Epit.*, cap. 42, sec. 21.) Aristotle (*De Part. Anim.*, lib. iii., cap. 7, p. 86), calls the spleen a spurious (νόθον) liver, to which it is a sort of equipoise (ἀντίζυγον, *ibid.*, cap. 4, p. 76), says that it is not an organ necessary for all animals (*ibid.*), and that it assists the liver in performing the functions of digestion (*ibid.*, p. 87, ed. Tauchn.) In another obscure passage (*ibid.*, p. 88), he says that 'the spleen attracts from the stomach (κοιλία) the superfluous and excrementitious humours (ἰκμάδας τὰς περιττάς), and concocts them,' by which he is supposed by Casp. Hofmann (*De Liene*, cap. 5) to mean the chyle. It is surprising that so eminent an anatomist as Erasistratus, while confessing that nature does nothing without a reason (Gal., *De Usu Part.*, lib. iv., cap. 15, tom. iii., p. 315; id., *Comment. in Hippocr.* '*De Alim.*,' sec. 14, tom. xv., p. 308), should nevertheless consider the spleen to be a useless organ (Gal., *ibid.*; id., *De Atra Bile*, cap. 7, tom. v., p. 131; id., *De Natur. Facult.*, lib. ii., cap. 4, 9, tom. ii., pp. 91, 131, sq.), an opinion adopted also by Rufus Ephesius (*De Appellat. Part. Corp. Hum.*, p. 59, ed. Clinch), and apparently by Pliny, who says (*Hist. Nat.*, lib. xi., cap. 80), that runners used to have their spleen removed in order to increase their speed. The followers of Erasistratus dissented from this opinion of their master, and said that the spleen first prepared the chyle (χυλὸν) for the liver afterwards to turn into blood. (Gal., *De Atra Bile*, loco cit.) The opinion of Galen, which had more supporters than any of the others, was, that the humour called *black* bile (χολὴ μέλαινα) is secreted by the spleen, in the same way as the *yellow* bile (χολὴ ξανθὴ) is secreted by the liver (*De Loc. Affect.*, lib. vi., cap. 1, tom. viiii., p. 377, 378; *Comment. in Hippocr.* '*De Humor.*,' lib. iii., sec. 4, tom. xvi., p. 367; *De Atra Bile* passim, tom. v., p. 104, sq.; et alibi); and it was from the supposed accumulation of this humour that persons afflicted with melancholy were believed to suffer. Aretaeus (*De Caus. et Sign. Diuturn. Morb.*, lib. i., cap. 15, p. 114, ed. Kühn) says that the spleen is nourished by black blood, of which it is the receptacle (ἰκμαγεῖον), and that when it is diseased this fluid is not elaborated by it, but is taken into the general circulation. Serenus Samonicus (*De Medic.*, v., 430, sq.) seems to consider the spleen as the organ of mirth, and that after its removal a person never laughed. (Conf. Pers., *Sat.* 1, v. 12; Lactant., *Div. Instit.*, lib. vi., cap. 15; id. *De Opif. Dei*, c. 14):

> 'Splen tumidus nocet, et risum tamen addit ineptum,
> Ut mihi Sardois videatur proximus herbis,
> Irrita quæ miseris permiscent gaudia fatis.
> Dicitur exsectus faciles auferre cachinnos,
> Perpetuoque aevo frontem praestare severam."

The same idea is found also in Pliny (*Hist. Nat.*, lib. ii., cap. 80), who however does not state it on his own authority, and seems hardly to believe it. It seems at first sight strange that as the organ was considered to be the seat of mirth and laughter, the words *spleen*, *spleenful*, *splenetic*, &c. should be commonly used in the present day to signify exactly the contrary state of mind. It has probably arisen, 1st, from the spleen having been supposed to secrete the black bile, μέλαινα χολή, whence the word *melancholy* is derived; and, 2nd, from its having been considered as one of the causes of melancholy when he 'doth not his duty in purging the liver as he ought, being too great or too little, in drawing too much blood sometimes to it, and not expelling it.' (See Burton's *Anat. of Melanch.*, part 1, sec. 2, mem. 5, sec. 4, and elsewhere.) Oribasius follows Galen's doctrine (*Collect. Medic.*, lib. xxiv., cap. 26, p. 540, ed. H. Steph.), as does also Alexander Trallianus (*De Arte Med.*, lib. viii., cap. 12, p. 268, ed. H. Steph.), Paulus Ægineta (*De Re Med.*, lib. iii., cap. 49), Joannes Actuarius (*De Urin. Differ.*, cap. 4, p. 34, ed. H. Steph.), and Haly Abbas (*Lib. Reg. Theor.*, lib. iii., cap. 29). Theophilus Protospatharius (*De Corp. Hum. Fabr.*, lib. ii., cap. 12) and Meletius (*De Nat. Hom.*, cap. 20) also agree with Galen concerning the functions of the spleen, and add, that it gives tone to the stomach, excites its appetite for food, and assists the digestion. Theophilus also mentions the warmth which it imparts to the stomach (*ibid.*, c. 4). According to Avicenna, the spleen assists the stomach in the process of digestion, by the warmth which it imparts, and which it derives not from its own substance, but from the numerous veins and arteries that it contains. (*Canon.*, lib. i., fen. i., tom. i., p. 28, ed. Venet., 1564.) Hofman mentions that some of the other Arabic writers considered the office of the spleen to be to cool and refresh the heart. In other antient writers (as, for example, St. Ambrose, *Hexaem.*, lib. vi., sec. 71), we find a slight modification of Galen's opinion, viz., that the spleen is placed near the liver in order to draw away the useless part of the aliment, and so, after retaining that which is necessary for its own support, transfer the purified and subtle remainder through the liver to the blood. (Compare Theodoret, *De Provid.*, lib. iii., tom. iv., p. 517, ed. Schultze.)

Various other more modern hypotheses on this subject are enumerated by Haller (*Elem. Physiol.*, loco cit.), as, for example, that it secretes a fluid which enters the stomach, or which is absorbed by the nerves, or which lubricates the joints, or which is an inferior sort of chyle. Of all these theories however, and of many others that might be mentioned, part are entirely destitute of anything like proof, and others are contradicted by experiments, which, if they have not assisted in determining what is the office of this organ, have at least decisively proved that most of the uses hitherto assigned to it are wholly fanciful and imaginary. Müller, one of the latest and ablest writers on physiology, confesses (*Elem. of Physiol.*, by Baly, 1840) that we are quite ignorant of the office of the spleen. 'We merely know,' says he, 'that its importance in the economy is not great, as the experiments of numerous observers have shown that it may be extirpated without any remarkable ill consequence.' Dupuytren observed increased voracity in dogs after the operation. Mayer (*Med. Chirurg. Zeit.*, 1815, 3 bd., 189) states that the lymphatic glands become enlarged, but this is certainly not a constant effect. It has been said by others that the secretion of urine becomes more abundant, but Tiedemann and Gmelin (*Versuche über die Wege*, &c., p. 105; *Recherches sur l'Absorption*, transl. by Heller) deny that such is always the case. Mead and Mayer had noticed signs of imperfect digestion after the removal of the spleen; and some writers have stated that the bile becomes very bitter and dark-coloured, both of which the Heidelberg professors likewise deny to be constant phenomena. 'The refutation of the hypotheses proposed to explain the use of the spleen' (continues Müller) 'will not occupy us long; for they either rest on wholly incorrect premises, or they are such as can neither be proved nor disproved. All the theories which regard the spleen as essentially connected in its function with the liver can be shown to be fallacious. Döllinger supposes the spleen to be formed merely for the sake of symmetry, to be the fellow of the liver—the rudimentary liver, as it were, of the left side' (an opinion formerly held by Aristotle, as has been noticed); 'but,' says Müller, 'the liver is originally symmetrical, and the spleen is also developed in the middle line. No greater value can be accorded to the circumstance that the splenic veins join the *vena portae*, and to the hypothesis, thence deduced, that the spleen prepares the blood for the secretion of the bile; for in this respect it does not differ from all the chylopoetic viscera, nor even from the inferior extremities in the lower vertebrata, and the generative organs and air-bladder of fishes.' (Froriep's *Not.*, 615.)

Some physiologists imagine, without any reason, that the spleen may exert a deoxidising influence on the blood; others again believe that it favours the secretion of the gastric juice, because, they say, it receives less blood at the time that the stomach is full, which is at least doubtful; while others, as Lieutand and Moreschi, regard it as a reservoir of blood for the stomach, supposing that the stomach, when distended with food, may attract more blood to itself, or may press on the splenic artery so as to diminish the quantity of blood sent at that time to the spleen. Dobson's hypothesis (*London Med. Phys. Journal*, Oct., 1820) is very similar: he states that he has found the spleen to have its maximum volume at the time when the process of chymification is at an end, viz., five hours after food is taken; and to be small and contain little blood seven hours later, no food having been taken in the interval: hence he inferred that the spleen is the receptacle for the increased quantity of blood which the system acquires from the food, and which cannot, without danger, be admitted into the blood-vessels generally, and that it regains its previous dimensions after the volume of the circulating fluid has been reduced by secretion. 'The premises of this theory,' says Müller, 'do not appear to me to be sufficiently proved. Dobson repeated Magendie's experiment of injecting fluids into the veins of an animal, and, he says, with the same result with regard to the spleen, viz. the increase of its size. The assertion of Defermon (*Nouv. Biblioth. Méd.*, Mars, 1824; Froriep's *Not.*, 148) that the spleen undergoes changes of volume when certain substances are taken into the system (*e.g.* that it becomes smaller under the influence of strychnine, camphor, and muriate of morphia), appears to me likewise to require confirmation.' Sir Everard Home (*Philos. Trans.*, 1808, p. 45, &c. and p. 133, &c.) revived the old theory of Hippocrates, and made the spleen to receive a great portion of our drink from the cardiac extremity of the stomach, so that the fluids passed through some short passage, hitherto unknown, from the stomach to the spleen, and thence into the mass of the blood. (Blumenb., *Physiol.*) He supposed that the spleen served as a reservoir or receptacle for any fluid that is received into the stomach, more than what is sufficient for the purposes of digestion; that this excess of fluid is not carried off by the intestines, but is transmitted directly to the spleen by the communicating vessels, and is lodged there until it is gradually removed, partly by the veins and partly by the absorbents. He illustrated his opinion by numerous experiments upon living animals, in which coloured infusions were injected into the stomach, and were afterwards discovered in the spleen, while it appeared that they had not passed through the absorbents of the stomach. (Bostock, *Physiol.*) This idea however he subsequently abandoned. Tiedemann and Gmelin represent the structure of the spleen as essentially resembling that of the lymphatic glands, and regard it as an organ which is merely an appendage to the absorbent system. They believe that its specific function is to secrete from the blood a reddish fluid that has the property of coagulating, is carried to the thoracic duct, and, being there united with the chyle, changes it into blood. 'The facts elucidated by the experiments of these physiologists,' says Mr. Cooper (Good's *Study of Med.*, vol. i.), 'are of great value; but it must be confessed that their hypothesis relative to the spleen being an essential organ of sanguification, is seriously shaken by the facts that a vast difference really exists between the structure of the spleen and that of an absorbent gland; that the chyle does not invariably exhibit a reddish hue; and that the absence or removal of the spleen may happen, not only without fatal effects, but even without much subsequent disturbance of the animal economy.' Mr. Hewson (*Experimental Inquiries*, chap. ii., p. 45, &c., 95, &c.) supposed that it was the office of the spleen, as well as of the lymphatic glands and thymus body, to secrete from arterial blood a fluid, which, mixed with lymph, should give rise to the formation of red blood particles. 'This however,' says Müller, 'cannot be true; for the red particles are formed equally well after the extirpation of the spleen. The reddish colour of the lymph of this organ, observed by Hewson, Tiedemann, and Fohmann, is not constant. Mayer has asserted that the spleen is reproduced after extirpation. He says that after the lapse of some years he has found in ruminating animals, in the place of the spleen, which had been removed, a body of the size of a lymphatic gland. This would be an interesting fact if it could be satisfactorily proved, which however is scarcely possible, as animals often have small accessory spleens (*spleniculi*), and besides in the operation of extirpation a small portion of the organ might be left behind in the body. The presence or absence of the bunches of white corpuscules, above described, might aid in determining whether any substance were really spleen or not. The blood of the splenic vein, according to Tiedemann and Gmelin, does not differ from other venous blood; they saw it coagulate like the blood of other organs. The older physiologists however, and more recently Authienreth (*Physiologie*, ii. 77), maintain that the blood has peculiar characters. Schultz (Rust's *Magazine*, 1835, 327) also found the blood of the vena portae of a darker tint than any other venous blood, and the dark colour was most evident in animals which were fasting. Neither neutral salts nor the action of the air had the effect of rendering it of a brighter red colour; its coagulum was less firm than that of other blood, and it contained less fibrin and albumen, but more fatty matter.' Müller's own idea of the function of the spleen is as follows:—'It probably consists,' says he, 'in the production of some change of unknown nature in the blood which circulates through its tissues, and in thus contributing to the process of sanguification; or in the secretion of a lymph of peculiar nature, which, being mixed with the contents of the lymphatic and lacteal system coming from other parts, tends to perfect the formation of the chyle. There are no other ways than the lymphatics and veins by which any animal matter, modified by the action of the spleen, can be conveyed away from it. Tiedemann believes that the lymphatics perform this office, but whether he is correct or not is quite uncertain, and the nature of the change which the animal matter is supposed to undergo in the spleen is still less known.' Perhaps the most plausible opinion on this subject is that the spleen is a sort of safety-valve to the vascular system, calculated to receive a large quantity of blood at a moment when over-distention would cause disease or death, the rupture of a blood-vessel, or even of the heart itself. This might happen, either when the cutaneous circulation is repressed by extreme cold applied to the surface, or during the cold stage of intermittent or remittent fevers; also in the case of running, hard riding, violent laughing, or any tumultuous agitation of the mind. The cellular structure of the spleen, and the large size of the artery which supplies it with blood, correspond perfectly with this hypothetical view of its function. From these observations may be deduced a ready explanation of the two principal facts in the pathology of splenic diseases: 1st, Their connection with intermittent fevers, and dependence upon malaria; and 2nd, The liability of the circulating system to haemorrhage during the presence of splenic disease. These circumstances have been long known, and the explanation of them which physiology suggests appears both simple and satisfactory. (Gregory, *Theory and Practice of Medicine*.)

*Pathology, &c.*—The opinions of the antients respecting the diseases of the spleen, and the curative means to be employed, are thus summed up by Mr. Adams, in the notes to his 'Translation of Paulus Ægineta' (book iii., chap. 49). Hippocrates describes several diseases of the spleen in his work *De Internis Affectionibus* (tom. ii., p. 483, sq.). He states that in scirrhus the spleen is sometimes larger and sometimes smaller than natural. It is an affection which continues long, but is not fatal. Sometimes, he says, it terminates in dropsy, and sometimes in suppuration, when he approves of burning the side. He also recommends diuretics and purging with hellebore. Aretaeus remarks (*De Caus. et Sign. Diuturn. Morb.*, lib. i., cap. 14, p. 110, sq.; id., *De Curat. Morb. Diuturn.*, lib. i., cap. 14, p. 328) correctly that the spleen is very subject to scirrhus, but little so to suppuration. Scirrhus, he says, is removed with difficulty. (Compare Leo, *Conspect. Medic.*, lib. v., cap. 22, ap. Ermerins, *Anecd. Med. Gr.*, Lugd. Bat., 1840.) For scirrhous enlargement of the spleen Celsus recommends (*De Medic.*, lib. iv., cap. 9, p. 198, ed. Argent.) unction, friction, and sudorifics. He directs to avoid all sweet things, milk, and cheese. He approves of pickled and salted things, acids, the vinegar of squills, a decoction of wormwood, and water in which a red-hot iron has been extinguished. Emollient ointments are to be applied externally. Cœlius Aurelianus says (*De Morb. Chron.*, lib. iii, cap. 4, p. 453, ed. Amman.) that some had directed to cut out the spleen when it is much diseased; but he held the proposal as mere words of course, and believes that the operation had never been performed. Octavius Horatianus recommends (*Rer. Medic.*, lib. ii., cap. 28, ed. Basil.) as general remedies for complaints of the spleen, bleeding, purging, and fomentations with wool soaked in equal parts of oil and vinegar. When it becomes indurated, he approves of vinegar of squills, friction, gestation, dropaces, salt-baths, &c. Most of the remedies recommended by Paulus Ægineta are taken from Galen, who treats fully and scientifically of diseases of the spleen. He states, as a general principle of treatment, that the proper medicines in cases of indurated spleen are such as are of an incisive and attenuant nature. He therefore approves of the mixture of bitter with austere things (*De Meth. Med.* lib. xiii., cap. 16 sq., tom. x., p. 916, sq.). Alexander Trallianus forbids (*De Re Med.*, lib. viii., cap. 10, sq., p. 472, sq., ed. Basil.) strong purging at the beginning of an inflammation either of the liver or spleen. The Arabians treat of these affections similarly to the Greeks. Haly Abbas remarks (*Lib. Reg. Theor.*, lib. ix., cap. 32; *Pract.*, lib. vii., cap. 40.) that the spleen can bear much stronger medicines than the liver, and recommends in the indolent diseases of it various bitter and very acid medicines. In inflammation he very properly bleeds. These are his general principles of treatment, the details of which he explains at great length. Avicenna (*Canon*, lib. iii., fen. 15, tract 1, sq.) and Alsaharavius (*Pract.*, tract 19, ed. Aug. Vindel.) treat of these diseases more minutely than any other of the antient authorities. Rhazes recommends (*Almans*, lib. ix., cap. 76) camel's milk in cases of indurated spleen. He joins Archigenes (apud Galen, *De Compos. Medicam Secundum Loco*, lib. ix., cap. 2, tom xiii., p. 256) in directing the application of sinapisms and leeches to the side.

The diseases of the spleen do not appear to have been much studied in this country, because they do not very frequently occur; they are however by no means of unusual occurrence in moist climates, whether warm or temperate, as Italy, Holland, South America, and some parts of India; in fact wherever malaria exits. The spleen is liable to many sorts of disease: Dr. Bigsby (*Cyclop. of Pract. Med.*) enumerates as many as ten, but of these only the most important can be here noticed. Splenitis*, or inflammation of the spleen, may be either acute or chronic; though Dr. Baillie remarks that this organ is much less subject to inflammation than many other of the abdominal viscera. (*Posthumous Lectures and Observations on Medicine*, 1825, unpublished.) Acute inflammation of the

* It should be mentioned that this term is used in its common acceptation, not in its classical sense. In the antient Greek authors this word, like *hepatis*, only occurs (as far as the writer is aware) as an adjective joined with φλέψ to signify the splenic vein; the term applied to persons affected with disease of the spleen was σπληνικός. (See Rufus Ephes., *De Appellat. Part. Corp. Hum.*, p. 41, ed. Clinch.)

spleen, together with heat, fulness, and tenderness in the splenic region, with pain upon pressure, is accompanied with the usual pyrectic signs, and often with a pain extending over the whole of the abdomen, but particularly in the left side, and shooting from the diaphragm to the left shoulder. There is also not unfrequently a dry short cough, and sense of constriction in the præcordia, sickness, or nausea, and a discharge from the rectum of black or livid blood, from a rupture of some of the splenic vessels. Of this disease a remarkable instance, which terminated in nine days, has been recorded by Dr. Ley, in the 'Transactions of the College of Physicians of London' (vol. v., p. 304). The texture of the spleen after death was in this case so altered as to resemble an extremely soft piece of sponge, of which the cells had been filled with an intimate mixture of pus and grumous blood. On placing it in water, innumerable vessels, as fine as the fibres of swans' down, floated separately, rising from every point of the superficies of the organ. The contents of this spongy mass having been removed by repeated washings, something like an attempt at the formation of cavities to contain the matter manifested itself. No regular cyst however had been formed. All the other viscera, abdominal and thoracic, were healthy, except the uterus, whose inner surface was gangrenous. The common causes of inflammation of the spleen are much the same as those of inflammation of the liver, viz. suddenly suppressed perspiration, especially from currents of cold and damp air, and excess of spirituous potation; sometimes however the cause is too obscure for detection. With respect to the treatment, the usual antiphlogistic remedies may be employed, but promptly and energetically. Dr. Baillie says, he is not aware that inflammation of the spleen would require a different treatment from that of other viscera.

If after a certain period the inflammation do not yield, it assumes the chronic form, in which the variation in the severity and duration of the complaint is very great. If it has accompanied ague, the symptoms may possibly not have been urgent in the outset, but it is almost always a painful as well as formidable disease. It commonly lasts for some months, and may continue for years with remissions. With respect to the terminations of chronic Splenitis, resolution does not take place often; suppuration is also rare upon the whole, and Dr. Baillie says he 'had never met with an abscess in the spleen in all the dead bodies which he had examined.' When pus is formed, it is of the ordinary creamy kind, but is sometimes concrete; it varies in amount from a few ounces to many pounds. The matter may find its way into the stomach, colon, or peritoneal cavity; it may burst into the left side of the chest, or into the lungs, inducing symptoms of phthisis; or it may empty itself outwards through the abdominal walls. Ossification of the spleen after inflammation is rare, as is also gangrene; softening, induration, and hypertrophy, especially the last, are much more common. With respect to the treatment of chronic splenitis, perhaps the best plan that can be adopted is the combination of aperients with iron and sedatives; the good effects of mercury in this disease being now generally considered precarious, trivial, and at best temporary. Local applications, such as cupping, issues, setons, &c., are sometimes productive of great benefit.

Besides the inflammatory softening of the spleen, there is another of a character quite peculiar, and unattended by any of the characteristics of inflammation, wherein the structure of the spleen is more or less destroyed, and it is often reduced to a simple bag, containing a substance which varies from the state of clotted or grumous blood to that of tar. This was very frequent in the Walcheren fever, in which cases the spleen was usually found after death of great size, and generally a mere bag filled with a liquid like tar, and weighing from three to five pounds.

One of the most common diseases of the spleen is hypertrophy, the most usual causes of which are ague and remittent fever. It is therefore chiefly to be found where these are endemial, but it is not very uncommon in any part of Great Britain. The size which this organ sometimes attains is enormous, and it is surprising to find how long persons can carry about with them very enlarged spleens, and at last die of some other disease. Dr. Bigsby quotes from Lieutaud the case of a woman who had for seventeen years a spleen weighing thirty-two pounds; similar facts are to be found in Haller. Dr. Baillie mentions (*Posthumous Lectures*) having met with cases where it was so large as to occupy nearly all the left side of the abdomen, extending from the diaphragm to the pelvis. When the enlargement is so considerable that the lower end of the spleen can be felt under the margin of the ribs upon the left side, there can be no doubt with respect to the disease. When the hypertrophy does not reach this extent, its most characteristic symptoms are a sense of weight in the left side, with or without evident swelling; inability to lie with ease on the right side; debility, without corresponding emaciation; disordered stomach, irritable bowels, dry cough, and absence of fever. The spleen, when enlarged, is always felt to be harder than in a natural state, but pressure upon it with the hand seldom produces pain. An hypertrophy of the spleen is sometimes followed by ascites; but there will frequently be no dropsy of the abdomen, even where this organ has been for a long time much enlarged. When this form of disease has been connected with ague, it more frequently subsides than in any other case; and the quina, which has been prescribed to cure the latter affection, will probably be serviceable also to the former. 'When the enlargement has taken place independently of this cause,' says Dr. Baillie, 'it hardly ever subsides of itself, or is materially diminished by medicine. According to my experience, mercury, administered both externally and internally, produces very seldom any good effect; I have seen, I think, more advantage from a seton inserted under the skin which covers the spleen. In some cases it has appeared to be diminished in size by this remedy, and to be rendered softer; but I do not recollect a single instance, except after ague, in which it has been reduced to nearly its natural size. Temperate living, abstaining from violent exercise, and keeping the bowels open, must be to a certain degree useful in retarding the progress of the disease.' The remedy largely employed in India for the cure of chronic tumour of the spleen is a compound of garlic, aloes, and sulphate of iron. When emaciation and diarrhœa are present, the garlic and aloes are macerated in brandy; under other circumstances, in vinegar. The proportion of aloes is so regulated as to produce three evacuations daily; and the medicine also produces copious secretions from the kidneys. The *Decoctum Aloes Compositum* with the *Tinctura* or *Acetum Scillæ* would probably prove equally effectual. The moxa, and even the actual cautery, have been recommended for this disease; and emetic cataplasms of tobacco-leaves, renewed constantly so as to keep up frequent vomiting, have in some instances produced the happiest effects.

Atrophy of the spleen is by no means so common as hypertrophy; and though some instances are related by modern writers, yet their statements are so meagre and unsatisfactory, that no use can be made of them. It is sometimes found exceedingly small and even shrivelled when some other organ is much enlarged, where there have been great discharges of blood, in ascites, and in extensive chronic disease. This form of disease of the spleen obviously admits of no remedy.

Hydatids in the spleen are found now and then, but not very often; Dr. Baillie had never met with a single case of them. It is hardly possible to discover their existence during the life of the patient, nor, even if it were more easy, could the complaint receive any cure, or even amendment, from medicine. The disease arises quite unconsciously to the patient; the first intimation of its existence being debility, dyspepsia, and the uneasiness created by a slowly increasing tumour, which in its progress causes further derangement by compression and displacement of other organs, and becomes itself perceptible externally. It is only when the containing membrane, or some organ, becomes inflamed, that fever, pain, and their fatal consequences ensue. Hydatids may prove fatal by passing into the peritoneal cavity from ulceration of the containing sac, or by disturbing the circulation, or by irritating other viscera; or the patient may live very long with this complaint, and die eventually of another disease during the indolent continuance of this.

Melanosis and calculi of the spleen are noticed shortly by Dr. Bigsby, but the instances are too rare to require any particular remarks here.

Rupture of the spleen from some external violence occurs not unfrequently; but in the majority of cases the injury is so overwhelming that little is left for the medical practitioner to do. Free venesection and perfect rest have occasionally saved life; but in many instances the patient dies in a few hours. In these latter cases the symptoms are great shiverings, coldness of body, vomiting, and other signs of extreme collapse: when there is time and strength for reaction, there is considerable fever, with a remarkable heat of skin, and great pain in the left side or all over the abdomen; the stools and urine are not materially affected.

(Good's *Study of Med.*; Gregory's *Theory and Pract. of Med.*; Bigsby, in *Cyclop. of Pract. Med.*, from which works, with Dr. Baillie's (posthumous) *Lectures and Observ. on Med.*, great part of the pathological part of this article is taken.

**SPLINT** is a piece of wood or other rigid substance which is used in surgery to maintain any part of the body in a fixed position, and especially for the purpose of holding steadily together the portions of a fractured bone. Splints vary almost infinitely in form and size, according to the part to which they have to be adapted, and the position in which it is to be held; the number and the arrangement of them in each case are equally subject to variation; nor can a surgeon have a better rule than that of following no general plan, but of determining in each case the apparatus best fitted for its peculiar exigencies. As much as can be said in general on the forms and modes of adaptation of splints is contained in the article FRACTURE. The material of which they are commonly made is light wood; each splint consisting either of one piece cut nearly to the form and size of the limb, or of several pasted together with a strap of linen so as to be flexible in one direction. In some cases tin is a preferable material; in some stiff pasteboard. In many cases also it is very advantageous to adapt the splints exactly to all the irregularities of the limb; and as this cannot be done with wood or any unyielding material, it is usual to employ one which, being applied moist and soft, gradually hardens. Stiff pasteboard will sometimes be sufficient, especially for children; but a better material for general use is sole-leather, applied while quite pliant after having been well soaked in hot water, and then bandaged closely to the limb and allowed to dry. Another plan of this kind now much employed is to form a splint of linen and some glutinous material, such as starch, or a mixture of white of egg and flour, or of mucilage of gum-arabic and whiting, made as thick as bird-lime. In using these, the limb or other part should be thinly padded with soft lint; then strips of coarse linen soaked in the tenacious material should be laid on one over the other, till on each side of the limb they form a layer about as thick as a common wooden splint. The whole should then be surrounded with a neatly-applied bandage soaked in starch. When dry, splints of this kind will so exactly fit the part to which they are applied, and be so rigid, that a patient may with safety execute the slighter natural movements of a limb within a fortnight after it has been fractured. All the further care of a simple case of fracture will generally consist in the occasional replacement of the starched bandage, and the adaptation of the splints, by cutting their edges, to the change of form which the limb may undergo as the swelling diminishes. Splints of this kind however must not be applied till all the inflammation immediately consequent on the fracture has ceased.

**SPLUGEN, MOUNT.** [ALPS.]

**SPODU'MENE**, *Triphane*. Occurs in embedded crystalline masses. Primary form a rhombic prism. Cleavage parallel to the primary faces, and to the diagonal planes; that parallel to the smaller diagonal is most brilliant, and that parallel to the greater most difficult. Fracture uneven, granular. Hardness, scratches glass and gives fire with steel. Colour whitish and greenish grey. Streak white. Lustre pearly on the cleavage planes. Specific gravity 3·17 to 3·188. Before the blow-pipe it swells and fuses into a glass almost colourless and transparent; with borax it swells, but does not easily dissolve.

It is found at Uto in Sweden, in the Tyrol, Ireland, and North America. Analyses of this mineral by Arfwedson from Sweden, by Stromeyer, and Le Hunt from Ireland, give the annexed results:—

| | Arfwedson. | Stromeyer. | Le Hunt. |
|---|---|---|---|
| Silica | 66·40 | 63·288 | 63·812 |
| Alumina | 25·30 | 28·776 | 28·508 |
| Lithia | 8·85 | 5·626 | 5·604 |
| Lime | — | — | 0·728 |
| Protoxide of iron | 1·45 | 0·794 | 0·828 |
| Protoxide of manganese | — | 0·204 | — |
| Moisture | 0·45 | 0·775 | 0·360 |
| | 102·45 | 99·463 | 99·840 |

**SPOFFORTH, REGINALD**, a composer in whom were united much originality, a very elegant taste, and a thorough knowledge of his art, was born in 1768, at Southwell in Nottinghamshire, and there received his early musical instructions from his uncle, organist of the Collegiate Church of that place. Repairing to London, he took lessons on the piano-forte from the celebrated Steibelt, and completed his studies in harmony under Dr. Benjamin Cooke. It was his fate, as unhappily it is the fate of the English musician generally, to depend during the greater part of his life almost wholly on his practice as a teacher, and he was in considerable repute as a piano-forte master. As a composer, he is now, and will be hereafter, known only as a glee-writer. Two of his earliest glees gained, in the year 1793, the prize gold medals given by the Catch-Club. This merited success established his reputation, and encouraged him to produce other works of the same kind, the best of which were published by himself, and most of these have taken their station among the classical musical productions of this country. On the death of his uncle, Mr. Spofforth came into the possession of considerable property, but did not long enjoy his independence, for his devotion to his profession and his unrelaxing industry brought on a nervous disease, which terminated in paralysis, and in 1826 deprived music of one of its most ingenious votaries, and society of one of its most amiable members.

**SPOHN, FRIEDRICH AUGUST WILHELM**, a German philologist, was born May 16, 1792, at Dortmund. He was educated at the university of Wittemberg, and afterwards went to Leipzig, where he was, in 1817, made professor extraordinary of philosophy, and in 1819 professor in ordinary of antient literature. He was a scholar of the greatest industry, and died at an early age, January 17, 1824, worn out by the severity of his studies. He illustrated antiquity by a variety of works in the several departments of criticism, philology, and geography. He published an edition of the 'Odyssey,' with valuable dissertations prefixed, entitled 'De Agro Trojano in Carminibus Homeri descripto,' Leipzig, 8vo., 1814; 'Commentarius de extremâ Odysseæ parte inde à rhapsod. Ψ 297, ævo recentiore orta quam Homerico,' Leipzig, 1816. He revised the text of Hesiod with great care: the edition was commenced in 1819, but never completed. In 1817 he edited the 'Panegyricus' of Isocrates; and in the last year of his life published 'Lectiones Theocriteæ.' He projected also Annals of the reign of Augustus, deduced from a chronological arrangement of the various passages in Latin authors illustrative of this period.

As a geographer, he made great additions to the materials collected by Bredow. His researches into the mythology of the antients led him to study Egyptian hieroglyphics; some remarks of his on this subject appeared in a German publication called 'Amalthœa.' In 1822 he was employed in examining and arranging the Egyptian antiquities brought to Berlin by Minutoli. His untimely death arrested the publication of his work on hieroglyphics, which has since been edited by Seyffarth, of Berlin, under the title 'De Linguâ et Literis veterum Ægyptiorum, cum permultis tabulis lithographicis literas Ægyptiorum tum vulgari tum sacerdotali ratione scriptas explicantibus atque interpretationem Rosettanæ aliarumque inscriptionum et aliquot voluminum papyraceorum in sepulcris repertorum exhibentibus. Accedit Glossarium Ægyptiacum,' Leipzig, 1825, with a life and portrait of Spohn. This work has not contributed very much to solve the difficulties still attending the interpretation of hieroglyphics. There is a life of Spohn in the 'Zeit-genossen, Neue Reihe,' heft xv.

**SPOLE'TO E RIE'TI, DELEGAZIO'NE DI**, an administrative division of the Papal state, formed by the union of the two former provinces of Rieti and Spoleto. The highlands of Rieti, which comprise a great part of the country of the antient Sabini, have been described under RIETI. The western part, or province of Spoleto Proper, consists of the valley of the Nera, one of the principal affluents of the Tiber, and of the valley of the Maroggia, another affluent of the Tiber, and of several ridges of highlands between these various rivers. This country was known in the dark ages after the fall of the Western Empire by the name of Umbria, being part of the region so called in antient times. (Paulus Diaconus, ii. 16.) The Longobards, about A.D. 570, established the duchy of Spoleto, which became one of the most powerful of their dukedoms, extending over the country of the Sabini, Picenum, and the country of the Vestini and Marrucini, or part of modern Abruzzo. The series of the Longobard dukes of Spoleto ends with the year 788, after which a Frank duke was appointed by Charlemagne.

The dukedoms in Italy were not hereditary, but the appointment of a successor after the death of a duke depended upon the will of the kings of Italy; and accordingly we find that the duchy of Spoleto passed through several families. It was for a time united with the duchy of Tuscany, and Godfrey the Humpbacked, husband of the famous countess Mathilda, appears to have governed both Spoleto and Tuscany. The series of the dukes of Spoleto ends with the twelfth century, when Pope Innocent III. took possession of the duchy. Since that time it has been annexed to the Papal State.

The united province of Spoleto and Rieti is bounded on the east by the kingdom of Naples, on the north by the Papal provinces of Ascoli and Camerino, on the west by those of Perugia and Viterbo, and on the south by the Comarca of Rome. The area is about 2000 square miles, and the population, by the census of 1833, was 166,142 inhabitants, distributed in nine walled towns, and 87 Terre, or open market-towns or villages. (Calindri; Neigebaur; Serristori.) With regard to the productions of the soil, the valleys of the Nera and of Spoleto are generally fertile, but the intervening highlands are rather poor. The fertility of the plain of Rieti has been already noticed. [Rieti.]

The province of Spoleto Proper is divided into the three districts of Spoleto, Norcia, and Terni. Spoleto, the head town of the province, is situated on an elevation, below which runs the Maroggia: the Maroggia flowing northwards, joins the Topino below Foligno, after which both streams run into the Tiber. The Nera flows southwards, and the two rivers are separated by the mountain of Somma, an offset of the Apennines, which lies between Spoleto and Terni. The high road from Rome to Ancona and Perugia passes through Spoleto.

An aqueduct, which served also as a bridge, crosses the Maroggia; it is a work of the Longobard times, but is now in a ruinous state.

Spoletum, then a Latin colony of Rome, was attacked by Hannibal after the battle of Trasimenus, but the inhabitants repulsed his attack, and thus checked his advance towards Rome. (Livy, xxii. 9.) An inscription above the gate called the gate of Hannibal, though built in much later times, records the event. Spoletum is honourably mentioned among the faithful colonies which furnished men and money to carry on the war against Hannibal, when other colonies refused (xxvii. 10).

Spoleto has a handsome cathedral, adorned with frescoes by Filippo Lippi, who was buried in it in 1469, after a life full of strange adventures. A monument was raised over his tomb by Lorenzo de' Medici, with an epitaph by Politianus. Several other churches, the town-house, and the palace of the family Ancajani, are also worthy of notice. The castle of Spoleto contains some remains of Cyclopean walls. There are also remains of a Roman theatre, of several temples, and other antiquities. Spoleto is a bishop's see, and has a college: it has also manufactories of hats and woollens, and about 7000 inhabitants. It carries on a considerable trade in corn, oil, wine, and truffles, which are found in the neighbourhood. The convent and hermitage of Monte Luco, in the neighbourhood of Spoleto, is a delightful spot, surrounded by a forest of old oaks; its attractions have been described in Latin verse, by Giustolo, a native poet, of the latter part of the fifteenth century. Near the post-house of Le Vene, half-way between Spoleto and Foligno, are the sources of the Clitumnus, a small but limpid stream, which seems to have been once much more considerable. (Pliny, *Hist. Nat.*, viii. 8.) It is an affluent of the Maroggia, which it joins after a course of six miles. The fine large-horned cattle which fed on the banks of the Clitumnus were preferred by the antient Romans for sacrifice, and also for the ceremony of their triumphs. (Virgil, *Georg.*, ii. 146.) There is a small temple of antient construction, but partly repaired and transformed into a Christian chapel, near its banks.

The other towns of the province are—1, Terni, the antient Interamna, built near the confluence of the Velino with the Nera, a bishop's see, with an old cathedral, the remains of an amphitheatre and of an antient temple, and about 6000 inhabitants. The territory of Terni produces much oil and some wine. The country is full of picturesque localities. 2. Narni. [Narni.] 3, Ameria, a small town of 2000 inhabitants, and a bishop's see, situated on a hill, not far from the left bank of the Tiber, and above the confluence of the Nera, is noted for its raisins and its prunes, which are exported. Ameria is said to have been built by the Umbri several centuries before the foundation of Rome, and was afterwards in possession of the Etruscans. (Pliny, *Hist. Nat.*, iii. 19.) 4, Bevagna, the antient Mevania, likewise a town of the Umbri, near the confluence of the Maroggia with the Topino, has about 2000 inhabitants. 5, Norcia, the antient Nursia, at the northern extremity of the province, near the borders of Naples, and at the foot of the lofty Apennine group called Monte della Sibilla, the antient Mons Tetricus, is 1200 feet above the sea; it is a bishop's see, and has 3000 inhabitants. A great number of swine are reared in the neighbourhood. The Corno, an affluent of the Nera, flows through a deep glen near Norcia. 6, Cascia, on the Corno, south of Norcia, among the highlands of the Apennines, is situated near the site of the antient towns of Carseoli and Marruvium. Medals, idols, and other remains of antient times have been found in the neighbourhood. The whole of this highland region, though very interesting, is little known, being removed from the high roads, and scarcely ever visited by travellers. The mountains are covered with chesnut and oak trees. Cascia and its territory contain about 3000 inhabitants. (Calindri.)

SPON, JACOB, the son of Charles Spon, an eminent French physician, was born at Lyon, 1647, and educated at Strassburg. He took the degree of doctor of medicine at Montpellier, and returning to his native place in 1669, studied medicine and archæology. In 1673 he published 'Recherches des Antiquités et Curiosités de la Ville de Lyon,' 8vo., and the following year endeavoured to draw attention towards the remains of antiquity in Greece, by the publication of 'Relation de l'Etat Présent de la Ville d'Athenes, avec un Abrégé de son Histoire et de ses Antiquités,' Lyon, 1674, written by the Père Babin, a Jesuit, who had been resident there. In 1675 he went to Italy, and spent some time at Rome studying antient art. At Venice he met with an English traveller, Sir George Wheler, and set out with him on a tour to the East. Their route lay through Dalmatia, the Archipelago, Constantinople, and Asia Minor: they then visited Athens and the Peloponnesus. From Negropont they set sail for Venice whence Spon returned to Lyon in the middle of the year 1676. In 1678 he published his Travels, printed at Lyon, 3 vols. 8vo.; reprinted Amsterd., 1679, 2 vols. 12mo. The third volume contains inscriptions, great numbers of which relate to the demi of Attica. In the same year he published 'Miscellanea eruditæ Antiquitatis, in quibus Marmora, &c., Grutero et Ursino ignota referuntur et illustrantur,' Lyon, fol., published in tom. 4 of the 'Thesaurus' of Polenus, and containing much interesting matter. About this time, having noticed the falsehood of Guillet's account of Athens, published under the name of La Guilletière, he became engaged in a controversy with him, and succeeded in exposing him as a literary impostor. (Leake's *Athens*, 2nd ed., i. 94, contains a full account of this matter.) In 1683 appeared a work of his, entitled 'Recherches Curieuses d'Antiquité,' Lyon. He continued to practise as a physician, and published several medical treatises. Being a Protestant, he quitted Lyon before the revocation of the Edict of Nantes, and went to Geneva, and thence to Vevay, where he died in great distress, 25th December, 1685. His archæological works are very valuable: his Travels show great learning, as well as accuracy of observation; and the fidelity of his descriptions has been confirmed by the testimony of later travellers, and by the recent discoveries at Athens. (Dr. Ross, *Die Acropolis von Athen.*) Spon and his companion were among the first European travellers who visited the Parthenon before its destruction during the siege of Athens by the Venetians, A.D. 1687.

The *Biographie Universelle* gives a list of Spon's works, but omits several which are in the Catalogue of the British Museum. (Jöcher's *Allgemeines Gelehrten-Lexicon.*)

SPONDEE (*spondeus*, σπονδεῖος) is a foot which consists of two long syllables ( - - ). The name is derived from σπονδή, a libation, as the metrical prayers on such an occasion were generally of a slow and solemn movement. To produce this solemnity the spondee is often used instead of a dactyl in the hexameter or pentameter· and in iambic, trochaic, or anapaestic metres, instead of an iambus, trochee or anapaest. There is no metre which consists of spondees alone, and indeed such a metre would be very disagreeable, even if it were possible; but spondees produce a good effect when mixed with other feet. A foot consisting of two spondees ( - - - - ) is called a dispondee. An hexameter verse which has a spondee in the fifth place, is called a spondaic verse.

SPONDIA'CEÆ, the name of a natural order of plants belonging to the syncarpous group of polypetalous Exogens. It has unisexual flowers; a 5-cleft regular calyx; 5 petals, inserted under the disk; 10 perigynous stamens, arising from the same part as the petals; superior sessile ovary, from 2- to 5-celled, with 5 very short styles and obtuse stigmas; 1 ovule in each cell; fruit drupaceous; seeds without albumen. The plants of this order are trees without spines, having alternate unequally pinnate leaves without pellucid dots. The flowers are arranged in panicles or racemes. This order was formerly included in Terebintaceæ, but has been separated by Kunth and Lindley, on account of their syncarpous fruit and the absence of a resinous juice. The real affinity of Spondiaceæ appears to be with Aurantiaceæ, from which they differ in little beyond their perigynous stamens and the absence of dots on their leaves. They are natives of the West Indies, the Society Islands, and the Isle of Bourbon. The fruit of some of the species of Spondias is eatable, and is known in the West Indies by the name of Hog Plums.

sence. *d*, Section of fruit, showing its 5 cells.

SPONDY'LIDÆ, a natural family of marine *Conchifera*, under which may be arranged the genera *Plagiostoma*, *Podopsis*, *Dianchora*, *Pachytes*, *Spondylus*, and *Plicatula*. Of these we shall presently see that few if any have a just claim to generic appellation except *Spondylus* and *Plicatula;* the latter can with difficulty be distinguished from *Spondylus*, and if its distinction be admitted, can only retain the rank of a subgenus.

M. Deshayes, in his edition of Lamarck, states that he had for a long time rejected the genus *Plagiostoma* as useless. He observes that it was established by Mr. Sowerby in his *Mineral Conchology*, and that Lamarck adopted it, ameliorating its characters; but, notwithstanding this, introducing, after the example of the English author, two sorts of shells which offered considerable differences. M. Defrance was the first to separate them. Having observed among the *Plagiostomata* some species which were equivalve and others inequivalve, he also remarked that among the last were to be found in the same species individuals more or less regular and symmetrical; finally, he had noticed at the upper part of the cardinal border of the great valve a very remarkable triangular aperture, similar to what is found in *Podopsis*. Defrance, struck with this difference of character, proposed the genus *Pachytes* for the reception of those shells which offered it. Now, remarks M. Deshayes, in continuation, the new genus, as we shall soon see, has no notable differences to distinguish it from *Podopsis*, and it would therefore have been sufficient to transfer to that genus the species in question, instead of establishing a new genus for them; and he cites *Plagiostoma spinosa*, Sow., to illustrate Defrance's genus, observing that *Plagiostoma sulcata*, Lam., is an internal siliceous cast of Sowerby's species, and in reality a *Spondylus*.

M. Deshayes goes on to institute a comparison between the *Plagiostomata*, left after separation from those shells, and the *Limæ;* and the result of his observations is, that he is satisfied that the *Plagiostomata* are composed of *Podopsides* and *Limæ:* consequently, that the genus *Plagiostoma* is useless.

The same author, when treating of the genus *Spondylus* in the same work, calls attention to the structure of its shell, as meriting a particular examination, especially as a test for appreciating the value of certain very little known genera recorded by Lamarck. When, says M. Deshayes, we have before us a *Spondylus*, *Sp. gæderopus* or *Sp. coccineus*, for example, we see that they are composed of two layers of different colours, the one external, variously coloured according to the species, the other internal and white. It will easily be perceived that the external layer envelopes the whole shell, except that part which is called the *talon*—that great plane surface of the lower valve is deprived of it, and one sees that it is entirely formed by the white or internal layer. This internal layer is very thick towards the hinge, it receives the muscular impression in the two valves, thins out towards their edges, and leaves, in a small zone, which forms the border of the valves, the external layer exposed on the inner side of the shell. If a longitudinal section be made, it will be observed that the external layer is very thin on the *umbones* of the valves, and that it goes on increasing in thickness towards the borders. The internal layer has an inverse disposition; that is to say, its greatest thickness is at the *umbones*, whilst it thins out towards the borders. The same longitudinal section will prove that the spines and the laminæ, with which it is externally covered, are formed of the substance of the external layer. Finally, if a transverse section of a deeply furrowed species be made, the external layer will be seen of an equal thickness at the point of the furrows or the ribs forming undulations filled by the internal matter. This is particularly well seen in the orange spondylus (*Spondylus aurantius*).

M. Deshayes then remarks that the observations made by him on the genera *Podopsis* and *Rudistes* will show the importance of what he has here said on the shell of *Spondylus*, observing that this is not the only genus in which the structure exists, but that it is to be remarked in most bivalve shells; only it is most striking in *Spondylus*.

Of *Podopsis*, M. Deshayes says, after referring to his observations on *Spondylus*, that he had for a long time sought in vain for specimens of the former sufficiently preserved towards the *umbones* to assure him of the value of one of the characters given by Lamarck. The *umbo* of the great valve, according to the last-named zoologist, should be entire, and not have the triangular facet of the *Spondyli;* a figure in the *Encyclopédie* represents, in fact, all the upper part of the *umbo* covered with the shell, so that the specimen resembles in some respects a *Gryphæa* without an elevated *umbo*. M. Brongniart himself, in the figures which accompany the geological description of the environs of Paris, has given many figures of *Podopsides*, in which may be remarked at the upper part of the *umbo* longitudinal and transverse striæ, which lead to the supposition that M. Brongniart, like Lamarck, believed that this part possessed a shell. M. Deshayes convinced himself by the examination of many well preserved individuals that this was not so: he found in these *Podopsides* a short auricle on each side, the very entire border of which auricles circumscribed a triangular aperture which, being filled, might be perfectly compared to the surface of the *Spondyli*, and it was this that led M. Defrance to establish for these species, with a posterior triangular opening, the genus *Pachytes*, which M. de Blainville adopted, and thinking that this posterior aperture was destined to give passage to a tendon of the animal, in order to its attachment to submarine bodies, placed the genus in the neighbourhood of the *Terebratulæ*, in his group of *Palliobranchiata*. M. Deshayes observes that nevertheless M. de Blainville was not unaware of the fact that *Pachytes* has at the umbo of the great valve an irregular impression resulting from the immediate adhesion of the shell to foreign bodies, and the former states that he has seen some old individuals still attached to the substances on which they had lived at the bottom of the sea. This genus then, says M. Deshayes, according to M. Defrance and M. de Blainville, offered the unique and curious example of animals having two modes of attaching themselves to submarine bodies. It is certain, says M. Deshayes, that in the molluscous animals actually known, one of these means of attachment excludes the other: those animals which fix themselves by the shell have neither byssus nor tendon, and those which fix themselves by a tendon or a byssus have the shell free and without immediate adhesion.

M. Deshayes then continues his discussion, remarking that the genus *Pachytes*, as we have seen, has been formed at the expense of the *Plagiostomata*. In comparing with the *Podopsides* the species there introduced, the most perfect identity, he remarks, had been recognised. The same comparative examination exercised upon the *Dianchora* of Sowerby, had convinced him that the last-named genus had all its characters identical with those of *Pachytes* and *Podopsis*. These observations conducted him to the conclusion that it was necessary to unite these three genera. But then the question arose, what was the nature of this genus? M. Deshayes avows that he knew not how to answer this question before he had made the following observation. M. Dujardin, he tells us, well known by his highly interesting observations on the corals of the chalk, as well as upon the so-called microscopic molluscous cephalopods [FORAMINIFERA], sent to M. Deshayes a very well preserved *Podopsis* from the chalk of Touraine. The latter zoologist, having remarked that in this individual the edges of the posterior triangular space were entire, and that this space itself was filled with a tender substance, was anxious to seek for some traces of the hinge; and he cleared away with precaution the interior of the *umbo*. The instrument with which he worked was soon arrested by a harder body, which when disengaged exhibited a singular shape, and determined him to break the part of the shell which stood in his way; and it was not without surprise that he disco ered in this *Podopsis* an internal cast which had too many relations with its external covering to leave the supposition ope.i that chance had thus placed it there. Well convinced that the cast belonged to the shell, M. Deshayes hesitated not to break away those parts of the external covering which obstructed the sight of the whole of the cast, the examination of which was necessary. The fracture exposed between the cast and the shell a layer of pulverulent matter very like pure chalk. This layer, which was thick towards the umbones, thinned out towards the borders, where it entirely disappeared, and left room for the examination of the solid part of the shell within. This external covering or *test*, extremely delicate and fragile towards the umbones of the valves, went on thickening towards the borders; it was furrowed within as well as without; no trace of hinge or muscular impression was seen; the pulverulent matter being removed, and the *test* placed conformably with the internal cast, it was plain that a vacant space existed between them, large towards the umbones, and progressively diminishing towards the borders of the valves; finally upon examining the internal cast itself, M. Deshayes states that there is found a great subcentral and posterior muscular impression, and that there may be observed on the side corresponding with the cardinal edge three great plaits or folds, which can only be the result of the impression made upon a strongly articulated hinge. The actually solid part of the *test* having no muscular impression and no hinge, it is certain that the internal cast could not have borrowed the impression of these parts from that portion, it must have taken it in the solid interior of a shell, and there is no doubt that this solid interior is represented by the new friable and pulverulent layer which in other individuals has entirely disappeared and left a void in its place.

The different new characters which M. Deshayes found in his *Podopsis* induced him to think that the shell belonged to the genus *Spondylus*. To leave no doubt on the subject, he took in soft wax the impression of the internal surface of the cardinal border of a recent *Spondylus*, with its valves closed. This impression was found entirely to resemble that of the cardinal border of M. Deshayes's cast of *Podopsis*. Thus did this acute and persevering investigator find in a *Podopsis* a cast completely resembling what would have been made in a *Spondylus*. He finds between the external and preserved part of the solid *test* or shell, and the internal pulverulent or dissolved part, the same affinity as between the two layers constituting the shell of *Spondylus*; he sees at the *umbo* of the great valve a triangular space which, being filled by the internal layer, would have formed that singular *talon* which is only seen in the *Spondyli*.

These indisputable facts conduct M. Deshayes to this conclusion:—the *Podopsides*, and consequently the *Dianchoræ* and *Pachytes*, are *Spondyli* whose internal layer has been dissolved, and has left the internal or cortical layer denuded. This partial dissolution or disintegration, he observes, is presented not only in the shells now under discussion, but also in all those composed of two layers. This disintegration, he adds, particularly shows itself in the fossils of the chalk strata, but the explanation of this incontestible fact is not yet manifest. How indeed, he asks, are we to explain the action of an agent capable of entirely dissolving a calcareous layer, and leaving at the same time another layer equally calcareous, and apparently of the same nature as the first, in the finest state of preservation? Our chemical laboratories are, he remarks, impotent when required to produce similar phenomena. M. Deshayes thus concludes this able argument:—'The preceding observations prove not only that it is necessary to unite the three genera in question, but also to refer them to *Spondylus*, and this opinion, which we have adopted for many years, will doubtless be also entertained by other zoologists.'

*Plagiostoma*, *Podopsis*, *Dianchora*, and *Pachytes* are thus disposed of and merged in *Spondylus*. Now let us see what the same learned observer says of *Plicatula*.

This small genus, instituted by Lamarck at the expense of the *Spondyli* of Linnæus, might, according to M. Deshayes, appear useful and sufficiently characteristic when only a small number of species are before the observer; but if he examines more, recent and fossil, he recognises the resemblance which it bears to *Spondylus*, and inquires whether it would be of any use to preserve it. Lamarck had himself perceived a passage from the *Plicatulæ* to the *Spondyli* by means of certain species. These intermediate species, participating in the character of both genera, are usually the most numerous; and M. Deshayes thinks that in a natural method the two genera ought to be united. He observes that the *Spondyli* and *Plicatulæ* have in common adhering inequivalve shells, which are spiny or rough, and with unequal *umbones*; a hinge with two strong teeth in each valve; and an intermediate fosset for the ligament, which is always internal. The characters proper to the *Spondyli*, according to Lamarck, consist in the existence of auricles on each side of the hinge, and of the prolongation of the umbo of the great valve into a talon, that prolongation having a flattened surface always divided by a furrow, in which the old traces of the ligament may be perceived. It is true, remarks M. Deshayes, that in the greater number of Spondyli the auricles are well marked, and that in nearly all the species of *Plicatulæ* they do not exist; but to appreciate the value of that character, it is sufficient to state that certain *Spondyli* have very small and hardly developed auricles, which may also be seen in the greater part of the *Plicatulæ*. It is true, he continues, that in the *Spondyli* the umbo of the adhering valve is always very much prolonged; but it is equally true that in the greater part of the *Plicatulæ* there is a remarkable prolongation of the adhering valve. Here we may remark that we have had in our possession *Spondyli* where the prolongation of the lower umbo was not great. But to return to the argument of M. Deshayes (which our remark appears to us to strengthen), though the prolongation in *Plicatula* is narrower and shorter, it has the same characters as in *Spondylus*. Finally, he argues, if it be true that in the greater part of the *Spondyli* the *talon* offers a furrow wherein one sees the old remains of the ligament, it is also true that many species of that genus have not this furrow, and have the ligament entirely concealed, and altogether resembling that of the *Plicatulæ*. These observations, says M. Deshayes in conclusion, prove that the more essential characters are entirely similar in both genera, and that those which have served to separate them are in reality of inferior importance, inasmuch as they vary in the species of the same group. These observations lead M. Deshayes to the following consequences:—that the *Plicatulæ* may be united to the *Spondyli*, and form a small group in the latter genus.

### Spondylus.

*Generic Character.*—*Animal* oval, oblong; the borders of the mantle disunited, thick, and furnished with many rows of tentacular cirrhi, many of which are truncated and terminated by a smooth and convex surface. Mouth oval, furnished with great cut (*decoupées*) lips, and on each side with a pair of oblong and pointed labial palps. Branchiæ in form of a crescent, and formed of detached filaments. Foot rudimentary, on the disk of which a club-shaped pedicle raises itself. Anus floating behind the adductor muscle of the valves. (Deshayes.)

*Shell* inequivalve, adherent, auriculated, beset with spines or rough; the umbones unequal; the lower valve offering an external cardinal facet which is flattened and divided by a furrow, and which increases with age. Hinge with two strong teeth in each valve, and an intermediate fosset for the ligament, communicating by its base with the external furrow. Ligament internal, the antient remains of which show themselves externally in the furrow. (Lamarck.)

Spondylus ducalis: internal view of valves, showing hinge, ligament, muscular impression, &c. *a*. upper valve; *b*, lower valve.

M. Deshayes remarks that there are few genera better characterized than *Spondylus;* so that, known as it has been from the days of Rondeletius and other naturalists of the same epoch, he has nothing to add to what Lamarck says of the shells; but, he adds, that as Lamarck gives an insufficient account of the animal, he will supply it.

M. Deshayes describes the animal of *Spondylus* as rounded or oval; its thickness being variable in different species. As in all the mollusks of the same family, the two lobes of the mantle are disunited, except in the short extent of the dorsal border corresponding to the hinge; they are thick in their circumference, and furnished with many rows of rather long fleshy cilia, between which, and on the internal border, may be remarked a certain number at irregular distances, truncated in the middle, and terminated by a smooth and convex surface, recalling to the mind of the observer the ocular surface of the tentacula of certain mollusks. [CONCHIFERA, vol. vii., p. 433.] These peculiar organs, he remarks, are also seen in *Pecten* and *Pedum*. He describes the adductor muscle as very large, circular, placed in the median and posterior part of the animal, and easily divided into two unequal parts. The abdominal mass is placed round this muscle, and especially at its anterior side. The mouth is situated below the anterior commissure of the mantle, it is surrounded with a large slashed lip, fringed on the edge and accompanied on each side with a pair of palps, but little elongated, in the form of myrtle leaves. The mouth communicates with the stomach by a short and rather wide œsophagus. The stomach is elongated, pyriform, conical, and continues itself by its pointed extremity into a cylindrical and slender intestine; this makes a single great convolution in the thickness of the liver, or rather, a great *ansa* having the sides parallel. It mounts again towards the dorsal border between the stomach and the adductor muscle, gives support to the ventricle of the heart, leans immediately afterwards on the superior and posterior surface of the muscle, and turns on itself to terminate posteriorly in a floating anus, which is easily perceptible in the posterior commissure of the mantle. At the anterior part of the animal, and towards the middle of the abdominal mass, a singular organ is found; it is composed of a disc supported by a short pedicle; from the centre of this disc a small cylindrical tendon, terminated by a small oviform fleshy mass, elevates itself. We see, remarks M. Deshayes, in this peculiar apparatus, a modification of the locomotive organ, the foot, become here useless for changing the place of the animal, because it invariably and immediately fixes its shell on rocks or other solid bodies constantly bathed by the sea. The *branchiæ* resemble those of the Pectens; they are large, equal, and crescent-shaped. The heart is symmetrical; a single ventricle embraces the intestine at the spot where it begins to lean upon the adductor muscle; this ventricle is flattened and lobated on each side; the auricles are similar, equal, and symmetrical; they are little elongated, pyriform, and their extremity is continued into a great branchial vessel, which soon becomes bifurcated. The distribution of the vascular system exhibits nothing particular, and resembles that of the Pectens and other acephalous mollusks.

We would add to the account above given of the shell of this genus, a few observations which we have made, sufficiently obvious indeed, but which have not, as far as we are aware, been noticed. The spines with which the *Spondyli* are armed, in some instances very long, must have struck everybody, and also that they bristle out on every side from the upper valve. The lower valve is attached, and adheres to submerged bodies by means of foliations. If the whole lower surface adheres, as it often does, not a spine is given out from the lower valve; but where the adhesion takes effect towards the anterior part of the lower valve only, as is very frequently the case, especially when the shell is affixed among the branches of corals, a favourite locality with some species, the foliations are confined merely to that part where adhesion is required, and the rest, a free part of the valve, is as profuse of spines as the upper valve itself. There are two points to be gained, support or adhesion, and defence; the first is of primary importance, but as soon as that is safe, all the resources of the animal seem to be turned towards its defensive and offensive armour. Those fishes which browse among the corals are thus deterred from injuring the living fixture which has there taken up its abode. A very fine series of specimens was collected with a view to this habit, and they showed not only the power which the animal had of secreting the proper process of shell according to the circumstances required, but of modifying the secretion according to the exigencies of the occasion.

Spondylus Americanus, with the valves closed; the umbones towards the spectator.

But there is another, and more interesting phenomenon well displayed in one of the species of this genus. Professor Owen, having been led to reflect, while considering the uses of the camerated part of the shell of NAUTILUS, upon the degree or extent of that structure as possibly dependent upon the mode of growth of the animal and its shell, and how far it was a necessary physical consequence of the increase and change of position of the animal, independently of any special purpose served by the forsaken parts or chambers of the shell, had paid attention to all the cases that had come under his observation of the formation of chambers in shells, by the secretion, on the part of the animal, of a nacreous layer, forming a new basis of support to the soft parts, and cutting off the deserted portion of the shell from the chamber of occupation. He laid the following observations on the structure of the Water-clam (*Spondylus varius*, Brod.) before a meeting of the Zoological Society of London, in June, 1837, and he observes that it is well known that the process above adverted to is not the only mode adopted to suit the shell to the changing form and bulk, or other exigencies of its occupant. Taking the genus MAGILUS, for one example, the Professor remarks that the part of the shell from which the body gradually recedes is filled up by the continuous compact accretion of calcareous matter, and a solid massive elongated shell is thus produced, which would be a great incumbrance to a locomotive mollusk, but is of no inconvenience to a univalve destined by nature to live buried in a mass of lithophytous coral.

Again, in *Helix decollata*, he observes, the deserted part of the shell, after being partitioned off by the nacreous layer secreted by the posterior part of the mantle, is broken away by some yet unexplained process, and, consequently, no chamber nor any solid apex of the shell remains.

But, continues the Professor, the retention of the deserted chambers, and the interception of certain spaces of the shell by calcareous septa, though not unknown in the gastropodous univalves, is more common in bivalves; and he adduces the case of a common oyster, which, if kept without food, will frequently expend its last energies in secreting a new nacreous layer, at a distance from the old internal surface of the concave valve, corresponding to the diminution of bulk which it has experienced during its fast, and thus adapt its inflexible outward case to its shrunken body.

Then he instances the calcareous tube exuded from the elongated mantle of Lamarck's *Septariæ*, in which the closed extremity is divided into chambers by a succession of layers at a distance of half an inch from each other, having a regular concavity towards the open extremity of the shell. These concave *septa* are, he observes, composed entirely of the nacreous constituent of the shell: in one specimen which he examined they were six in number; and he adds that they are thin, smooth, and closely resembling the partitions in the NAUTILUS and SPIRULA, save in the absence of the siphonic perforation.

Returning to the bivalves, Professor Owen points out the fact that among them the *Ostreæ* not unfrequently present shallow and irregular chambers in the substance of the shell, and that the *Etheriæ* have vesicular cavities interposed between the testaceous laminæ; but he states that the most constant and remarkable example of the camerated structure of the shell is presented by the large Spondylus or *Water-Clam* above named, so called from the fluid which (until lost by slow evaporation) occupies the chambers, and which is visible in the last-formed chamber through the thin semi-transparent exposed septum.

We possessed several fine examples of this species, and it was only in advanced stages of growth that the water was included. Young shells were entirely without it. The old shells, some of which were of great size, were copiously supplied. The water could be seen through the semitransparent floor or septum on which the animal reposed in the lower valve, and through the thin ceiling, so to speak, of the upper valve. As the shell was turned in the hand, the fluid could be observed through these transparent laminæ finding its level with air-bubbles at its surface, and could be heard as it trickled to that level. But to return to the Professor's interesting memoir.

In order to examine this camerated structure, and more especially to see how it was modified by the presence and progressive change of place of the adductor muscle, he had a fine specimen sawn through vertically and lengthwise: it measured eight inches in length; the substance of the concave valve, which was two inches and one-third in thickness at the thickest part, included fourteen chambers, separated from each other by very regularly formed and stout partitions, composed, as in other chambered shells, of the nacreous portion or constituent of the shell. The septa were slightly undulating in their course, but presented a general concavity towards the outlet of the shell. Not any of these partitions were however continued freely across the shell, but each became continuous at the muscular impression, which is near the middle of the shell, with the contiguous septa. In general also the septa commenced singly from the cardinal or upper wall of the valve, and divided into two when about one-fourth of the way towards the opposite or lower wall; the thickness of the undivided part of the septum being equal to, or greater than, that of the two divisions of layers into which it splits.

Professor Owen accounts for the fact of the septa becoming united together at the point of insertion of the adductor as follows:—The muscle never quits its attachment to the valves; while the lobe of the mantle, except in its circumference, and where it is attached to the adductor muscle, must detach itself from the surface of the valve which is about to be partitioned off, when it secretes upon the interposed fluid the new septum or basis of support. It is obvious therefore, he observes, from the condition under which the partitions are successively secreted, that they must adhere not only to the circumference of the valve, but to the preceding and succeeding septum at the part occupied by the adductor muscle, and for an extent corresponding to its circumference. The progressive change in the position of this muscle by the absorption of the posterior fibres and the addition of others anteriorly, changes in a corresponding degree the relative position of these subcentral confluent parts of the septa, and a beautiful undulated disposition of the whole chambered part is the result. If the adductor muscle were a tube instead of a solid mass, the central confluent part of the septa would of course be perforated, and a siphon would result, the calcareous walls of which, from the proximity of the chambers, would no doubt be continuous, as in many *Polythalamous* shells.

The same author notices the disposition to form chambers manifested, but in a much less degree, in the smaller flattened or superior valve of the species under consideration. In the specimen which formed the subject of his paper there were three chambers, with narrower intervals and much thicker partitions than in the lower valve. These partitions were confluent opposite to the muscular impression, as in the lower valve, and each partition expanded from this attachment in an infundibular manner, which reminds the observer of the *emboitement* of the calcareous part of the siphon in the *Spirula*.

'The secreting power of the lower lobe of the mantle in the *Spondylus*,' says Professor Owen in continuation, 'is greater than in the upper; and the layers of nacre which are successively deposited on the cardinal margin push forward in a corresponding degree the upper valve, leaving a heel or *umbo* behind the hinge of the lower valve, which, from the inactivity of the secreting surface of the upper lobe of the mantle, is not opposed by a corresponding *umbo* in the upper valve.

'The *laminæ*, which are deposited in a continuous series of superimposed layers at the hinge of the lower valve, are not continued in a like state of superposition throughout; they soon separate from each other, and do not again unite, except at the space corresponding to the adductor muscle, and at the circumference of the valve.

'The interspaces of these successive layers of the growing *Spondylus* cannot, from the absence of a medium of intercommunication, serve any purpose hydrostatically with reference to locomotion: it is a singular fact indeed that the *Spondylus*, in which the chambered structure is constant, and the *Ostreæ* and other bivalves, in which it is occasional, are cemented to extraneous bodies by the outer surface of the shell, generally by the concave valve. So that the septa must be regarded as mere dermal *exuviæ* still left adhering to the animal, to which, as a motionless bivalve, they are no incumbrance. It is highly probable that all the chambers are originally filled with fluid, as more or less is found in the outer ones of the specimens brought to this country.

'In the *Testaceous Cephalopods* a new structure is added, viz. the siphon, whereby the exuvial layers of the old shell and the deserted chambers are converted into a hydrostatic instrument, subservient to the locomotion of the animal. The operation of the siphon and chambers has been ably explained by Dr. Buckland in the *Nautilus*, where the calcareous inflexible tube protecting the membranous siphon is not continuous. The working of the siphon is however less intelligible in those species in which the outer calcareous tube is continued from chamber to chamber, as in the *Spirulæ*, *Orthoceratites*, &c.; and it is with respect to camerated shells of this kind that I would ask how far the reasoning suggested by the chambers in the Water-Spondylus may be applicable in their case, and whether a final intention can be clearly traced beyond the diminution of specific gravity occasioned by a large proportion of the shell being converted into receptacles of gas; if indeed we have sufficient evidence to assume that they do not contain a denser fluid, like the *Spondylus*.'

The cut represents a section of a very old individual of this species, in which the upper valve was very convex, and furnished with a great number of septa.

The fluid contained in the specimen exhibited by Mr. Owen, which is in the Museum of the College of Surgeons in London, was put into the hands of Dr. Bostock for examination by him, and the Doctor obtained the following results:—

It was turbid, had an acid saline taste, and a rank disagreeable odour. After standing for twenty-four hours, it deposited a whitish curdy sediment, and became clear and transparent. The clear fluid, amounting to 54 m., was

Section of Water-Spondylus cut longitudinally through both valves, which are represented as closed.

poured from the sediment, and was subjected to various tests. It was neither acid nor alkaline; it produced a very copious precipitate with the nitrate of silver, indicating the presence of a large proportion of muriatic acid; the muriate of barytes indicated a slight trace of sulphuric acid; while the appropriate tests of lime, magnesia, and iodine produced no effect. A portion of the fluid was evaporated by a gentle heat, when a quantity of crystals of the muriate of soda was obtained, amounting in weight to very nearly twenty per cent. of the fluid. After the removal of the crystals, a little brown matter was left in the capsule, but in too minute a quantity to enable Dr. Bostock to ascertain its nature and properties, except that it was not soluble in alcohol: we may however, he observes, presume that it gave the fluid its peculiar flavour and odour. It appeared then that the fluid in question consisted almost entirely of a solution of pure muriate of soda, differing therefore in its chemical constitution from sea-water. The sediment above mentioned appeared to consist of small globular, or rather, pyriform bodies, probably of an organic origin. (*Zool. Proc.*)

*Geographical Distribution, &c. of the Genus.—Spondylus* has been found attached to rocks, corals, other shells, &c., at depths varying from the surface to seventeen fathoms in the seas of warm and temperate climates (the Mediterranean for instance). The finest and most beautiful species are natives of tropical and intertropical localities.

The number of recent species recorded by M. Deshayes in his tables is 25. Of these, *Sp. gæderopus* is noted as recent and fossil (tertiary). The number given in the last edition of Lamarck is 21; but this does not include *Spondylus varius*, nor four other species brought home by Mr. Cuming, and described by Mr. Broderip. (*Zool. Proc.*, *Synopsis Testaceorum.*)

Plicatula.

*Shell* inequivalve, inauriculate, narrowed towards its base; the upper border rounded, subplicated; with unequal umbones, and without external facets. Hinge with two strong teeth in each valve. A fosset between the cardinal teeth, receiving the ligament, which is entirely internal. (Lamarck.)

Shell of Plicatula. *a*, hinge of upper valve.

*Geographical Distribution.*—The seas of warm climates, where it has been found adhering to stones, shells, and other submarine bodies, at depths varying from four to eleven fathoms.

M. Deshayes, in his tables, makes the number of recent species five, and the same number is recorded in the last edition of Lamarck.

Fossil Spondylidæ.

The fossils of this family are very numerous, and have a somewhat wide geological distribution. The number of species of *Spondylus* found in the tertiary beds is stated in the tables of M Deshayes to be nine, the same as that in the last edition of Lamarck; but two of these last (*Sp. Niissoni* and *Sp. spinosus*) are stated to be from the chalk: the first (which is *Podopsis truncata*, Nils.) from that of Scania and Maestricht, and the second (*Plagiostoma spinosum*, Sow.) from that of England, Germany, and France.

The number of fossil species of *Plicatula* noted by M. Deshayes as being found in the tertiary beds is seven. In the last edition of Lamarck the number recorded is ten: the locality given to one there described (*Plicatula pectinoides*) is the lias of France, Germany, and England. Mr. Lea notices another (*Plicatula Mantellii*) from the Claiborne beds (tertiary).

Dr. Mantell records two (*Plicatulæ inflata* and *pectinoides*) from the chalk-marl, Sussex.

Dr. Fitton notes the same two species from the gault and lower green-sand, and an uncertain species from the Portland stone (Dorset, Bucks), and the Oxford oolite (Cam.).

Professor Sedgwick and Mr. Murchison record *Plicatula aspera* from the Gosau deposits, and its equivalents in the Alps.

Of the other so-called genera belonging to this family, Dr. Mantell gives *Plagiostomata spinosum*, *Hoperi*, and *Brightoniense*, as found in the Sussex chalk-formation, and *Dianchoræ lata* and *obliqua*, from the same locality; *Plagiostomata elongatum* and *asperum* from the chalk-marl, and an unnamed *Plagiostoma* from the firestone or upper green-sand. Mr. Lonsdale enumerates *Plagiostomata giganteum*, *punctatum*, *duplicatum*, and *Hermanni*, from the Bath lias, and unnamed *Plagiostomata* from the inferior oolite, the great oolite, and the Forest marble of the same district; that from the Forest marble with a? Professor Phillips records *Plagiostoma giganteum*, from the inferior oolite and lias; *Pl. rusticum*, from the lias and coralline oolite; *pectinoïdium*, from the upper lias; *læviusculum* and *rigidum*, from the coralline oolite; *rigidulum*, from the cornbrash; one from the Oxford clay; *cardiiforme?* one from the Bath oolite; *duplicatum*, from the coralline oolite, Oxford clay, and Kelloway's rock; and *interstinctum*, from the cornbrash and Bath oolite. Also *Dianchora striata*, from the chalk. (*Organic Remains, Yorkshire Coast.*)

Dr. Fitton's list includes *Plagiostomata cardiiforme*, *elongatum*, *Hoperi?*, *rigidum*, *obliquatum*, *rusticum*, and a small species; and *Podopsis striatus* (*Dianchora striata*). (*Strata below the Chalk.*)

The number of *Plagiostomata* given in the last edition of Lamarck, exclusive of *Pl. spinosum*, noticed above, is six. The number of *Podopsides* stated in the same work, exclusive of *Pod. truncata*, noticed above, is one, viz. *Podopsis gryphoïdes*, and M. Deshayes expresses his opinion that Lamarck founded this species on a variety of *Ostrea vesicularis*; at all events, he says, M. Goldfuss is wrong when he refers this shell to Brocchi's *Ostrea navicularis*; this species, he adds, peculiar to the Subapennine beds, has never been found at Meudon.

SPONDY'LUS. [Spondylidæ.]

SPO'NGIA, the generic name under which Linnæus and many subsequent systematists have ranked the very numerous forms of organization analogous to the sponges of commerce. Generally, and we think justly, zoologists have claimed these organizations for the animal kingdom, and ranked them among the zoophyta; but there are eminent writers who dissent from this view on different grounds, and prefer to rank the marine and freshwater sponges with plants. That the animal and vegetable organizations both terminate obscurely toward the inorganic structures of creation, and that in this approach to their common boundary they touch and melt into each other at more than one point, are propositions which, for the purpose of the present argument, and in the actual condition of natural history, seem to require no proof; but much of the difficulty which is admitted or supposed to attend an exact determination of the animal or vegetable nature of certain stony corals (Nullipora, Lamarck), Spongiadæ, Corallinadæ, &c. arises from a want of recollection and application of these truths. If the boundaries between the animal and vegetable creations be *indefinite*, this must happen because the structures and functions to which these terms are rightly applied insensibly pass into and mix with each other, so as to render *definition* impracticable by single *diagnostic* characteristics, and difficult even by a careful *summation* of *analogies* and *differences*. When therefore zoologists define animal life to be characterized by locomotion, by sensation, or by irritability; or by a certain chemical constitution; or by certain orders of structures, as an internal digestive cavity, a nervous system, and the like,—it is not to be wondered that whole groups of undoubted animals are excluded by this inadequate method from all place in the real system of nature, and thrown into an appendix. But if, on the other hand, we recognise and act upon the principle that life manifests itself on the globe in a variety of aspects no otherwise limited than by certain general conditions, and by special adaptation to peculiar exigencies, then it will follow that all organic structures will be grouped round particular types, according to the number and importance of their agreements; these types, treated as single objects, will admit of similar arrangements; and a general classification may result, approaching to a really 'natural system,' and justifiable on the basis of the 'inductive philosophy.' [SARCOIDEA.]

The pervading idea which connects together the members of each group round one central type, is a community of structure and functions, and the place of a group among the other types of animal or vegetable life will be found by the analogies which, in respect of these structures and functions, it presents with other groups.

Considered in this manner, sponges, though they may not, as Aristotle reports, ever exhibit a shrinking movement (κίνησις) when touched—though no polypi and no real digestive cavities are recognised in them, must surely be admitted among the zoophyta. For in regard to their constituent structure, they are composed, as so many of the Polypiaria are, of a firm horny or stony skeleton, immersed in a soft gelatinous living mass; in respect of the aspect of these two substances, the resemblance which they offer to Alcyonia appears very strong, while their external forms, uncommonly varied, sometimes resemble Alcyonia, often approach to Palmipora, frequently to Pavonia, Agaricia, and other forms of Lamelliferous Zoophyta. The currents of water which pass through the canals of their substance are analogous to many operations among Polypiaria and Mollusca, and perhaps depend on similar ciliary organs, though, except on the young ova of sponges, they have not yet been detected. As however they contain no Polypi, it is difficult to rank them under the Polypiaria. Dr. Johnson omits, in his excellent work on British Zoophyta, the sponges, and the following summary of his reasons deserves attention: 'If they are not the productions of Polypes, the zoologist who retains them in his province must contend that they are individually animals, an opinion to which I cannot assent, seeing that they have no animal structure or individual organs, and exhibit no one function usually supposed to be characteristic of the animal kingdom. Like vegetables, they are permanently fixed; like vegetables, they are non-irritable; their movements, like those of vegetables, are extrinsical and involuntary; their nutriment is elaborated in no appropriated digestive sac; and, like cryptogamous vegetables or algæ, they usually grow and ramify in forms determined by local circumstances, and if they present some peculiarities in the mode of the imbibition of their food, and in their secretions, yet even in these they evince a nearer affinity to plants than to any animal whatever.' On this we may remark, that very many animals are as permanently fixed as sponges; that irritability is not to be looked for in every part of a sponge, any more than in a Rhizostoma, whose divided digestive cavities are very unlike ordinary stomachs; and that the forms of sponges include remarkable analogies with the supports of Polypi.

It is to our countrymen Ellis and Dr. Grant that the history of sponges is most indebted. The former established the existence and nature of the currents of water which pass through the substance; and the latter, besides confirming the results of Ellis, added a vast quantity of new and valuable observations. Mr. Bowerbank has contributed precise information regarding both the fossil and recent sponges. (Ellis, *On Corallines*; Grant, 'On Sponges,' in *Edinburgh Phil. Journal*; Bowerbank, *Geol. Proc.*, 1840; and *Micros. Journ.*, 1841.)

Sponges are thus characterized, in accordance with the researches of Ellis and Grant, by Dr. Fleming (*British Animals*, p. 518): 'Sponges consist of an albuminous skeleton and gelatinous matter, forming a mass not irritable, with numerous holes, connected internally with anastamosing canals. The skeleton is either simple, consisting of *horny fibres*, as the species so commonly used for domestic purposes; or compound, being strengthened by calcareous or siliceous *spicula*.* The gelatinous matter, abounding in transparent globules, connects the different parts of the skeleton, lines the various canals, and forms the margins of the openings. The *pores* are minute openings (on the surface) with a gelatinous margin, strengthened or defended by the skeleton or spicula, into which the water enters in currents, generated probably by a ciliary apparatus, which however has not yet been detected by the microscope. The water, after traversing the interior canals, is ejected by means of *orifices* which are larger than the pores, and in many species are elevated above the surface in the form of perforated papillæ. The *Ova* are numerous, at first appearing like groups of minute, irregularly shaped, opaque granules, derived from the gelatinous matter, which unite into ovate bodies, falling at maturity into the canals, and are expelled by the orifices. These ova float in the water, and exhibit spontaneous motion by the rapid action of the ciliæ, which cover the anterior portion of the body, and at length attach themselves and then expand into the forms of maturity. The currents from the orifices are best examined by placing the recent animal in a shallow dish of water, and throwing a little powdered chalk on the surface, the motion of which will indicate the direction of the streams. For the purpose of examining the skeleton, it is requisite to macerate the sponge in hot water, which removes the gelatinous matter, and leaves the skeleton in a state fit to be examined under a microscope. When the spicula are siliceous, the animal matter may be removed by nitric acid, or by combustion, as was practised by Müller (*Zool. Dan.* t. 85), when the vitreous needles will appear unaltered.'

* Some of the skeletons of sponges are (perhaps) entirely *horny*: others, as in a beautiful specimen from the West Indies which M. Stutchbury has shown us at Bristol, are entirely *siliceous*; possibly some are entirely *calcareous*: but the greater number are *compound*, and consist of horny matter with additions of spicula in various proportions.

The gelatinous substance of sponges is scarcely capable of conservation. It is usually of a ropy consistence, sliding off from the skeleton, or else pressed off by the divers for sponge. It is of various colours, but commonly fawn coloured or orange coloured; in this respect resembling the gelatinous parts of Polypiaria.

Horny sponges with anastomosing fibres, fit for domestic use, belong mostly to warm zones of the sea; sponges with calcareous spicula are rather numerous on the British coasts; and siliceous spicula are common in the sponges of most latitudes. [SPONGIADÆ.] Remains of both horny and spicular sponges occur in a fossil state.

**SPO'NGIA, MEDICAL USES OF.** The use of sponge by surgeons, in its natural state, to absorb fluids, needs no notice, but it is also employed by them under the name of sponge tent, when prepared in a particular manner. This consists in dipping the sponge in melted wax, and compressing it between iron plates till it hardens on cooling; it is then cut into cylindrical or other forms. The pieces are introduced into sinuses and other narrow canals, with the intention of dilating them by the expansion of the sponge, when the wax melts by the heat of the part. Sponge tents are however little used by modern surgeons.

According to the analysis of Hornemann, sponge consists of a substance similar to osmazome, animal mucus, fat oil, a substance soluble in water, a substance only soluble in potash, and traces of chloride of sodium, iodine, sulphur, phosphate of lime (?), silica, alumina, and magnesia.

When sponge has been cut into pieces, beaten in order to free it from little stones and shells, and burnt in a closed iron vessel, till it is black and friable, it is then called *burnt sponge* (spongia usta), and has in 1000 parts the following composition, according to Preuss:—343 parts are destroyed by heat; the remaining parts are—carbon and siliceous insoluble matters, 327; chloride of sodium, 112; sulphate of lime, 16; iodide of sodium, 21; bromide of magnesium, 7; carbonate of lime, 103; magnesia, 4; protoxide of iron, 28, and phosphate of lime, 35. As the virtues of this greatly depend on the proportion of iodine, much of which is volatilized by the high temperature required to calcine the sponge, it has been proposed only to expose it to such a heat as will thoroughly dry, and colour it brown, and render it friable, when it may be powdered, and preserved in well-closed bottles. For use it is generally formed into an electuary or into lozenges. A test of its goodness consists in heating it in a glass flask with sulphuric acid, and if copious violet-coloured fumes be evolved, this proves that it contains much iodine. Burnt sponge has been almost completely superseded in the treatment of bronchocele and scrophula by iodine and its preparations; but as it obviously consists of a natural combination of many of the principles which have been deemed useful in scrophula, it ought not to be hastily discarded. It is with great propriety retained in the Dublin Pharmacopœia.

SPONGIADÆ. Regarding sponges as Apolypiferous Zoophyta, composed of flexible or rigid skeletons enveloped in a gelatinous mass, productive of inward currents through small surface pores, and outward currents through continuous canals, we may proceed to analyse the large group of organic forms possessing these characters, by the nature and arrangement of the skeleton, for the gelatinous part (though perhaps conservable, if due care be used) is not probably capable of being examined so as to furnish distinctive and recognisable characters.

Dr. Grant pointed out the principles of this analysis, by his observations on the nature and arrangement of the horny fibres, the calcareous and silicious spicula, and the formation and distribution of the pores and orifices of sponges. Dr. Fleming (*British Animals*) gives the following genera, under the family of Spongiadæ:—Tethya, Halichondria (including Spongilla of Lamarck), Spongia, Grantia. (Siphonia, Choanites, and Ventriculites of Parkinson and Mantell are included in Halichondria.)

Blainville (*Actinologie*) arranges under the head of Amorphozoa — Alcyonellum, Spongia, Calcispongia (Grantia, Fleming), Halispongia, Spongilla (Ephidatia, *Lamouroux*), Geodia, Cœloptychium (fossil), Siphonia, Myrmecium (fossil), Scyphia, Eudea (fossil), Halirrhoa (fossil), Hippalimus (fossil), Cnemidium (fossil), Lymnorea (fossil), Chenendopora (fossil), Tragos (fossil), Manon (fossil), Ierea (fossil), Tethium.

Very few of these genera, adopted from Schweigger, Goldfuss, and others, can be considered as at all sufficiently determined, because the constituent structures of the fossil masses, on which alone they can be justly founded, have, in most cases, been altogether left unexamined. When the modern achromatic microscope shall have been directed upon them, with such perseverance as Mr. Bowerbank (*Proceedings of Geol. Soc.*, 1840) has employed on the spicular structures of the sponges imbedded in or constituting the nodules of flint in chalk, so that the forms of the anastomosing fibres or stiffening spicula, the sections and distribution of the canals, &c., can be certainly defined, a great benefit will arise to this branch of zoology, and an equal advantage for geology.

*Groups of which the Constituent Structure is known.*

Spongia.—Mass soft, elastic, more or less irregular in shape, very porous, traversed by many tortuous canals which terminate at the surface in distinct orifices. Substance of the skeleton, cartilaginous fibres anastomosed in all directions, without any earthy spicula.

Example, Spongia communis. (Blainville's *Actinologie*, pl. 93, fig. 3.)

Calcispongia, *Blainville* (Grantia, *Fleming*; Luchelia, *Grant*)—Mass rigid, or slightly elastic; of irregular form, porous, traversed by irregular canals, which terminate on the surface in distinct orifices. Substance of the skeleton cartilaginous fibres, strengthened by calcareous spicula. The spicula are seldom simple, often triradiate in figure.

Example, Calispongia compressa. (Montague, in *Wern. Trans.*, vol. ii., pl. 12.)

Altogether Fleming and Blainville admit five species of this genus as determined. . They occur on the British and other northern shores.

Halispongia, *Blainville* (Halichondria, *Fleming*).—Mass more or less rigid or friable, irregular, porous, traversed by tortuous irregular canals, which terminate at the surface in distinct orifices. Substance cartilaginous, fibres strengthened by silicious (generally fusiform or cylindrical) spicula.

Example, Halispongia papillaris, Grant. (*New Edinb. Journal*, vol. ii., tab. 11, f. 21.)

Blainville admits fourteen species. Fleming, who includes in it the fresh-water spongilla (Ephydatia, *Lamouroux*), counts eighteen species. In what manner the immense number of species of sponges mentioned by Montague and Lamarck are to be distributed among these three groups, which ought to be considered *families* rather than genera, does not appear.

The remarkable silicious sponge which has been before alluded to [Spongia] as under examination by Mr. Stutchbury of Bristol, would appear justly entitled to constitute a new genus, if, as we suppose, it is in no manner dependent for its figure on a cartilaginous skeleton, but is really and entirely a silicious mass, supporting a gelatinous envelope.

Spongilla, *Lamarck* and *Blainville* (Ephydatia, *Lamouroux*).—Mass more or less rigid or friable, irregular, porous, but not furnished with regular orifices to internal canals.

Examples, Spongilla fluviatilis, *Linn.*: Spongilla lacustris, *Lin.*

For the animal nature of these fresh-water sponges the argument is less complete than for the marine tribes. By experiments as to the effect of light on them, Mr. John Hogg (*Linn. Trans.*) has endeavoured to show that they are influenced by this agent in the same manner as plants are, and that their green colour depends upon exposure to it.

*Groups depending on Characters of Surface or general Figure.*

Geodia, *Lamarck*.—Mass fleshy, tuberous, irregular, hollow within, externally incrusted by a porous envelope, which bears a series of orifices in a small tubercular space.

Example, Geodia gibberosa, *Schweigger*. (Blainville, *Actinologie*, pl. 91, fig. 4.)

Coeloptychium, *Goldfuss*.—Mass fixed, pedicled, the upper part expanded, agariciform, concave, and radiato-porose above, flat and radiato-sulcate below. Substance fibrous.

Example, Coeloptychium agaricioideum, *Goldfuss*. (*Petrefactenkunde*, pl. 9, fig. 20, *a—e*.)

From the chalk of Westphalia.

Siphonia, *Parkinson*.—Mass polymorphous, free or fixed, ramose or simple, *concave* or *fistulous above*, porous at the surface, and penetrated by anastomosing canals, which terminate in subradiating orifices within the cup.

Example, living, Siphonia typum. (Blainville, *Actinologie*, pl. 95, fig. 1.) Sicily.

Example, fossil, S. pyriformis, *Goldfuss*. (*Petrefactenk.*, tab. 6, fig. 7, *a*, *b*, *c*, *d*, *e*.)

Siphoniæ abound in the green-sand formation.

Myrmecium, *Goldfuss*.—Mass subglobular, sessile, of a close fibrous texture, forming ramified canals which radiate from the base to the circumference; summit with a central pit.

Example, Myrmecium hemisphericum, *Goldfuss*. (*Petref.*, tab. 6.)

Scyphia, *Oken*.—Mass cylindrical, simple, or branched, fistulous, ending in a large rounded pit, and composed entirely of a reticulated (firm) tissue.

Example, living, S. fistularis, *Esper*. (Tab. 20, fig. 2.)

Example, fossil, S. mammillaris, *Goldf.* (*Petref.*, tab. 2, fig. 1.)

Eudea, *Lamouroux*.—Mass filiform, attenuated, subpedicellated at one end, the other enlarged, rounded, with a large terminal pit; surface reticulated by irregular lacunæ, minutely porous.

Example, Eudea clavata, *Lamouroux*. (*Gen. des Polyp.*, tab. 74, fig. 1-4.)

Halirrhoa, *Lamouroux*.—Mass turbinated, nearly regular, circular, or lobate; surface porous; a large central pit on the upper face.

Example, Halirrhoa costata, *Lamouroux*. (*Gen. des Polyp.*, pl. 78, fig. 1.)

From the oolite of Caen.

Hippalimus, *Lamouroux*.—Mass fungiform, pedicellated below, conically expanded with a central pit above; surface porose, and irregularly excavated.

Example, Hippalimus fungoides, *Lamouroux*. (*Gen. des Polyp.*, pl. 79, fig. 1.)

From the oolite of Caen.

Cnemidium, *Goldfuss*.—Mass turbinated, sessile, composed of close fibres and horizontal canals, diverging from the centre to the circumference; a central pit on the upper surface, cariose in the exterior, and radiated at the margins.

Example, Cnemidium lamellosum, *Goldf.* (*Petref.*, tab. 6, fig. 1.)

Lymnorea, *Lamouroux*.—Masses mammellated, finely porous and reticulated, agglomerated within a common calyciform wrinkled adherent base.

Example, Lymnorea mammillosa, *Lamouroux*. (*Gen des Polyp.*, tab. 79, fig. 2.)

From the oolite of Caen.

Chenendopora, *Lamouroux*.—Mass conical, infundibuliform, external surface sulcated across, internal face porose.

Example, Chenendopora fungiformis, *Lamouroux*. (*Gen. des Polyp.*, pl. 75, fig. 10.)

From the oolite of Caen.

Tragos, *Schweigger*.—Mass composed of dense, close, coalescing fibres; surface covered by distinct scattered orifices.

Example, Tragos difforme, *Goldfuss*. (*Petref.*, tab. 5, fig. 3.)

Manon, *Schweigger.*—Mass composed of reticulated fibres, pierced on the upper face by distinct encrusted circumscribed orifices.

Example, Manon tubuliferum, *Goldf.* (*Actinologie*, pl 95, fig. 4.)

From the chalk of Maastricht.

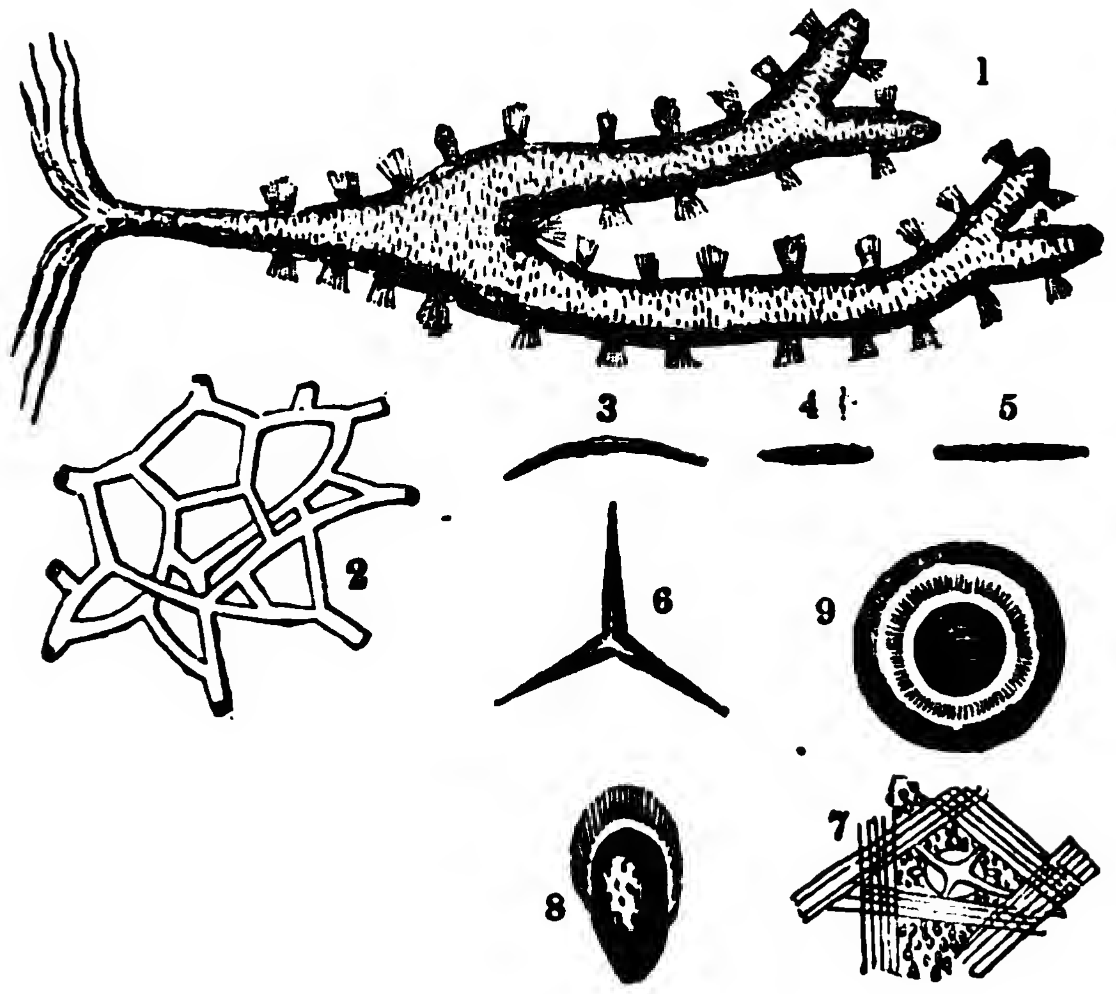
Ierea, *Lamouroux.*—Mass ovoid, subpediculated, finely and irregularly porous, pierced on the upper part by many orifices, the terminations of internal tubes.

Example, Ierea pyriformis, *Lamouroux.* (*Gen. des Polyp.*, tab. 78, fig. 3.)

From the oolite of Caen.

Tethium, *Lamarck.*—Mass subglobose, tuberose, composed of a cariose firm substance, strengthened by abundance of simple (silicious?) spicula fasciculated and diverging from the centre to the circumference.

Example, Tethium lyncurium, *Marsigli.* (*Actinologie*, pl. 91, fig. 3.)




(From Dr. Grant.)

1, Spongia oculata, British, showing the orifices and currents outwards; 2 anastomosing horny substance of Spongia communis; 3, silicious spiculum of Spongia papillaris; 4, of Spongia cinerea; 5, of Spongia panicea; 6, calcareous spiculum of Spongia compressa; 7, transverse section of a canal of Spongia papillaris, to show the structure and the ova passing along the canal; 8, ovum of Spongia panicea seen laterally—the ciliæ are anterior; 9, the same seen on the end, with a circle produced by the ciliary action; 10, young Spongia papillaris, grown from an ovum which had ceased to move about.

**SPONGIOLE, or SPONGELET,** is a term applied by De Candolle to the extremities of the ultimate fibrils into which the roots of all plants are divided. It was thus named on account of the great power of absorption which this part possesses, compared with other parts of the root. It must not however be looked upon as a special organ, as upon examination the spongiole will be found to consist of merely a looser mass of cellular tissue than is found in the root above it. It is at this point that the fibrils of the root elongate by the addition of cells of cellular tissue, so that this part of the root is at once the immediate agent in the absorption of fluid from the soil and the growing point of the root. The spongiole has been considered by some as the sole agent in absorption, but we have pointed out, in the article ROOT, that there are other organs, called root-hairs, which are seated all over the surface, which appear to assist in this process, in the same manner as the hairs of leaves participate with the stomates in the absorption of moisture from the air. Nevertheless the spongioles are undoubtedly the principal agents in absorption, which the following experiment of Senebier in a great measure proves. He placed two roots in such a manner that the extremities alone of one were immersed in water, whilst every other part of the other root was exposed to the water except the extremities. In the first instance the plant retained its freshness for several days, but in the latter the plant withered quickly, but recovered its freshness as soon as its extremities were immersed. A knowledge of the function of the spongioles should be taken advantage of in the operation of transplanting. If these parts are not preserved during this process, it is to most plants certain destruction. Consequently every care should be taken by loosening the soil and using only a gentle application of force in order to prevent the injury to which these delicate parts are exposed in removing plants from one spot to another.

The extremity of the root being so active in absorbing, explains the reason of the luxuriant foliage of large forest-trees during seasons of drought or in dry arid soils. The ground in contact with the principal trunks of the roots is probably dry and hard for a great distance; but the extremities of the root will have sunk deep enough into the soil or have extended far enough to find a reservoir of moisture, from which they absorb the supply of fluid that maintains the freshness and vigour of the tree. In the same manner trees are prevented from suffering by the exhaustion of the nutritious particles of the soil, as the lengthening spongioles are constantly introducing themselves into new and unexhausted parts of the surrounding soil.

The spongiole is also the growing point of the root. That this is the fact is proved by the experiments of Duhamel, who marked corresponding points on the root of a plant and a glass vessel, and found, after some time, that although the root had elongated considerably, the marked points of the root and glass still corresponded. The same results have been obtained by other experimenters. From some experiments made on the aerial roots of the Orchidaceæ, Dr. Lindley thinks that this property of elongating at the point is confined to plants which have to overcome some resistance in the course of their growth. He found that by tieing some pieces of thread at certain distances on the roots of a Vanilla, these distances were, at the end of a short period, considerably increased. The possession of this property by roots meeting with resistance would seem to be a provision for facilitating their functions; as in this way they grow straight and even, and thus transmit their fluids rapidly, whilst if they lengthened at any other part, they would become tortuous and twisted from resistance, and their functions would be impeded.

*Spongiole* is also applied to indicate the warty excrescences that are often found upon the testa of various seeds, especially near the hilum. In this case it is almost synonymous with *Strophiola.* The spongiole of the roots is called *spongiola radicalis;* that of the seed, *spongiola seminalis.*

**SPOON.** The great and constant demand for this useful article of table-furniture has led to the exercise of much ingenuity in its manufacture. Spoons and similar articles, when made of silver or plated metal, are generally formed by stamping with dies, with more or less of ornamenting and finishing by hand. A machine for stamping spoons, ladles, forks, &c. was patented in 1833 by Mr. Jonathan Hayne of Clerkenwell, consisting of a very heavy weight, or hammer, capable of sliding up and down between two vertical cheeks, like the hammer of a pile-driving engine. The protuberant portion of the die, which is to form the hollow of the bowl of the spoon, is laid on the bed of the machine, and the other part is secured to the under side of the hammer. The metal to be stamped is applied in the form of a thin plate, roughly cut to the shape of the article, and sometimes a little bent or hollowed with a hammer to make it lie steady upon the lower die. The dies are so formed as to complete the article at a single blow, leaving only a thin *fin*, or rough edge, to be trimmed off by hand; and their edges are so bevelled that the upper and lower dies never come in contact with each other in any part. The hammer is elevated by a windlass, or other suitable means, and released, when required to fall, by means of a trigger. The violence of the blow causes the hammer to rebound, and an ingenious apparatus is attached to it to prevent it from falling again so as to strike the article a second time. A particular description of this machine, with engravings, is given in Dr. Ure's 'Dictionary of Arts,' &c., under the head 'Stamping of Metals.' Spoons of Britannia-metal and similar fusible alloys are formed by casting in brass moulds; and to avoid the risk of fracture from the softness of the metal, they are sometimes cast with a narrow slip of tinned-iron along the inside of the shank.

The medicine-spoon invented by Mr. George Gibson, and rewarded by the Society of Arts in 1828, is a convenient instrument for administering fluid medicine to children, or to patients in a recumbent position The bowl is of longer and deeper proportion than that of a common spoon, and is completely covered, excepting a small aperture at the end; and the handle is short, and consists of a tube opening at one end into the bowl, and capable of being closed at the opposite end by the application of the thumb. The medicine is poured in at an opening in the lid, which is then closed with a tightly fitting cover hinged to the spoon. The end of the tubular handle is then closed with the thumb, which, by precluding the access of air, prevents the medicine from running out until the spoon is placed in the mouth of the patient; the thumb being afterwards removed, air enters by the handle, and the medicine flows out from the point of the spoon, and is swallowed with very little annoyance from its disagreeable taste.

SPOONBILL. [HERONS, vol. xii., p. 167.]

SPORA'DIC (the Greek word σποραδικός, with the termination dropped) is a term applied to any disease which, being usually epidemic or contagious, occurs at any time in a few persons, without spreading extensively through a district. For example, in the year just past (1841) several cases of *sporadic* cholera have occurred; that is, several persons, at different times and in different parts of the country, have been affected with a disease in no respect different from the cholera which raged as an epidemic in 1832; but it has not spread beyond them by contagion, nor has it attacked a number sufficient to give it the character of an epidemic. The circumstances on which the occasional occurrence of diseases that are usually epidemic, in a sporadic form, depend, are altogether unknown.

SPORA'NGIUM (from σπορά, a sowing, and ἄγγος, a vessel), a term first employed by Hedwig to designate the capsule of Mosses, and since applied very generally in cryptogamic botany to that part of the reproductive apparatus which contains the spores. It is used in almost all the cryptogamic tribes synonymously with the terms *theca, capsule, conceptacle, folliculum, involucrum, sporocarpium*. The multiplication of names applied to parts performing the same functions in the various tribes of Cryptogamia has often led to much inconvenience; and it is much to be desired that writers on this department of botany would agree to the adoption of a few well-defined terms, that would apply to the whole of this class of plants.

In the Ferns, the sporangia are seated in the back of the frond, forming little heaps called sori. [SORUS.] They are small brittle compressed bags, consisting of cellular membrane, and are partially surrounded by a thickened ring called the *gyrus*. By means of this ring the sporangia burst, and emit the spores which they contain. Most writers consider these organs to be the analogue of the ovary, or female organs, in the flowering plants. In Ophioglossaceæ, a small tribe of ferns, there are no sporangia, the spores being contained in two lines parallel with the midrib of the fertile frond, and are emitted when the frond unfolds itself.

In Lycopodiaceæ the sporangia are seated in the axils of a bract upon the fruit-stalk, and either burst by distinct valves or are indehiscent. In this order there are two kinds, the one containing minute powdery granules, the other containing only three or four roundish fleshy bodies. The contents in both cases are considered sporules.

In Marsiliaceæ the sporangia form a sporocarpium. [SPOROCARPIUM.] In Salviniaceæ they are of two kinds: in the one kind the sporangia are composed of a thin reticulated membrane, and contain one or six and nine granules in their interior; in the other kind the granules are attached by pedicles to a central column, and are much smaller than the first. These latter have been supposed to be male organs, and the former female organs.

In the Mosses the sporangia are open and urnshaped, and are mostly elevated on a slender stalk called the *seta*. The brim of this organ is furnished with an elastic ring called the *annulus*, and it has an interior organization called *peristomium*. This internal part of the sporangium has been called by Endlicher the *sporangidium*. In the small section Andræaceæ the sporangia are closed and split into four valves. Linnæus supposed the sporangia were the male organs of the Mosses.

In the Jungermanniaceæ the sporangium has no central column, as in Mosses, nor does it open by an operculum. It is a valvular brown case elevated upon a cellular frequently twisted seta. It is filled with spiral fibres, called *elaters*, among which the sporules lie intermixed. The spiral fibres by their hygrometric properties open the sporangium, which is composed of four valves, and in this way the spores escape.

In Marchantiaceæ the sporangium is placed, in some, beneath a fungus-like receptacle, which is covered by a calyptra; and in others it is buried in the substance of the frond or seated upon it.

Sporangium is not applied to the reproductive organs of Lichens, but the analogues of this organ in these plants are what are called the *shields*, or *apothecia*, which are filled with little tubes called *asci*, in which the sporules are contained. There is also another form of the reproductive organs in Lichens, called *soredia*, which are little heaps of powdery grains scattered over the surface of the plant, which are also the analogues of the sporangia.

In the Algæ, the sporules are scattered in most instances throughout the substance of the plant, so that they have no proper seed-case or sporangium; but whenever the sporules are collected together into one spot, and covered over by a distinct case, this is called a sporangium.

Among the Fungi the spores are frequently disseminated throughout the cellular tissue of the plant, so that they have no particular organ to contain them. Some of the Fungi however consist of a hollow case containing spores, as the Lycoperdons and Sphærias, and the case consisting of the whole plant is called by many writers the sporangium. [SPORULES.]

SPORENDO'NEMA, a genus of plants belonging to the natural order Fungi and the tribe Mucedines. It is exceedingly simple in its organization, consisting merely of sporidia disposed in rows within the tubular pellucid flocci. There are two species of this form of mould, the one, S. *Casei* (red cheese-mould), is found on cheese, presenting little red tufts, which, under the microscope, exhibit the flocci somewhat branched and woven together. The other species, *S. muscæ*, is called fly-mould, and is found on the bodies of flies in the autumn of the year. It consists of flocci glued together, forming little white-lobed tufts, which make their appearance between the plates of the abdomen of the insect. This is one of the few instances of plants being parasitic on animals. This however has been denied, and some writers assert that the fly-mould is nothing more than a diseased secretion from the body of the fly. But Fries, Berkeley, and other cryptogamists have recognised this mould as a plant.

SPORES. [SPORULES.]

SPOROCARPIUM (from σπορά, a seed, and καρπός, fruit), a term proposed by Link, and very generally adopted by German cryptogamic botanists, to express a combination of sporangia when placed near together, and more especially when any number of sporangia are enclosed in a common membrane.

Sporocarpium in this sense has been applied by Endlicher to the organ containing the reproductive organs in the

Marsilea Fabri.

*aa*, Sporocarpia or involucra seated in the axils of the leaves; *b*, sporocarpium bursting; *c*, a mucilaginous curved cord, to which the sporangia are attached; *d*, the sporangia; *e*, the same removed from the cord, exhibiting the ovules; *f*, reverse side showing the anthers; *g*, the mucilaginous cord straightened, and the sporangia seated on it.

order Marsileaceæ. To this part the name involucre has been given by many writers. The sporocarpium of Marsilea when cut into exhibits several cells, which contain little granular bodies. In the course of time these granular bodies are projected from the sporocarpium, which splits into two valves, being arranged around a mucilaginous cord, which when it first appears is curved round, as seen at *c* in the accompanying drawing of Marsilea Fabri. This mucilaginous cord eventually becomes straight (*g*), bearing upon it the granular bodies arranged in a spiral whose expression is $\frac{2}{5}$. The granular bodies, or sporangia, consist of two parts: first, the upper surface, which presents a number of small globular bodies, *e*, called ovules, and are surrounded by a little projecting hood surmounted by a papilla; and, second, the under surface, which presents a number of little membranous sacs, which are filled with grains resembling pollen, and hence have been called anthers. For an accurate account of the structure of this singular tribe of plants we are indebted to M. Fabre, who made his observations upon a new species of Marsilea discovered by himself, and named after him by M. Dunal. His paper is printed in the seventh volume of the second series of the *Annales des Sciences Naturelles*. In the course of his observations M. Fabre found that the ovules above described did not germinate unless the little papilla at their point had been brought in contact with the pollen grains contained in the sacs on the under surface of the granular bodies. M. Fabre's paper is a valuable contribution on this obscure department of vegetable physiology, and points out in this plant a beautiful link between the flowering and flowerless plants.

SPORULES, or SPORES, the minute organs in cryptogamic or flowerless plants from which new plants are produced, answering to the seeds in the phanerogamic or flowering plants. Although these organs perform the same office in the economy of the plant as seeds, yet they differ very essentially, and the objection that some have made to giving them a different name has been very properly disregarded by most writers on cryptogamic botany. They differ from seeds, first, in their *origin*. Seeds are produced as the result of the action of two organs on each other, whilst in spores, whatever may be the anxiety of botanists to discover in the organs of reproduction of the lower plants parts analogous to stamens and pistils, there is no evidence of their general existence. In *structure* they differ also very much. The action of the stamen on the pistil in flowering plants is to introduce a pollen-grain from the former into a little bag, the ovule, in the latter, which becomes the embryo constituting the essential part of the seed. In the spore no embryo exists. It consists of a simple cell of tissue, frequently containing a fluid, in which smaller grains may be observed floating about. Lastly, in the *germination* of spores and seeds there is also a great difference. In the seed, the embryo plant is provided with organs, the plumule and radicle, which it sends upwards and downwards always from the same point, and no treatment will induce the one to grow up and the other down. But in the spores generally there is no fixed point from which the root or stem proceeds. That part of the spore which is exposed to the light will put forth a stem, and that which is towards the dark will put forth a root, and so much is this a matter of indifference in plants produced from spores, that Mirbel found that up to a certain point, by merely inverting the germinating sporules of a Marchantia, he could make the root assume the character and functions of the stem, and *vice versâ*. Some observations have however been lately made by Mr. Valentine on the spores of *Pilularia*, from which he infers that in the higher Cryptogamia, at least, the direction of the root and stem is fixed. (*Linnean Transactions*, vol. xviii.)

The situation of the sporules is exceedingly various. In the Fungi and Algæ they are frequently diffused throughout the substance of the plant without any proper covering or receptacle. In the higher forms, as the Mosses, Ferns, Jungermannias, &c., they are contained in a special organ called the SPORANGIUM.

The sporules of many plants exhibit a curious relation with the animal kingdom in their power of spontaneous movement. This is seen to a greater extent amongst the Algæ than any other, especially the group which has been called Zoocarpeæ. In these plants the sporules, after being discharged, assume the existence and character of animalcules: at the end of a short time they attach themselves to some surface, commence germinating, and spend the rest of their existence as plants. [ZOOCARPEÆ.] In many of the higher Cryptogamia these movements are observed. In the organs called antheridia of the genus Sphagnum, Unger and Meyen have observed a kind of spermatic animalcule resembling a Vibrio, which seems to be only another form of the sporules of this plant. The granular matter contained in the middle of the sporules is also endowed with motion; and when the sporule bursts, the grains are sometimes very active. The same circumstance is also observed in the pollen-grains of the flowering plants.

A question has arisen amongst botanists as to whether the spores of all cryptogamic plants have a specific power of reproduction. It has been maintained by men of no mean reputation that the lower tribes have no such power; that their sporules are a common matter, which, meeting with a proper nidus, develops the various forms which are seen, according to the character of the nidus. Many facts can be brought forward to support this theory; but seeing we have so much evidence in favour of the existence of a specific power of reproduction in the seeds and sporules of higher plants, it seems to be more philosophical to conclude from analogy that the same law regulates the reproduction of lower plants, than to have recourse to the supposition that a different law prevails where we cannot disprove the existence of the other. In objecting to the doctrine of equivocal generation, Fries says: 'The sporules are so infinite, that in a single individual of Reticularia maxima I have counted above 10,000,000, so subtile that they are scarcely visible to the naked eye, and often resemble a thin smoke, so light that they may be raised by evaporation into the atmosphere; and are dispersed in so many ways by insects, wind, elasticity, adhesion, &c., that it is difficult to conceive a place from which they can be excluded.'

Although the spores have been stated to be the analogues of the seeds in higher plants, it is very evident that they are a much lower development of the reproductive energy of the vegetable system; and as in the animal kingdom it is found that all the higher forms of beings pass through stages at which the lower ones have stopped, so the seeds have passed through a stage of existence in which they have resembled spores. This stage will be found to be the period before the embryo-plant was introduced into the ovule, that is, when it possessed the form of a pollen-grain; and the spores may be looked upon as nothing more than permanent pollen-grains. This view has been developed by Mr. Valentine, in the volume of the 'Linnean Transactions' above referred to. He confines his remarks principally to the sporules of mosses, and gives the following points of resemblance between them and pollen-grains:—1, They are both enclosed in cases of a similar kind, the sporangia of cryptogamia and the anther-cases having a similar structure; 2, the lining membrane of sporangia and anther-cases are alike; 3, they are both developed in a similar manner by the union of fours in the cavities of simple cellules; 4, they have neither of them any organic connection with the plant in which they are developed; 5, the action of sulphuric acid on the pollen-grain and the sporule are precisely similar, as Mr. Valentine has proved by a series of experiments; and lastly, when the sporules commence germinating, they emit their lining membrane in the form of a tube, which is exactly analogous to the pollen-tube.

SPOTSWOOD, JOHN, archbishop of St. Andrews, was born in 1565, in what is now the parish of Mid-Calder, in the county of Edinburgh, of which, and of West Calder, then forming one parish, his father, a descendant of the antient family of Spotswood of Spotswood in Berwickshire, still subsisting, was parson.* The house in which he was born, called Green-bank, is still, or was a few years ago, shown near the village. The parson of Calder (whose father had fallen at Flodden Field) was soon after his induction to that benefice invested with the office of superintendent of Lothian, Merse, and Teviotdale (a sort of bishopric under what was thought a less odious name), which he held till his death in 1585. Spotswood's mother was Beatrix Crichton, described by the English writer of his Life, prefixed to his 'History of the Church of Scotland,' as 'a grave and a discreet matron, daughter to the laird of Lugton, an antient baron of Scotland.'

* The spelling of the name which we have adopted is that given on the title-page of Spotswood's 'History of the Church of Scotland,' and is also that followed by his contemporaries Calderwood and Martine. But it is often written Spotiswood; that is the spelling of the writer of the biographical memoir prefixed to the History, and also in the inscription on the archbishop's monument.

Spotswood was educated at the university of Glasgow, where he is stated to have 'received his degrees' in his sixteenth year; 'for,' says his biographer, fantastically enough, 'though the fruits of the earth under that northern clime do not mature so soon, the men generally are of better mould, and mellow as early into ripeness as any of those nations who, because they have more of the sun, plead for a priority, forgetting that some kind of grain are ripened best by frosts; and this so many excellent men of all sorts as have been of that nation are so many examples of.'

At the age of eighteen Spotswood was appointed to take the place of his father, who was disabled by age and infirmities, as parson of Calder; and for several years he confined himself mostly to the duties of his parish. During this period of his life however, he appears to have been considered as belonging to the ultra-presbyterian party, and to have gone along with the majority of the church in their opposition to the attempts of the government to restore episcopacy. Calderwood seems to assert (*History of the Church of Scotland*, p. 369) that the remarkable paper published by Bruce, one of the ministers of Edinburgh, in 1697, as his apology or defence for refusing to subscribe the bond demanded from the clergy by the king, engaging that they would not hold themselves privileged to utter sedition or treason in their pulpits, was written, or at least revised, by Spotswood; 'he would seem,' says Calderwood, 'so frank in the cause, that he would needs write it with his own hand, and give it a sharper edge.' It is sharp and also sly enough in various passages. 'The Greek proverb, ἀνὴρ ὁ φεύγων [καὶ] πάλιν μαχήσεται, He that fleeth will fight again,' says Bruce, who had taken to his heels, and dates from the place of his sojourning, 'requireth a wise foresight in men, and forbids foolhardiness. It is natural to fear death, and provide for life; and to be prodigal of the life that God hath given, I see nowhere allowed,' &c. This is not unlike a touch of Spotswood's. Latterly however symptoms of a tendency to defection may be detected. We find him mentioned (Calderwood, p. 394) as one of twenty-one ministers appointed by the General Assembly, which met at Perth in 1597, to confer with the king's commissioners upon certain articles propounded by his majesty; but, in the notion of the zealous historian, the acts and proceedings of that and several subsequent assemblies 'were framed as best might serve for advantage to the corrupt party.' In the Assembly again, which met at Burntisland in 1601, which, says the historian, 'began with small contentment to either party,' and ended, he intimates, in not much more, Spotswood was one of twenty-five members commissioned to act with the king's ministers, or any nine of them, in supplying ministers to churches in burgh-towns. And perhaps there may be other occasions on which he is mentioned that may have escaped us, for Calderwood's large volume is without an index.

Spotswood's father had, before becoming minister of Calder, been employed by Matthew, earl of Lennox (afterwards regent, and the father of Darnley); and now, in 1601, when the earl's descendant Ludowick was sent on an embassy from king James of Scotland to France, Spotswood was appointed to attend him as his chaplain. While in Paris, according to Calderwood, the parson of Calder 'made no scruple to go in to mass.' Spotswood has himself given a detailed account of the embassy (*History*, pp. 465-6), but does not descend to such particulars. He returned in the duke's retinue through England, 'having, while in France,' according to his biographer, 'so discreetly carried himself as added much to his reputation, and made it appear that men bred up in the shade of learning might possibly endure the sunshine, and when it came to their turns might carry themselves as handsomely abroad as they whose education being in a more pragmatic way usually undervalue them.' At the last General Assembly however Spotswood was delated (or indicted) for his attendance at mass while in France; and Calderwood says, 'he was *removed*, notwithstanding of the opposition of the king and some ministers; many voting that he should be suspended or deposed.' We should conjecture the word 'removed' here to be a misprint for 'reproved.' 'The king and commissioners,' it is added, 'packed it up.' There is no hint of this little affair either in Spotswood himself or his biographer.

When James set out for England, in April, 1603, Spotswood was one of five Scotch clergymen whom he appointed to attend him on his journey, along with the bishops of Ross and Dunkeld, the duke of Lennox, and other noblemen and gentlemen. While his majesty was at Burleigh House, near Stamford, he received intelligence of the death, at Paris, of James Bethune, archbishop of Glasgow; on which he immediately nominated Spotswood to that see, which he had never hitherto regarded as vacant, although Bethune had been out of the country for many years, and continued to adhere to the old religion as long as he lived. Spotswood, thus elevated, was, as he tells us himself, immediately sent back to Scotland to attend the queen on her journey, and serve her for 'eleemosinar,' or almoner. He was also made a privy-councillor for Scotland. It is remarkable however that none of the Scotch bishops were consecrated till 1610, when Spotswood and the bishops of Brechin and Galloway were summoned to London for that purpose, and, being consecrated at London House, on the 21st of October, by the bishops of London, Ely, Bath and Wells, and Rochester, conveyed their new character in the same manner to their brethren on their return home. The bishop of Ely (Andrews) would have had them be ordained first deacons and then priests before their ordination as bishops, as was in fact done in the case of Sharp and Leighton, when they were appointed to the sees of St. Andrews and Glasgow, after the Restoration; but in the present case, according to the relation of Spotswood himself, 'the archbishop of Canterbury, Dr. Bancroft, who was by, maintained that thereof there was no necessity, seeing, where bishops could not be had, the ordination given by the presbyters must be esteemed lawful; otherwise that it might be doubted if there were any lawful vocation in most of the reformed churches.' This was applauded by the other bishops, and Andrews acquiesced. Burnet's account is that Andrews's objection was overruled by the king himself, 'who thought it went too far towards the unchurching of all those who had no bishops among them.' Neither of the archbishops was appointed to officiate in the consecration of Spotswood and his brethren, to prevent its being supposed that there was any intention to revive the old claims of the sees of Canterbury and York to a supremacy over the Scottish church; this was James's own arrangement, and the same precaution was taken in the consecration of Sharp and Leighton in the next age.

The next year Spotswood returned to London, bearing a letter or petition from the synod of Lothian, supplicating the king for a General Assembly, a prayer which his majesty did not grant, and which the archbishop probably did not very earnestly urge. 'Returning from court,' writes Calderwood, 'he rideth out of Haddington when the people were repairing to the kirk to hear sermon upon the Lord's day. And it was always the custom of this profane bishop to cross the ferries or to ride upon the Lord's day in time of sermon.' (p. 487.) This historian afterwards inserts some Latin verses on the Scotch bishops, which, he says, were spread in Edinburgh, in January, 1609, beginning, 'Vina amat Andreas, cum vino Glasgua amores.' (p. 601.)

Spotswood, as might be expected, employed his best exertions in re-edifying and strengthening the ecclesiastical system, of which he had thus been appointed one of the chief overseers; but the detail of the proceedings in which he bore a part must be sought for in the histories of Scotland and of the Scottish church. 'At his entry to the archbishopric of Glasgow,' says his biographer, 'he found the revenues of it so dilapidate, that there was not one hundred pounds sterling of yearly rent left to tempt to a new sacrilege; but such was his care and husbandry for his successors, that he greatly improved it, and yet with so much content to his diocese, that generally both the nobility and gentry, and the whole city of Glasgow, were as unwilling to part with him as if he had been in the place of a tutelar angel to them.' Yet, 'part with him they must,' as this cordial panegyrist proceeds to relate; for in June, 1615, on the death of Archbishop Gladstanes, Spotswood was appointed to the metropolitan see of St. Andrews. According to Calderwood, when he returned from London to Glasgow, on the 10th of that month, he seemed to be 'altogether ignorant who had obtained the gift [of the vacant mitre], till one of his servants, attending in Edinburgh upon the king's patent, sent to him advertisement to come in haste to Edinburgh. When he came, he seemed to be miscontent, as desirous to stay still at Glasgow; but in the meantime his gift passeth the seals.' He had previously, in 1609, been appointed an extraordinary lord of session, when it was proposed to restore that court to its antient constitution of a mixed civil and ecclesiastical tribunal; but this design was abandoned the following year, on the erection of the two courts of High

Commission, over one of which Spotswood was appointed to preside, and which were united under his presidency on his removal to St. Andrews.

As soon as he obtained the primacy, his biographer informs us, 'he, by his favour with the king, procured three hundred pounds sterling of yearly rent (being by the sacrilege of former times swallowed up in the crown revenues) to be restored to his see,' and, continues the same authority, 'all King James his time he lived in great favour with him, and was the prime instrument used by him in several assemblies for the restoring the antient discipline, and bringing that church to some degrees of uniformity with her sister church of England. . . . Nor was his industry less for the recovery of some remnants and parcels of the church's patrimony, which (although they were but as a few crumbs in comparison of that which at a full meal sacrilege had swallowed), he found to be an hard province; yet by his zeal and diligence he overcame many difficulties, and so little regarded his own ease, that, for the effecting of this, and what else conduced to the recovery of that church in patrimony and discipline, they who knew the passages of his life have computed that he made no less than fifty journeys from Scotland to London.' Spotswood was succeeded in the see of Glasgow by Law, bishop of Orkney. 'Here it is to be observed,' writes the acrimonious Calderwood, 'that Mr. John Spotswood and Mr. James Law, both sometime ministers within the presbytery of Linlithgow, two pretty foot-ball men, are now the only two archbishops in Scotland, and have now, as we use to say, the ball at their foot. They were both near the point of suspension in the purer times for the profanation of the Sabbath; now they have power to suspend, deprive, imprison, fine, or confine any minister in Scotland. Out of preposterous pity they were spared then; but now they spare not the least and the most blameless.' (p. 655.)

The same royal favour that he had enjoyed in the time of James, Spotswood retained under the new king Charles I., whom he crowned in the Abbey church of Holyrood on the 18th of June, 1633. The writer of his Life states, that besides procuring the revenues of the priory of St. Andrews, which were then in lay hands, to be added to his see, he prevailed with the king to separate so much of his diocese as lay to the south of the Forth, and to erect it into the new bishopric of Edinburgh This was in 1633. Within two years after, on the death of the Earl of Kinnoul, Spotswood was made lord high chancellor of Scotland.

He had not yet attained this last height of promotion when, in 1634, he drew upon himself a storm of popular odium by his conduct in instigating the oppressive proceedings against Lord Balmerino, who, on the ground of his having had in his possession a petition, considered to be seditious, which had been drawn up with the design of being presented to the king by a number of the opposition peers, and the knowledge of which had been betrayed to the archbishop, was arraigned for the then capital crime of leasing-making (verbal sedition), brought to trial before the court of justiciary (in which Spotswood's second son, lord president of the court of session, sat as one of the assessors to the justice-general), found guilty by an intimidated jury, condemned to death, and only pardoned at last, after a long imprisonment, in consequence of the government becoming afraid to permit the execution of the sentence, much, it was understood, to the disappointment of the archbishop and the other prelates. The part that Spotswood took in this business excited the greater disgust from his notorious hereditary enmity to Balmerino, whose father also had been disgraced and destroyed six and twenty years before, chiefly through his management. The prosecution of Lord Balmerino contributed as much perhaps as any other single cause to produce the general dissatisfaction in Scotland which a few years later broke out into so wild a flame. It was followed in 1637 by the ill-managed attempt to impose a liturgy on the Scottish church, which was the immediate provocation of the rebellion against the government. This scheme, too, has been attributed to Spotswood by some of his indiscriminating admirers: Martine, in his 'Reliquiæ Divi Andreæ' (p. 251), describes this 'grave, sage, and peaceable prelate,' as deserving 'a singular note and mark of honour,' among other things, 'for composing one excellent liturgie.' But in truth, Spotswood appears to have been all along disinclined to the innovation, though, possibly, as the project was one upon which Charles himself had set his heart, he did not openly oppose it; it was pushed principally by Laud, who had formed a party among the younger Scottish bishops; and the new liturgy and book of canons were compiled by three or four members of this party, whose adherence to the English primate had for some time thrown them into opposition to the head of their own church. Spotswood, who was constitutionally of a temporising disposition, and could gain nothing by any disturbance of the established state of things, did what he could to check the precipitation of these zealots, and, in recommending delay and caution, is believed to have entertained the hope of being able to prevent the perilous experiment altogether. But of course he shared with the rest in the destruction brought upon their whole order by its failure. Deposed from his 'pretended' office of a bishop, declared infamous, and excommunicated, by the famous Assembly which met at Glasgow, in November, 1638, he fled to England, 'where,' says his biographer, 'age and grief, with a sad soul in a crazy body, had so distempered him, that he was driven to take harbour in Newcastle, till by some rest, and the care of his physicians, he had recovered so much strength as brought him to London.' Laing, in his 'History of Scotland' (iii. 154), says, we do not know upon what authority, that he now 'resigned the seals for a pecuniary consideration:'—if so, the money was probably all he had to subsist upon. The writer of his Life expressly affirms that he enjoyed the honour of the chancellorship 'to his death.' But, however this may be, he soon fell ill again, and died on the 26th of November (6to *Calendas Decembris*), 1639. 'The manner of his burial,' concludes his biographer, 'by the command and care of his religious king, was solemnly ordered; for, the corpse being attended by many mourners, and at least 800 torches, and being brought near the abbey church of Westminster, the whole nobility of England and Scotland then present at court, with all the king's servants and many gentlemen, came out of their coaches, and conveyed the body to the west door, where it was met by the dean and prebendaries of that church in their clerical habits, and buried according to the solemn rites of the English church, before the extermination of decent Christian burial was come in fashion.'

Burnet, in his 'History of his own Time' (i. 26), has described Spotswood as 'a prudent and mild man, but of no great decency in his course of life; for,' he adds, in a passage first printed in the Oxford edition of 1823, 'he was a frequent player at cards, and used to eat often in taverns; besides that all his livings were scandalously exposed to sale by his servants.' This version of the gossip of the day may be taken as giving us a tolerably correct view of the archbishop's character. Like the generality of the members of the Scottish episcopal church in that age, he appears to have signalised his aversion and contempt for the precisianism of the Puritans by a laxity of manners which would now be accounted indecorous in a churchman; but those were the days when even the puritanical Abbot, wearing the mitre of Canterbury, was wont to join in the diversion of the chase; and there is no evidence that Spotswood led in any respect an actually immoral life; on the contrary, writers of his own party warmly eulogise the piety and simplicity with which he demeaned himself. 'In his life,' says his biographer, 'he had set so severe a watch upon himself, that his conversation was without reproof, even in those times when the good name of every clergyman was set at a rate, as formerly were the heads of wolves.' He was no doubt an ambitious man; and he was probably chargeable with the carelessness as to money matters, and something of the unscrupulousness in other respects, which are the frequent concomitants of political ambition. Of the superiority of his general talents his success in the world may be taken as a sufficient evidence; of his learning and literary abilities we have a sample in his 'History of the Church of Scotland, from the year 203 to the end of the reign of James VI.,' a folio volume of about 550 closely printed pages, published at London in 1655. It was undertaken, we are told, in obedience to the command of King James, and it is dedicated by the author to Charles I. in an epistle dated 'from the place of my peregrination, 15th Novemb., 1639.' This would be only eleven days before the archbishop's death, according to the common account; yet the dedication, which extends to three pages, contains no allusion either to the illness or the exile of the writer. On the contrary, he speaks throughout as if he were still in Scotland. All but the first 120 pages of this work, which bring down the history of the Scottish church to the Reformation, may be regarded as the narrative of a contemporary; and it contains some details not elsewhere to be found: but its chief value consists in its giving us the views of public events entertained by one of the principal actors; and in this way even its suppressions and perversions of facts are not without interest. It is written in a clear enough but in rather a poor and unimpressive style, the chief merit of which is its comparative freedom from the fashionable pedantry and quaintness of the age. Spotswood's biographer says that he had heard of no other works which he had left behind him; but Martine, in his notice of him in the 'Reliquiæ,' attributes to him likewise 'a like tract, in good and refined Latin, called Refutatio Libelli de Regimine Ecclesiæ Scoticanæ, dedicated to King Charles I., a learned and eloquent piece, pitifully refuted by Mr. David Calderwood, under the name of Dido Clavius.'

By his wife 'Rachel Lindsay, daughter to David Lindsay, bishop of Ross, of the house of Edzell, an honourable family in Scotland,' Archbishop Spotswood left two sons and a daughter. Of the eldest, Sir John Spotswood, his father's biographer, writing in 1655, says that he was then alive, 'though not in a plentiful, yet in a contented condition, not any way cast down or ashamed of his sufferings, but comforting himself rather, that, in this general ruin brought upon his country, he hath kept his conscience free, though his estate hath suffered.' These are like the expressions of a man speaking of himself, and would lead us to conjecture that Sir John Spotswood was the writer of this sketch of his father's life, and the editor of his 'History.' The archbishop's second son, Sir Robert Spotswood, after having been made a lord of session by James VI., and lord president of that court by King Charles, was removed from the bench by the Covenanters in 1641, and in January, 1646, after the defeat of Montrose at Philiphaugh, was executed at St. Andrews, along with other adherents of that royalist general. A son of one of these brothers was also put to death at Edinburgh, in March, 1650, a few days after the execution of Montrose. The archbishop's daughter was married to Sir William Sinclair of Rosslyn.

In the neighbourhood of his residence at St. Andrews, Archbishop Spotswood has left a memorial of his taste in the church of the parish of Dairsie, 'which,' his biographer tells us, 'he publicly at his own charges built, and adorned . . . after the English form;' adding that 'if the boisterous hand of a mad reformation hath not disordered' it, it 'is at this time one of the beautifullest little pieces of church-work that is left to that now unhappy country.' The church still stands, though disfigured in the interior, and stripped of whatever decoration it had that could be torn down without pulling the building to pieces. There is a view of it, and also of a house (now, we believe, entirely demolished) built by the archbishop in the neighbourhood of the church, in the last edition of Sir Robert Sibbald's 'History of Fife and Kinross,' 8vo., Cupar-Fife, 1803. Spotswood had purchased the estate of Dairsie.

SPOUT, WATER, a meteorological phenomenon of the same class probably as the whirlwinds which raise pillars of sand in the deserts of Africa. The manner in which it has been observed to take place at sea is nearly as follows:—

Below a thick cloud the sea appears to be greatly disturbed within a circular area, whose diameter varies from 100 to 120 yards, the waves tending rapidly towards the centre of the agitated mass, where there is formed a vast body of water or aqueous vapour; from hence there rises, with a spiral movement, towards the cloud, a column of a conical form resembling a trumpet. Vertically above this ascending column there is formed in the cloud, but in an inverted position, a corresponding cone, whose lower extremity (the apex of the cone) gradually approaches the summit of the ascending column: and at length both are united, the diameter at the place of junction being only two or three feet. The water-spout is said to be accompanied, during its formation, by a rumbling noise, and, when complete, it assumes a magnificent appearance. The whole column, which extends from the sea to the clouds, is of a light colour near its axis, but dark along the sides, which gives it the appearance of being hollow.

The spout appears to move with the wind, though, even when no wind is felt, it sometimes varies its position, tending successively in different directions. It frequently happens that the upper and lower parts of a column move with different velocities, and then, after the whole has taken an inclined position, the parts separate from one another, often with a loud report. Previously to the rupture of the column, the dark parts seem to be drawn upwards irregularly, leaving only a slender tube in connection with the water below. The whole of the vapour is at length absorbed in the air, or it descends into the sea in a heavy shower of rain. The duration of the phenomenon is various: some spouts disappear almost as soon as they are formed, and others have been known to continue nearly an hour: occasionally they form themselves, continue for a short time, vanish, and again appear, and so on several times successively. No ship could escape if it were carried within the vortex; and mariners formerly endeavoured to accelerate the fall of the column by a discharge of artillery towards it. (See a description in Falconer's 'Shipwreck,' canto 2.)

Water-spouts are occasionally seen above land, and consequently there is then no ascending column of water or vapour to meet that which descends from the clouds. In Dr. (Sir David) Brewster's 'Journal of Science' (No. 5) there is an account of one which was seen in France: it is stated to have appeared like a conical mass of vapour, and to have given out a strong sulphureous smell; flashes of lightning issued from it, and it threw off a great quantity of water. It moved forward in one direction over high grounds and valleys, and it crossed the course of a river, but on coming to hills of a conical form, it passed round them. Water-spouts have occasionally been witnessed in this country. In 1718 one of them burst in Lancashire, when, at the place where it fell, the ground was torn up to the extent of about half a mile in length, and to the depth of seven feet, so as to lay bare the surface of the rock underneath. (*Phil. Tr.*, No. 363.)

The formation of water-spouts has been ascribed to a whirling motion produced in the air by currents coming in opposite directions; it has been supposed that the particles of vapour in the upper regions thus acquire, by the centrifugal force, a tendency to move towards the exterior parts of the column, leaving the interior void or in a rarefied state. The pressure of the atmosphere being thus removed from the surface of the sea or ground immediately below, that which takes effect on the surrounding water (when the spout is formed at sea) must impel the latter towards that part, and cause it to rise into the space where the partial vacuum exists. There is great probability that the elevation of the sea under the cloud is in part caused by the rarefaction of the air; but as the pressure of the atmosphere could only raise the water in a perfect vacuum to the height of about 30 feet, and as the height of a water-spout is known to be sometimes about half a mile, some other explanation of the phenomenon must be sought for.

From the occurrence of such phenomena at seasons when the electrical principle in the air is most active; from the sulphureous smell, the flashes of lightning, and the storms of rain or hail by which they have been accompanied, and from the destruction of trees, buildings, &c. which they have produced, their formation has been ascribed with great probability to the action of electricity. The cloud and the sea or ground may be in opposite electrical states, and therefore there will be a mutual attraction between them; this will of course be attended by all the consequences of a vast discharge of the fluid: but it must be admitted that the precise manner in which the phenomena are produced by the agency of electricity is not yet satisfactorily known.

SPRAGGE, SIR EDWARD, was a distinguished commander in the naval battles between the English and Dutch during the reign of Charles II. Of his parentage, the date of his birth, and the circumstances of his early life, there are no records. He fought as a captain in the battle between the English and Dutch, June 3, 1665, and for his gallantry on that occasion received the honour of knighthood. He was engaged in the four days' battle which took place in June, 1666; and also in the following one of July 24th. When Van Tromp sailed up the Thames in 1667, he defended Sheerness; which however, from the weak state of the garrison, he was compelled to abandon. He afterwards collected a few frigates and fire-ships, and when the Dutch admiral Van Nes sailed up the Thames, Spragge engaged him, burnt some of his ships, and chased him out of the river. In 1671 Sir Edward Spragge fought against the Algerines, burnt several of their vessels, and did considerable damage to the castles and towns on the coast of Algiers. In the battle of Solebay, May 28, 1672, he sunk a Dutch ship of 60 guns. In 1673 he was made admiral of the blue, and on the 28th of May in that year another fight took place, in which Spragge and Van Tromp were compelled to change their ships two or three times in consequence of the damage done to them. On the 4th of June he fought Van Tromp again, and the two admirals were once more compelled to leave their shattered vessels. On the 11th of August another similar contest took place between them, when Spragge, passing in a boat from the battered St. George to the Royal Charles, was drowned, a shot having struck and sunk the boat. He was buried in Westminster Abbey. Sir Edward Spragge has been highly praised by his contemporaries, not only for his courage and skill as a commander, but for his gentlemanly manners and amiable disposition.

(Campbell's *Lives of the Admirals.*)

SPRAIN, or STRAIN, is an injury of muscular or tendinous tissues, resulting from their being forcibly stretched beyond their natural length. Its ordinary consequence is, after the first pain is gone by, to produce some degree of swelling, and a considerable dull aching pain of the injured part, which is greatly increased by any movement of it. These signs are due to an inflammation of the sprained tissues, which partakes of the slowness and obstinacy that characterise all the diseases of the tendons and ligaments, and which, if not early and duly attended to, frequently terminates in thickening, rigidity, and even more serious disorganization of them and the adjacent parts.

The treatment to be adopted for sprains is the immediate application of leeches, in number proportionate to the severity of the injury and the importance of the part. They should be repeated till the pain and swelling are distinctly decreased: the part should be kept perfectly at rest and cool, and the patient's general health should be kept or made good. When the pain has nearly ceased, and there remains little more than stiffness of the injured part, stimulating liniments (the common soap liniment, or a mixture of hartshorn and oil, for example) may be used.

SPRAT. [CLUPEIDÆ.]

SPRAT, THOMAS, was born in 1636, at Fallaton in Devonshire. He was the son of a clergyman, and was educated at Wadham College, Oxford, of which foundation he became fellow. He took the degree of MA. in 1657. In 1659 he published a poem on the Death of Oliver Cromwell, and another, 'The Plague of Athens.' Having been ordained after the Restoration, he was made chaplain, first to the duke of Buckingham, whom he is said to have assisted in writing 'The Rehearsal,' and afterwards to the king. At this time he was made one of the original fellows of the Royal Society, and in 1667 published its history. In 1668 he was made prebendary of Westminster, in 1683 dean of Westminster, and in 1684 bishop of Rochester. In return for these marks of royal favour, Sprat in 1685 published a history of the Rye-house plot, entitled 'A true Account and Declaration of the horrid Conspiracy against the late King, his present Majesty, and the present Government;' but he repented of having written this work; and when requested by James, after Monmouth's execution, to add a second part, he refused, on the ground that the lives of many innocent persons would be endangered thereby. (See his letter to the earl of Dorset, written in 1689, printed in 1711, 4to.) In the following year he was appointed one of the commissioners for ecclesiastical affairs: he voted in this office for the acquittal of the bishop of London; and in 1688, though he had himself acknowledged the king's declaration of Toleration, he refused to take part in any proceedings against the disobedient clergy, and withdrew from the commission. On the abdication of James, Sprat was one of those who in the convention held on that occasion proposed the appointment of a regent; but after the settlement of this question, he did not refuse allegiance to William. In 1692 an attempt was made to implicate the bishop in a pretended plot for restoring James, his signature having been fraudulently obtained by two men of infamous character, Robert Young and Stephen Blackhead. He succeeded after some little time in triumphantly establishing his innocence and the villany of his accusers. From this time till his death, May 30, 1713, at Bromley in Kent, he lived undisturbed by any political troubles. His property was bequeathed to his son Thomas Sprat, archdeacon of Rochester.

Burnet, who appears to have viewed Sprat with the jealous eye of a rival, speaks slightingly of his moral character, but his conduct on many occasions shows an integrity superior to the feelings of personal gratitude towards the king. There is a list of his works in Wood's 'Athenæ Oxon.,' among which is a Life of Cowley, and some sermons and letters: there is also a letter of his among the Lansdowne MSS., British Museum. His prose style is remarkable for choiceness of expression and beauty of structure: he is styled by Wood a commanding and eloquent preacher, and this praise is confirmed by Burnet. He wrote a few short poems, in the manner and with all the faults of the school of Cowley. The longest of them, 'The Plague of Athens,' is, to borrow Sprat's own words in the dedication of it, 'an example how much a noble subject is changed and disfigured by an ill hand.' (See 'Some Account of the Life and Writings of the Right Reverend Father in God Thomas Sprat, DD.,—with a True Copy of his Last Will and Testament,' London, printed for E. Curll, 1715; and Johnson's 'Lives of the Poets.')

SPRENGEL, CURT, one of the most learned physicians and botanists of the last and present century, was born on the 3rd of August, 1766, at Bolderkow in Pomerania, where his father was a clergyman. His early studies were entirely directed by his father, and he is represented at the age of fourteen as being conversant not only with the Latin and Greek classics, and some modern languages, but to have made considerable progress in Hebrew and Arabic. Nor was his attention confined to languages, for at this age he published a little work on botany, in a series of letters, entitled 'Botany or Ladies.' In 1784 he commenced his studies at Halle, and devoted himself to both theology and medicine, but he soon gave up the former for the latter. In 1787 he took his degree in medicine, and on this occasion presented as his thesis a paper entitled *Rudimenta Nosologiæ Dynamicæ*.

During his medical studies he kept up his acquaintance with the antient languages, and extended his knowledge of those of the East, and was thus remarkably qualified for the study of the history of medicine. To this department he applied himself, and in 1789 was appointed extraordinary professor of medicine in the university of Halle. In 1795 he was made ordinary professor of the same department. Although his application to the study of medicine was great, and he had already commenced his work on the 'History of Medicine,' and had published his 'Manual of Pathology,' he yet found time to cultivate his acquaintance with plants, and in 1797 was appointed professor of botany. To this department he applied the same learning that he had done to medicine, and his prolific pen has furnished the most complete history of botany extant.

Through his works he became celebrated throughout his native country, and was called upon to fill very important chairs. In 1803 he was invited to Marburg to fill the chair vacated by Baldinger; in 1809 to Dorpat; and on the death of Willdenow, in 1812, he was invited to occupy his place at Berlin. All of these he refused, and remained his whole life at Halle. The fame of his learning however was not confined to Germany; almost every country in Europe sought to confer honours upon him. Upwards of seventy learned societies and academies sent him their honorary diplomas, and many kings conferred upon him their orders of distinction. These however were objects at which he never aimed, and which he never allowed to divert him from his favourite studies. He was one of the most industrious and learned men of his age, but whilst his great learning enabled him to become perfectly conversant with what had been done by previous writers, he did not neglect to observe for himself, and add the fruit of his own experience to that which had been previously produced.

The early part of Sprengel's life seems to have been more particularly directed to medicine. In 1788 he published a defence of Galen's doctrine of fever, and in 1798 an apology for Hippocrates. In 1792 the first part of his 'History of Medicine' appeared, and was not completed till 1820. These works were followed by smaller ones on various departments of the science of medicine, a complete view of which was given in his 'Institutiones Medicæ,' a work in six volumes, which appeared at various intervals from 1809 to 1816. In this work the whole field of medical science is gone over, and each department displays the author's characteristic learning. As a botanist Sprengel stands very high. He had in early life contracted a love for botany, and after his appointment to the professorship of that science in Halle, he never ceased, till disabled by disease, contributing important additions to its literature. In 1798 he published his 'Antiquitates Botanicæ,' which was followed in 1808 by his 'Historia Rei Herbariæ.' In these works he has brought his knowledge of antient languages to bear upon the illustration of botany in the earliest times, and in the latter work the history of the science is brought down to the period at which it was written. To descriptive botany he made great additions, especially in the ‘Flora Halensis,’ published in 1806, and subsequent editions. These works were illustrated by many plates from his own pencil. Besides these he has published many other papers in this department of botany. He took a part with Schultes in preparing an edition of the ‘Systema Vegetabilium’ of Linnæus, and subsequently, in 1824, published an edition of that work himself, with an appendix. He also described a part of the Brazilian plants, collected by Sellow, in his ‘Neue Entdeckungen im ganzen Umfang der Pflanzenkunde,’ published in 1820. In the systematic arrangement of plants he established many improvements, both in the Linnean and natural systems, the principal of which are contained in his works on descriptive botany. In 1811 he published a work on physiological and descriptive botany, entitled, ‘Von dem Bau und der Natur der Gewächse,’ in which he has given the result of the labours of others, and added many new observations of his own. In 1822 he published a German translation of Theophrastus's ‘Natural History of Plants,’ and in 1829 a new edition of ‘Pediani Dioscoridis Anazarbei de Materia Medica Libri v.’ His last work was an edition of the ‘Genera Plantarum’ of Linnæus, in 1830.

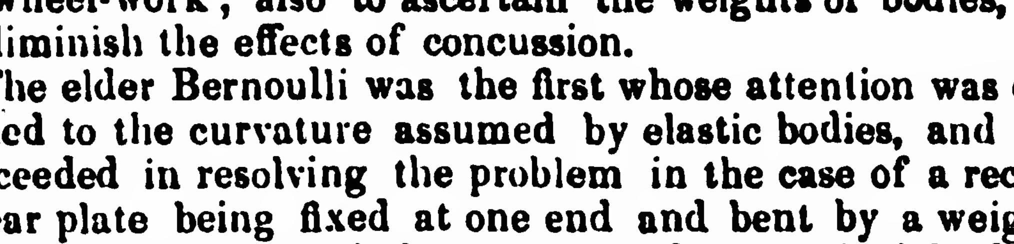
His eldest son William was professor of surgery at Greifswald, and died in 1828. This loss affected the father very severely, and he never recovered the stroke. He was attacked by several apoplectic fits, and died in one of these seizures, on the 15th of March, 1833.

SPRING. [SUMMER and SPRING.]

SPRING, in Mechanics, is an elastic plate or rod, which is employed as a moving-power, or a regulator of the motions of wheel-work; also to ascertain the weights of bodies, or to diminish the effects of concussion.

The elder Bernoulli was the first whose attention was directed to the curvature assumed by elastic bodies, and he succeeded in resolving the problem in the case of a rectilinear plate being fixed at one end and bent by a weight applied at the other: it being assumed as a principle that, at any point in an elastic body, the force by which the body when bent by any power endeavours to recover its previous position is proportional to the angle of contact at that point; that is, to the angle which a tangent to the curve surface of the body makes, at the point, with that surface.

In order to give some idea of the manner in which the effects of elasticity are to be determined mathematically, let AB be a thin elastic plate immoveably fixed at A, and bent into the form AB′ by a power P applied at B, and let $a, a$, $aa'$ be two consecutive elementary portions of the bent plate: let also E represent the unknown force of elasticity acting perpendicularly to $aa'$ by which that element tends to recover the direction $a, a$, from which it has been made to deviate by the power at B; and for simplicity let it be supposed that this power acts in the direction B′C parallel to AB. Let fall $ap$ perpendicularly on B′C; also represent B′$p$ by $x$ and $ap$ by $y$. Then, by mechanics $P.y$ expresses the momentum of the power at B′ to bend the plate at $a$, and in the case of equilibrium we have $P.y = E$. But E varies with the angle of contact, or the angle between the




element $aa'$ and $a_{\prime}a$ produced, and that angle in any part of AB′ varies inversely with the radius of curvature at that part; therefore let $r$ be the known radius of curvature at a point where the force of elasticity is given, and let this force be represented by $e$: also let R be the radius of curvature at a point, as $a$, where the force is represented by E. Then $\frac{1}{r} : e :: \frac{1}{R} : E$, or $\frac{er}{R} = E$, and putting E′ for $er$, we have $P.y = \frac{E'}{R}$. Substituting in place of R the differential expression for the radius of curvature, the elastic force might be obtained by the processes of integration. The integral however can only be obtained approximately.

If the elastic plate were in a vertical position with its lower end A resting on an immoveable object, and a weight P, applied at the upper extremity B′, were to act in a direction towards A, the equations of the curve, approximately determined, are (the deflection being small)

$$y = \Delta \sin . x \left(\frac{P}{E'}\right)^{\frac{1}{2}}, \text{ and } L = \left(1 + \frac{P.\Delta^2}{4E'}\right)h,$$

where $x$ is any abscissa from B′ on the line B′A, $y$ is the corresponding ordinate, $\Delta$ is the greatest deflection, or the ordinate at the middle point in B′A, $h =$ B′A, and L is the length of the curve line A$a$B′: also the greatest weight which the plate or spring will bear without bending when pressed in that direction is expressed by $\frac{E'\pi^2}{L^2}$. ($\pi = 3\cdot1416$).

If P exceed by a small quantity the value of $m^2 \frac{E'\pi^2}{L^2}$, where $m$ is any whole number whatever, the spring will make several bends crossing the straight line AB′ in $m - 1$ points between the two extremities.

When the elastic plate, in a horizontal position, is fixed at one end, as A, and the weight P, applied at the extremity B′, acts always vertically, the equation becomes (the deflection being small)

$$y = \frac{1}{E'}\left(\frac{1}{6} Px^3 + Cx\right)$$

where C is the tangent of the angle of contact at B′. If, on account of the smallness of this angle, C be neglected, it will follow, when $x$ is made equal to B′C, that the whole deflection AC or BB′ will vary nearly with the weight P, and with the cube of the length of the spring.

The use of a spring as a moving-power may be best exemplified in its application to watch-work. The mainspring of a watch is a thin and narrow plate of well-tempered steel, which is coiled in a spiral form: one of its extremities is attached to a pivot or axle, and the other to the interior circumference of the cylindrical box in which it is contained. In being wound, the spring closes round the axle, and afterwards, in the effort by its elasticity to recover its former position, it turns the cylinder in a contrary direction: thus the chain which is attached to the exterior circumference of the cylinder and to the fusee causes the latter to revolve.

A slender and highly elastic spring of a like form is employed to produce a vibratory motion in the *balance* ring of a watch: one extremity of the spring is attached to the axle of the balance, and the other to some part of its circumference. If a movement of small extent about the axle be given in one direction to the balance, the spring will be compressed near the axle, and, in the effort to recover its previous state, the balance-ring will be moved round in a contrary direction; but the force of elasticity carries any point in the ring beyond the place which it occupies when the ring is in a state of rest; and when that force is destroyed by the compression again produced in the spring, near the axle, the balance is made to return in the direction in which it was at first moved. Thus an alternate motion in the balance-ring is continued; the time of the vibrations, and consequently the velocities with which the wheels revolve, depending upon the force of elasticity in the spring. The elastic power of the spring varies with the tension, and is directly proportional to the angle through which the spring is wound about the axle; and thus the vibrations of a spring, like those of a pendulum in a cycloidal arc, are isochronous [ELASTICITY, p. 327.] The length of the spring and the diameter of the balance are increased by heat and diminished by cold; consequently, without some compensating power, the times of vibration will vary according to the changes of temperature.

When a carriage moving along a level road passes suddenly over an obstacle, so that a point in the circumference of the wheel is in contact with the obstacle, the centre of the wheel describes a circular arc about the point of contact as a centre; and then, if the carriage is perfectly rigid, a portion of its velocity will be lost. In order to maintain that velocity, an additional force of draught would be necessary; and an expression for this additional force is investigated in Whewell's ‘Mechanics’ (art. 261, and the following). Part of this additional force is employed in counteracting the motion of ascent, and the remainder, which is generally much the greater quantity, in diminishing the effect of the sudden change which takes place in the direction of the motion of the carriage. This latter part may be in a considerable degree removed by the use of springs; for then, on the wheel meeting the obstacle, the suspended body of the carriage bending the springs by its weight, the centre of gravity of that body is made to describe a curve line, to which its previous rectilinear direction is a tangent; and thus the jerks which arise from movements in directions making finite angles with one another are avoided.

The force of draught required in addition to that which is due to friction, when a stiff carriage passes over a roughly paved road, varies as the square of the velocity and the height of the stones directly, and as the radius of the wheel inversely.

SPRING-BALANCE, a machine in which the elasticity of a spring of tempered steel is employed as a means of measuring weight or force. The name is most commonly applied to machines for the former purpose; those employed to ascertain the muscular strength of men and animals, the amount of power required to move a carriage or a boat, or any other force applied in the form of a pull, being called dynamometers.

One of the simplest kinds of spring-balance is that which, when employed as a weighing-machine, is known as the spring or pocket steelyard. It consists of a helical spring formed by bending a steel wire spirally round a cylindrical mandril or axis, so as to form an extensive series of convolutions. This spring is placed in the interior of a tube of brass or iron, closed at both ends; one end of the spring abutting against the plate which closes the lower end of the tube. A rod, having a hook or loop at its lower extremity, to hold the article to be weighed, passes through a hole in the bottom of the tube, and up the inside of the spring. At the upper end of this rod is a small plate, which slides up and down like a piston in the tube, and rests upon the upper or free end of the spring; thereby causing it to collapse when a heavy body is attached to the hook at the bottom of the sliding rod. The machine is supported by means of a hook or ring attached to the upper end of the tube; and the extent of the motion of the spring, and consequently the weight of the body suspended from it, are indicated by the degree to which the rod is drawn out of the tube. For this purpose a graduated scale is engraved upon the rod; the divisions indicating the extent of compression produced in the spring by the application of known weights. Several spring-balances on the same principle are made for various purposes. That known as Salter's balance has a brass plate attached to the tube or cylinder, within which the spring is enclosed, and a vertical slit through the plate and tube. A scale is engraved on the face of the brass plate, and the weight is indicated by a pointer which moves up and down with the spring, with which it is connected through the vertical slit in the tube. A very delicate balance of this kind has been manufactured for weighing letters, since the introduction of Rowland Hill's plan of penny postage. In 1814 the Society of Arts rewarded Mr. Martin for an 'index weighing-machine,' acting upon the same principle, but having a circular dial-plate and a revolving pointer or index, resembling the hand of a clock. On the axis of the index, but at the back of the dial-plate, is a toothed pinion, which is turned by a straight rack attached to the vertical rod, which rises and falls with the spring. The index remains in a vertical position when the balance is unloaded, and deviates more or less from it when a weight is attached to the hook. One advantage of this construction is that the point of the index traverses a much greater space than the spring itself, so that a very small movement of the spring becomes readily discernible.

Spring-balances with helical springs are applied to several useful purposes besides that of ascertaining the weight of bodies. A spring of this character is sometimes used to hold down the lever of the safety-valve in a steam-engine boiler, the movement of the index also showing the pressure of the steam. Such an apparatus is especially useful in a locomotive engine, the shaking motion of which might derange a valve loaded with moveable weights. A helical spring-balance forms also a good cable-stopper. When applied to the measurement of muscular force, the tractive power of a locomotive carriage, &c., one end of the cylinder in which the spring is enclosed is made fast to an immoveable object, and the power to be measured is applied to the sliding-rod. If used to ascertain the force necessary to draw a carriage, the spring is placed between the carriage to be drawn and the power employed to draw it. In using a spring-dynamometer for this purpose, especially when the carriage is moved by animal power, some inconvenience is occasioned be the vibration of the index with every trifling variation in the force applied, to remedy which Mr. H. R. Palmer contrived an apparatus in which the quick vibration of the spring is checked by means of a piston moving in a cylinder filled with oil. A very narrow space is allowed for the oil to pass between the edge of the piston and the cylinder, so that a considerable resistance is opposed to the motion of the piston and the springs, and the index consequently represents the mean amount of force applied without being affected by sudden variations.

The ingenious method adopted by Mr. Martin for transmitting the motion of a spring to an index moving upon a circular dial-plate, is applicable to spring-balances of other than the helical construction. It was used by M. Hanin, a French gentleman, who was rewarded by the Society of Arts, in 1790, for an apparatus for showing at one view the weight of an object according to several different scales or systems of weights. His machine, which is described and figured in the ninth volume of the Society's 'Transactions,' consists of a dial-plate, on which are marked several concentric circles, divided according to the systems of weights used in different countries, and an index moved by a rack and pinion, as before described. The spring, instead of being of a helical form, is semicircular; its upper extremity being firmly attached to the back of the dial-plate by means of screws, while its lower end is attached to the hook which carries the weight, and the sliding rack by which the index is moved. Marriott's patent weighing-machine is very similar to that of M. Hanin, but the spring is a perfect ellipsis, with its longer axis laid horizontally. The stem to which the ring for holding the apparatus is attached is fastened by a nut and screw to the middle of the upper side of the spring; and the rack, with the hook which holds the article to be weighed, to the corresponding point on the lower side of the spring. The spring, rack, and pinion are enclosed in a circular box at the back of the dial-plate, the periphery of which serves as a stop to prevent the spring from being overstrained. A similar apparatus, contrived by M. Regnier, has been used as a dynamometer, as well as a weighing-machine.

A scale-plate or dish may be added when necessary to any of the spring weighing-machines which have been described. On account of the absence of weights, and the great simplicity of their application, spring-balances are very useful in cases where extreme accuracy is not required, especially when a portable weighing-machine is desirable. Machines for ascertaining the weight of the human body are often made on this principle, a kind of chair being suspended from the spring.

It has been proposed to apply the elasticity of steel springs for indicating the weight of very heavy bodies, such as loaded carriages; but we are not aware that the suggestion has been carried into effect. The apparatus commonly used for this purpose is described under WEIGHING-MACHINE.

(*Manufactures in Metal*, vol. ii., p. 297, in Lardner's 'Cabinet Cyclopædia;' Hebert's *Engineer's and Mechanic's Encyclopædia*, arts. 'Dynamometer' and 'Steelyard.')

SPRING-CARRIAGE. The progress of a wheel-carriage, even upon the best of roads, is continually impeded by the wheels coming in contact with, and being compelled to rise over, undulations or asperities of surface, which check their rolling motion. In a well-constructed iron railway this kind of resistance is reduced to the minimum, but it is not entirely obviated, as no degree of care which can be bestowed in practice will prevent small irregularities at the joints, or minute undulations in the surface of the rails. On a stone pavement, owing to the greater frequency of the joints, and the comparative roughness of the stone, deviations from a perfectly smooth surface are more frequent and greater in amount. Indeed in many old rough pavements, owing to the openness of the joints, and the wear of the upper edges of the stones, the road consists of a series of blunt ridges, in passing over which the motion of the wheel can be no other than a succession of jolts. The surface of a well-made road of broken stone, whep in perfect order, presents few important asperities; but when metal or broken stone has been recently laid on, it is exceedingly rough. If a rigid carriage be drawn over any of these surfaces, the irregularities which affect the path of the wheels will be communicated through them to the body, to which they will impart a jolting or vibratory motion

When the carriage is moved very slowly, the path traced by the axle, or by any point of the body, supposing the vehicle to have but two wheels, and to be free from other disturbing causes, will be nearly the same as the surface of the road in the track followed by the wheel; every undulation of the surface being transmitted to the body of the carriage. In a four-wheeled carriage the movement of the body will be influenced by the discordant motions of the fore and hind wheels; and also, supposing its construction to be perfectly rigid, it will be continually liable, owing to the imperfections of the road, to have the whole of its weight thrown upon three wheels, whereby the framework will be exposed to injurious strains. With either kind of carriage, if the speed be increased, the impulses received from the irregularities of the road will follow each other in such rapid succession as to set the carriage in violent vibratory motion, throwing the weight alternately from side to side, and causing the wheels to leap from one prominence to another; and so producing a series of concussions tending to the rapid destruction of the vehicle, and extremely unpleasant to the riders. To enable it to sustain such strains, the framework of carriages which are unprovided with springs or contrivances for eluding concussion must be made very strong and heavy; and the destructive and painful effect of increasing the velocity of inelastic carriages would alone have been sufficient to limit the speed of vehicles intended for the conveyance of passengers before the introduction of springs. Alluding to the earliest English stage-coaches, which had no springs, Edgeworth observes, 'The danger of sitting on the roof of the coach was then never hazarded by outside passengers; they were stuffed in straw in a huge clumsy basket, that was fastened precisely over the hind axletree of the coach.' 'When springs came into fashion for gentlemen's carriages,' he continues, 'stage-coaches were obliged to adopt them; and by degrees outside passengers ventured to sit on the tops of coaches, and coachmen found, to their surprise and profit, that their horses could draw a greater number of passengers than formerly.'

One of the simplest means of alleviating concussion to the riders is that often adopted in light carts, of suspending the seat from the sides of the body by leather straps or lashings. Next to this is the use of straps to suspend the body itself, an expedient which seems to have been occasionally resorted to from a very early period. The first approach to a slung carriage which had been met with by Mr. Adams, occurs in an illustration to a Saxon MS. in the Cottonian Library, of which an account is given in his interesting work on 'English Pleasure-Carriages.' It is found in a representation of the meeting of Jacob and Joseph; the latter is seated in a kind of chariot, consisting of a hammock suspended from a framework of wood, mounted upon four wheels. The vehicle in which Jacob is seated is described as a cart, which, from its primitive simplicity, may be supposed to be a faithful representation of those in common use at the time when the illumination was executed. It is supposed from this illustration that carts were then used by the common people, and the superior kind of vehicle by the principals only. With very few exceptions, it appears that slung or suspended carriages were not used until the seventeenth century. In the early carriages of this kind the straps were usually attached to a framework of wood at each end of the vehicle, rising to a considerable height above the axles. 'The antique four-wheeled carriages of Europe used for state purposes are mostly constructed on this plan, and their great weight and slow movement prevent any violent concussion.' 'Many of the public stage-coaches of France,' proceeds Mr. Adams, 'are suspended on the same principle, as well as those of the United States and Canada: for in the latter countries, though there is not any lack of enterprise or want of energy to improve the public vehicles, it is found by experience that the imperfect condition of the roads precludes the possibility of using steel springs with a due regard to economy.' A serious disadvantage of this construction is the great length of carriage that it renders necessary, and the cumbrous character of the wooden framework which supports the braces. The carriage must also be heavily loaded, in order to make the motion tolerably comfortable, especially when the straps or braces are suspended from points not much higher than the bottom of the body. In the light carri-coche of Buenos Ayres, which is supported on two nearly straight braces, or twisted cords of untanned hide, the quick vibration when on a rough road is stated to be almost as unpleasant as actual concussion. As an illustration of the necessity of weight to render a suspended carriage agreeable, Adams observes, 'Those who have travelled in the heavy and heavy-loaded French diligences at a slow rate will not have found their motion unpleasant; but whoever has experienced the movement of the rude leather-covered carts formerly used for the conveyance of the French mail will never wish to repeat the experiment.' To remedy the defects of the primitive slung carriage, it was desirable to render the pillars from which the straps were suspended somewhat elastic. This could not be readily effected with wood, because the pillars were necessarily short, and therefore stiff. Hence arose the use of elastic steel supports, which have gradually assumed the form now well known as C-springs. These were formerly used for almost all kinds of spring-carriages; but the great improvement of our roads has made way for the introduction, in all stage-coaches, and in many private carriages, of the less yielding, but lighter and more compact, straight and elliptic springs.

Straight springs of steel probably owe their origin to the straight wooden springs occasionally used in light vehicles in this and other countries. Used either singly or in combination, they afford sufficient elasticity for many purposes, without raising the body to an inconvenient degree, or interfering with its form; since they may be placed entirely beneath it, and require but little room for their play. Elliptical springs have, in some degree, the same advantages; but they require rather more depth than straight springs.

Carriage-springs are usually formed of several thin plates of steel, of various lengths, so laid and fastened together that the spring shall be thick in the centre, or at the end by which it is fixed, and thin, or consisting of only a single plate, at the end or ends where the greatest play is required. The steel used is of coarse quality, and has little carbon in its composition. It is fashioned by rolling-machinery to the transverse dimensions required, which vary from one inch and a half to three inches in width, by one-eighth of an inch to three-eighths of an inch or half an inch in thickness. The plate forming the back of the spring is usually thicker than the rest, on account of its being the longest, and, having its ends formed into bolt-eyes, to receive the bolts by which the body is connected with it. With this exception, it is not usual to make any difference in thickness in the several plates of a spring, notwithstanding their different lengths. The mode of construction may be understood from the following description, extracted from Adams, of the process of making a straight double spring; that is, a spring which is fixed in the centre, and acts or plays towards each extremity. The spring described is intended to rest upon the axle, which it crosses at right angles:—

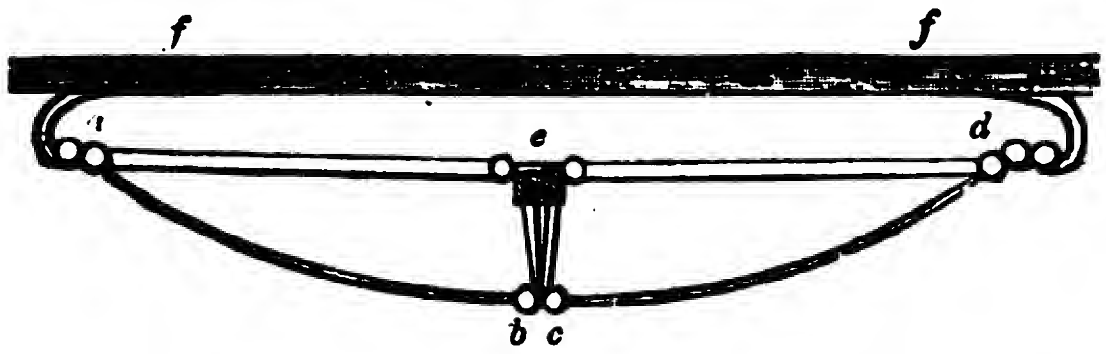
'The back plate being cut to the proper length, the ends are slightly tapered in the direction of their thickness, by the hammer, and curled round a mandril of the size of the suspension-bolt. The side which fits against the other plates is then technically 'middled;' *i. e.* it is hollowed by hammering, so that the centre may be sunk below the edges. The next plate is then cut nearly as long as the first, and the ends are tapered down; after which it is 'middled' on both sides. A slit is then cut at each end, about an inch in length and one-quarter of an inch wide, in which a rivet-head is to slide and connect it with the first plate; so that whichever way the force or weight may act, these two plates sustain each other. At a little distance from this rivet, a stud is formed upon the under surface by a punch, which forces out a protuberance, sliding in a slit in the next plate; by which contrivance all the plates are retained parallel while they work. The next plate is prepared in precisely the same manner, with the exception that it is from three to four inches shorter at either end; and so on with as many plates as the spring may happen to consist of. The last one, like the first, is only 'middled' on one side.' After the plates are thus wrought into the form required, they are hardened by heating them in a hollow fire, and then plunging them into water. They are subsequently tempered by drawing them again through the fire, until they become so hot that a stick rubbed over the surface will be kindled to a blaze. Any accidental warping acquired in these processes is removed by a hammer, the plates being slightly warm during the operation, to avoid the risk of breakage. This is called *setting*, and is, at best, an operation very liable to strain and injure the plates. They are then finished by filing all the parts that will be exposed to view when the spring is complete; and are finally put together, and secured by a square hoop of iron, which is shrunk on hot, and by a rivet passing through the hoop and through all the plates. 'After this mode,' Mr. Adams states, 'all carriage-springs are made, whether they be straight or circular, double or single; the only difference being that the circular spring requires more setting.'

In the work from which these particulars are derived, suggestions are made for several improvements in the manufacture of springs. Those engaged in the business generally state that steel of superior quality would not answer for carriage-springs; but Mr. Adams conceives that the use of an inferior material is persisted in on account of its smaller cost, and because the spring-makers are trained to working it; and he is of opinion that steel of better quality might be used with economy, even as regards first cost, because a smaller quantity of metal might prove equally efficient. It would also be desirable to vary the thickness of the plates in proportion to their length, and to taper each plate regularly from the hoop to the points, instead of, as at present, tapering the ends only. The tempering process is susceptible of much improvement. The operation depends, as commonly performed, on the experience and skill of the workman, instead of being regulated by such means as are adopted in some other kinds of tempering, as in the manufacture of saw-blades. [SAW, vol. xx., p. 477.] The practice of *middling*, or hollowing the centre of each plate, produces a series of cavities in the spring, which collect and retain water, and thereby facilitate the destruction of the spring by rust. The rust greatly impedes the action of the spring, by occasioning much friction; and very soon impairs its elasticity, by corroding and wearing away the hardened surfaces of the plates, wherein much of their elasticity resides. It also injures the appearance of the carriage by oozing out between the edges of the plates. To check this evil, some coach-makers paint the inner sides of the spring-plates before putting them together; but this practice interferes with the action of the spring, by rendering it difficult for the plates to slide upon each other; and it is of little avail, since the paint soon wears off the parts which come in contact with each other, and so allows the corrosion to take place. Adams recommends tinning the plates as a better remedy, and conceives that their surfaces should be perfectly flat and smooth.

Coach-makers apply distinct names to a great many varieties of springs, or rather of combinations of springs; but those which are most generally used may be briefly enumerated. The straight spring, if single, or acting only on one side of the point at which it is fixed, is technically named the *single-elbow spring*. The *double-elbow spring* is a straight spring, acting on both sides of the fixed point. It is a kind of spring very extensively used in stage-coaches, omnibuses, and light two-wheeled vehicles. Elliptic springs, which are usually but little curved, are used single in some carriages, between the axle and the framework; the spring resting on the axle, and being connected with the carriage by means of a curved bar of iron, called a *dumb-iron*, placed over it like another spring. The spring, which is then called an *under-spring*, is hinged at one end to the dumb-iron, and connected with it at the other end by means of a shackle, which permits the trifling variation of length occasioned by its play. Elliptic springs are often used in pairs, under the name of *nut-cracker springs*, the two springs being hinged together at each end, so as to form a long pointed ellipsis. In this way elliptical springs are much used in such four-wheeled carriages as have no perches. *C-springs*, which are chiefly used in private carriages, usually consist of two-thirds of a circle, lengthened out into a tangent; the tangent being laid horizontally, and bolted down to the framework of the carriage. When these springs are used, the body is not, as in most other cases, connected immediately with the springs, but it is suspended by leather straps, which pass round the back of the springs, and are fastened to the framework near to their base. To prevent the body from swinging too far backwards and forwards, small check-straps are added before and behind, and another check-strap attached to the pole limits the vertical action. In old carriages these springs were generally less curved; in some cases deviating but little from a straight line, and being attached to the framing vertically, instead of horizontally. Other curved springs have been occasionally used, but it is unnecessary to continue the enumeration farther. The following are some of the principal combinations of springs used by English carriage-builders. *Telegraph-springs* are combinations of straight springs in sets of four. Two are placed longitudinally, resting either immediately upon the axles, or upon the lower framework of the carriage; and two others, placed transversely, are suspended from their ends by shackles. The body is supported upon the centres of these transverse springs. This arrangement is adopted both in two-wheeled and four-wheeled carriages; two sets of springs, or eight single springs, being used in the latter case. *Tilbury-springs* are another combination of straight springs used for the two-wheeled carriage called a tilbury. Two single-elbow springs are attached to the hinder part of the body, and suspended by means of leather braces from the ends of a transverse spring which is elevated on an iron standard at the back of the framework. The front of the body is suspended from the shafts by two single-elbow springs with short leather braces, and sometimes a pair of double-elbow springs are interposed between the shafts and the axle. In this arrangement there is much unnecessary weight. *Dennet-springs* are a combination of three straight springs, two of them placed across the axle, and attached at their fore ends to the shafts or the framing of the body, and the third placed transversely, suspended by shackles from their hinder extremities, and fastened to the body at its centre. Springs of this kind are used for two-wheeled vehicles, and for the hinder part of some with four wheels. They are adopted in most modern omnibuses, and in light stage-coaches or private carriages without perches, the fore part of the carriage in such cases usually resting upon under-springs with dumb-irons. The bodies of private cabriolets are usually hung upon C-springs, with small curved springs in front, and double-elbow springs are frequently added between the shafts and the axle. The combination of springs used in what are called under-spring carriages is stated by Mr. Adams to be 'the most effective which has yet been discovered for producing the minimum of concussion or motion to the passengers.' The body of such a vehicle is suspended by braces from C-springs; and the framework of the carriage, to which the C-springs are fastened, is supported upon under-springs, which intercept concussion from the unevenness of the road. The weight of a carriage hung upon this principle is its chief disadvantage; but the smooth and elastic motion which it occasions, by relieving every part of the vehicle, excepting the wheel and axles, from concussion, tends so greatly to its durability, that, when under-springs were first used, it was prophesied that they would be the ruin of coach-making.

Of these various springs, none but the C-springs with leather braces allow universal motion to any important extent. Telegraph-springs, owing to the shackles by which they are connected with each other, have, to a very small extent, the power of universal motion; but elliptic and elbow-springs, as commonly constructed, play in a vertical direction only. A plan has been lately adopted by which double elliptic springs have a little lateral motion; but it is necessarily very trifling in amount. In some carriages loops of leather or caoutchouc have been used, instead of iron shackles, for connecting straight springs, by which means the motion is rendered pleasanter, and the rattling noise of the shackles is avoided. A contrivance of this kind has been tried, we believe with success, in railway carriages, in which, owing to the great weight of the vehicle, the springs are usually very thick and rigid. This limited motion of straight and elliptic springs is not only uncomfortable to the riders, but injurious to the carriage and to the springs themselves; irregular lateral and longitudinal strains being unavoidable. Another defect of ordinary springs is their want of adjustibility to the weight they have to carry. They must, of course, be made strong enough to sustain the maximum weight they are intended to bear; but, by being so, they become too stiff to play easily under a light load. To meet the deficiencies of the springs in common use, Mr. Adams contrived one on the principle of the bow, which will yield in any direction, and may be made capable of adjustment, by means of screws, to a light or heavy load.

This spring consists of a single plate of well-tempered steel, forced into a curved form by the tension of a chord, which may be made either of prepared hempen rope, or of a riband of iron or steel, and to which the axle is attached, In the form in which this kind of spring was first used, the bow was placed above the axle, and secured by its centre to the body of the carriage; while the axle was attached, by suitable fastenings, to the centre of the chord; but the action being found defective and uncomfortable, the form represented in the following cut was adopted. In this there are two bow-springs, *ab* and *cd*, connected with each other and with the same axle. These are jointed together at *bc*,



and attached to the body, of which the lower framing is shown at *ff*, by moveable joints at *a* and *d*, which allow the springs to lengthen and shorten in playing. The chord of each bow is in two parts of unequal length, each of which is connected at one end with the bow, and at the other with the axle at *e*; so that the chord of the bow, *ab*, takes the direction *aeb*, and that of the bow, *cd*, the direction *ced*. When connected with the fore axle of an ordinary carriage, the springs are frequently attached to a dumb-iron. Springs of this sort are already much used, both on common roads and on railways; and, on the latter especially, their use is extending. Among the advantages claimed for them are their lightness and extreme elasticity, arising from the superior quality of the steel, and the absence of the friction which attends the action of the common laminated springs.

As some degree of elasticity is essential to the durability of every part of a carriage intended for rapid motion, it is desirable that even the wheels should possess it in a slight degree. How this is provided for in ordinary wheels is explained under WHEEL; and the numerous plans which have been tried for spring-wheels require no notice in this place, beyond the remark that their contrivers often appear to have overlooked the circumstance that, if the wheel be capable of becoming in any sensible degree elliptical or excentric, by the weight bearing upon its axle, the labour of draught will be increased; the effect being the same as that of constantly ascending a hill.

The great advantage of springs in lessening the labour of draught has been ably illustrated by Edgeworth, who thus explains their action in this respect: 'Theory shows,' he observes, 'that whilst the wheels of a carriage pass over an obstacle, the load on the carriage must rise along with the wheels, unless it be supported by springs; but that if the load be hung upon springs, whilst the carriage-wheels tend to throw the load upwards, as they rise suddenly over an obstacle, the springs will bend, because they are opposed not only by the weight, but by the *vis inertiæ* of the load acting downwards; and the load will consequently not be thrown up *suddenly* so high as if there were no springs.' But the advantage does not rest on theory alone. Among the interesting experiments on carriages of which the results are recorded in Edgeworth's treatise, are some which are very decisive as to the saving of labour occasioned by them. In one experiment, with two-wheeled carriages, a gross load of 8 cwt. 2 qrs. was drawn with rather greater ease, *with* springs, than a gross load of 5 cwt. 2 qrs. 7 lbs. *without* them. In another trial, with four-wheeled carriages, the gross weights drawn with and without springs were respectively about 17 cwt. and 15 cwt.; but in this case, it is stated, the carriages were not loaded sufficiently to bend the springs with facility, so that their full effect was not ascertained. Some of these experiments were directed to the effect of wooden springs; and the results were sufficient to show how much might be gained by their general adoption in such carriages as are usually constructed without any springs whatever. In one of the cases related, a man was found capable of drawing, in a two-wheeled carriage, with wooden springs blocked to prevent them from acting, a load of 2 cwt.; but when the springs were allowed to play, he drew a load of 3 cwt. 2 qrs. with equal ease. Edgeworth states that he had employed carts with wooden springs for nearly four years, and had used both straight and elliptic wooden springs successfully. He recommends, as cheap and durable, a piece of common tough ash, five inches and a half deep in the middle, two inches deep at each end, and three inches broad, mounted on fixed shackles at one end, and with linking plates at the other. The iron-work of the shackles will last for many years, and the wooden springs may be renewed at very trifling cost. Three wooden springs, connected in a similar manner to dennet-springs, may be used conveniently for common carts.

All the springs that have been alluded to in this article are *bearing-springs*, for supporting the weight of the body of the carriage, and of the load which it conveys. In ordinary carriages no other springs are used; but in those employed upon railways, springs are also used to impart elasticity in the direction of the line of draught, so as to render the starting and stopping of the carriages gradual and easy. [RAILWAY, vol. xix., p. 258.] Somewhat akin to these are the spring splintre-bars which have been recommended for equalizing the pull of the horses in ordinary carriages, and preserving the riders from any unpleasant jerking sensation occasioned by their isolated and sometimes irregular impulses.

(Adams's *English Pleasure-Carriages*; Edgeworth's *Essay on the Construction of Roads and Carriages*.)

SPRING WHEAT. [WHEAT.]

SPRINGS. Rain and snow fall in quantities so unequal in different districts, and on soils which exercise upon them such various influences, that the phenomena of springs, which are primarily dependent on the penetration to some depth in the earth of water which was absorbed at the surface, are extremely complicated and curious. It is very interesting to geologists to classify and determine the causes of these phenomena, and very important in agriculture and the arts to acquire a power of directing the water currents in and below the soil and strata. The art of draining consists essentially in giving to the diffused and injurious springiness of particular soils and situations a concentrated, perhaps beneficial, current; while artesian wells relieve the hydrostatic pressure prevalent at great depths, and yield copious streams in dry lands and deserts.

As a general rule, springs are permanent in proportion to the depth to which the water which supplies them has descended from the surface; they are perennial and almost inappreciably constant in temperature and volume, whether hot or cold, copious or full, in situations where, from the arrangement of the mineral masses of the globe, deep subterranean channels exist for the reception of rain, and particular impediments direct and contract the passages of reflux to the surface. Such cases are common in stratified countries where jointed limestones or sandstones receive water at elevated points on the surface, and conduct it downwards below strata of clay, which are only pervious at a few points, and there permit natural discharges at lower levels than the recipient surfaces. Frequently these argillaceous strata are so nearly impervious, that artificial perforations relieve the pressure of the subterranean columns of water better than the few natural points of efflux, and thus pits and levels excavated for mines may drain springs at some distance.

On the contrary, in a country which contains narrow and frequently mixed masses of clay and gravel, or clay and sand, which cover the solid rocks, concentrated springs are almost absent, but there is a prevalent humidity and diffused springiness along the limit of the gravelly or sandy tracts. After a continuance of dry weather such springs and wetness disappear, to be renewed after the next fall of rain.

The particular points at the surface where springs, or 'wells,' as they are often called in the districts where somewhat of the Saxon elements of our language remains (*quelle*, in German, signifying not what is commonly understood by the English word 'well,' and the French 'puit,' but a spring), are determined in general by one of three things:—

1. They occur at the point of lowest level, on the edge of the impervious clay which dams up the water. This happens in the cretaceous and oolitic districts of England.

2. They are often dependent on the lines of great joints, or fissures of the rocks, produced in the course of the consolidation and shrinking of the mineral masses. Large springs are thus poured out of the mountain-limestone of England.

3. The waters are directed to the surface by lines of fault, which are often quite impervious to water, and traverse the rocks in vertical or inclined planes. The hot springs of England and Wales are mostly thus circumstanced.

In general then, the water which issues from the earth in one copious spring has been received by minute absorption on a large surface: as the living tissue of a sponge receives water by absorption through the numerous pores, collects it internally in a few channels, and rejects it by a very limited number of orifices, or as the capillaries collect blood for the veins, and these supply the heart, so the porous texture and channelled structures of rocks permit that continual circulation of water below the earth's surface, on which, in a great degree, its habitable character depends.

Between perennial or constant springs, and those which are merely dependent on the last shower of rain, the gradations are insensible, and the explanation is entirely obvious upon the general principles stated. One of the most interesting cases of this intermediate series, is that of the 'intermitting' springs. It is a common circumstance on the chalk downs of the South of England (Wiltshire, Dorsetshire) for the valleys to be quite dry in one part of the year (autumn or winter), and very fully watered in another (spring, summer); the springs bursting higher up the valley in some years than in others, according to the quantity of rain which fell in some previous season (as the autumn), and the rate of its transmission through the jointed and absorbent chalk. A Wiltshire proverb says—

'As the days lengthen, the springs strengthen.'

Another peculiarity of springs flowing out of cavernous limestone rocks is marked by a variable discharge; the springs now gush with vehemence, now subside, shrink away, and disappear. These ebbing and flowing wells are noticed in many districts, as near Dynevor in Caermarthenshire, at Tideswell in Derbyshire, and near Settle in Yorkshire. The explanation most generally received supposes the water to fill cavities underground, from which the discharging channels are siphon-formed, so that at a particular moment the full cavity begins to be discharged and finally runs out, and the current then ceases till the space be again filled to the vertex of the siphon-formed arch.

In thus descending downwards and rising upwards through various mineral masses, springs become impregnated with gaseous, saline, earthy, or metallic admixtures—as carbonic acid gas, sulphuretted hydrogen gas, nitrogen, muriate of soda, sulphate of lime, carbonate of lime, silica, carbonate of iron, &c. There appears to be a connection (See Murchison's *Silurian System* in regard to the sulphuretted wells of Llandrindod) between the extrication of sulphuretted hydrogen from springs and the lines of trap rocks or great faults; nitrogen is a frequent concomitant of hot springs which have similar geological relations (Daubeny, in *Reports of British Association*); and even carbonic acid gas and supercarbonate of lime appear in uncommon abundance on the lines of great dislocations. [ARTESIAN WELLS; WATERS, MINERAL.]

**SPRUCE BEER**, a fermented liquor made from the leaves and small branches of the spruce fir, with sugar, molasses, or treacle. Though called *beer*, it is, in fact, observes Professor Donovan, a *wine* as much as many others that are acknowledged as such. There are two kinds of spruce beer—the brown and the white—of which the latter is considered the best. The following directions for making white spruce beer are condensed from Donovan's 'Domestic Economy,' vol. i., forming part of Lardner's 'Cabinet Cyclopædia;'—Dissolve seven pounds of the cheapest loaf-sugar in four gallons and a half of hot water, and when the temperature has fallen to blood heat, mix in about four ounces of essence of spruce, and dissolve it perfectly by agitation; then add half a pint of good solid yest from a brewery, and mix it in thoroughly. Fermentation will soon commence, and will proceed rapidly in summer, but must, if in winter, be maintained by keeping the cask in a warm apartment. When this fermentation very perceptibly subsides, the liquor should be drawn off, and the cask should be washed. The liquor being then returned to it, a second fermentation, inconsiderable in degree, will take place; and when this diminishes, the beer is fit for bottling. The corks should be wired down, and the bottles laid on their sides until the liquor becomes brisk and in high order, which must be ascertained by trial. The bottles should then be placed upright, lest they should burst; but if they are kept too long in that position, the beer is apt to become flat, in which case they may be placed on their sides again. Brown spruce beer may be made according to the same directions, only substituting an equal quantity of molasses or treacle for the white sugar. In places where spruce-firs abound, a simple decoction of the leaves and small branches is used instead of the essence of spruce. This agreeable and wholesome beverage is useful as an anti-scorbutic.

**SPRUCE FIR.** [ABIES.]

**SPUR-WING**, the English name for species of the genus *Parra*. [RALLIDÆ, vol. xix., p. 280.]

**SPURI'NNA, VESTRI'TIUS**, a Roman poet, who lived in the time of Pliny the younger, who in one of his letters (iii. 1) speaks of him as one of the most delightful persons that he ever met with, and states that he wrote lyric poetry both in Latin and Greek. He further adds that his poems were distinguished for their extraordinary sweetness, elegance, and cheerful spirit. At the time when Pliny wrote this letter, Spurinna was seventy-seven years old, and enjoyed in his old age the leisure and comforts which he had earned by a long and active life, during which he had held several offices, and had also distinguished himself in the administration of the provinces. (Compare Plin., *Epist.*, i. 5; ii. 7.)

There are extant four odes bearing the name of Spurinna, which however, as some critics think, were written by another person, as they do not possess those merits which Pliny assigns to the poetry of Spurinna. But the whole letter in which Pliny speaks of the poet is written with such an enthusiastic admiration of the man, that nothing is more natural than to conceive that he greatly overrated his poetical powers. The odes were first edited by Caspar Barth, in 1613, in his collection of 'Poetæ Latini Venatici et Bucolici,' from an antient manuscript in the library of Marburg. They are also contained in Wernsdorf's 'Poetæ Latini Miores,' iii., p. 326, &c.

**SPURN POINT, or SPURN HEAD**, a long curved bank of sand and pebbles, which in a slight degree contracts the entrance of the Humber æstuary, and supports two lighthouses, in the construction of the higher of which the talents of Smeaton were employed. This eminent engineer paid much attention, while considering in what part of the moveable mass of sea-drifted sand and pebbles constituting 'the Spurn' (as it is commonly called) he should fix the lighthouse, to the daily action of the tides and currents, and was thus enabled to choose for the works a situation probably the best which could be had. (See Smeaton, *On the Eddystone Lighthouse*.) The peculiar elongation and incurved form of the Spurn is due to the set of the tide, which runs southward on the seaward side and drifts the materials which fall from the wasting cliffs of Holderness into the Humber Channel, and then turns suddenly up to the west. Should the waste of the Holderness Coast at a point north of the Spurn (Kilnsea) continue at its present rate for many years, the Spurn may become an island, and other great geographical changes ensue. Ravenspurn was situated within the protection of this low sandy ridge, on the north bank of the Humber, which has witnessed the accumulation of Sunk Island, and undergone great changes within very modern periods.

Spurn Point has been very often considered by antiquarians to be the 'Ocellum Promontorium' of Ptolemy, but there is more reason to give this title to the bold promontory of Flamborough Head, than to the flat sand of the Spurn, which in Camden's time perhaps hardly extended beyond the firmer and higher land near Kilnsea, and which between 1676, when M. Angell constructed the lights, and 1766, when Smeaton restored them in a new situation, had been elongated so as to impede the navigation, and render the old lights dangerous. The low lights which Smeaton began in 1776 fell by the sea's force in 1786.

**SPURZHEIM, JOHANN GASPAR**, was born in 1776, at Longwich, near Treves. He was educated in the university of Treves, and in 1799 went to study medicine at Vienna, where he first became acquainted with Dr. Gall, the founder of the system of phrenology. Spurzheim attended his lectures for the following four years, and then associated himself with him for the prosecution of his researches. In 1805 they left Vienna and visited the principal parts of Germany, France, Prussia, and Denmark, to confirm and promulgate their doctrine. In 1807 they settled at Paris, and there first delivered their joint courses of lectures. They pursued their subject together till 1813, when they separated; and Spurzheim, after taking the degree of Doctor of Medicine at Vienna, came to this country and continued for three years, lecturing in many of our principal towns, and actively engaged in publishing works on phrenology, and in defending it against the severe criticisms to which it had been subjected. From 1817 to 1825 he resided and lectured at Paris; and when the French government prohibited the delivery of lectures except with special permission, he returned to Britain. At this visit he found his doctrines entertained with much more favour than during his former residence here; but he still occupied himself with the greatest energy in their promulgation by lecturing in nearly all the large towns of the whole kingdom, and by repeated publications. In 1832 he embarked on a similar mission for America; and in a few months after his landing, he died at Boston.

In the articles GALL and PHRENOLOGY we have given a general account of the differences between the systems of Spurzheim and his preceptor. The scientific reputation of the former must rest chiefly on his having proved the fibrous structure of the brain, and many other very important facts in its anatomy, which, though published in his name jointly with that of Gall, were certainly due to the researches of Spurzheim alone. These indeed have as yet no certain application in phrenology; yet Spurzheim must be regarded as having exercised an important influence on the progress of that science. He claims the merit of having discovered eight new cerebral organs, of analysing and classifying the mental powers, of pointing out the moral and religious relations of phrenology, and the relation of natural language or bodily actions to it, and of having made many improvements in the mode of investigating the facts bearing upon it. Admitting these claims however to their fullest extent, the scientific merit of Spurzheim (whether phrenology be true or not) must stand far below that of Gall. The great influence which he has had in giving the predominant character to the phrenology of the present day must be ascribed entirely to his power of rendering it a subject of popular study. For this purpose he was admirably adapted. He was an eloquent lecturer, and a most agreeable companion; his style both of speaking and of writing was fluent, bold, positive, and unhesitating: his illustrations were always pointed and amusing; his arguments, though often quite illogical, were very easy of apprehension; his conclusions general and indefinite; and he always treated his subject with an enthusiasm which none could feel but one convinced of the truth of his cause, and which was enough in itself to carry conviction to the minds of all who were not well-disciplined in the fallacies of science. That which Gall discovered and invented, but could scarcely have taught, was by Spurzheim made to seem intelligible to the most ordinary understanding; and to him therefore must be attributed the reputation of having made phrenology one of the most popular studies of the present day.

The works of Spurzheim are very numerous, and most of them are generally known. A complete account of them is given, with his Life, in the 'Phrenological Journal,' vol. viii. A memoir of the life and philosophy of Spurzheim was published at Dublin, in 1833, by Mr. Carmichael.

SPY. It is proper to premise that in the discussion of this and many other questions of international law the terms Right, Law, Lawful, and others of the same class, must be understood in a different sense from their proper technical meaning. What writers on international law speak of as a right is very often merely what appears fair, reasonable, or expedient to be done, or to be permitted. It is this reasonableness or expediency alone which is the foundation of those various usages which are recognized by independent civilized nations in their intercourse among one another, and constitute what is called the Law of Nations. Thus a person or a power is said to have a right according to the Law of Nations, which means that the usage of civilized nations permits the act, and this is the least objectionable sense in which the word Right is used. But when writers use the word Right merely in the sense of what is expedient, without reference to its being the foundation of a recognized usage, they are confounding the reason or foundation of a usage with the usage itself.

No doubt, we believe, has ever been intimated by any writer of authority on International Law, as to the right of nations at war with each other to avail themselves of the service of spies, or secret emissaries, in carrying on their hostile operations. 'Exploratores, quos mittere jure gentium haud dubie licet, quales misit Moses, qualis fuit ipse Josua,' are the expressions of Grotius, in the only passage in which he touches upon the subject, (*Bel. et Pac.*, iii. 4, § 18, par. 3): 'Spies, whom it is, without doubt, permitted by the law of nations to employ; Moses made use of such, and Joshua himself acted in that capacity.' And still more expressly is the general right of employing spies conceded to every conductor of military operations by Vattel: 'If those whom he employs make a voluntary tender of their services, or if they be neither subject to, nor in any wise connected with, the enemy, he may unquestionably take advantage of their exertions without any violation of justice or honour.' (*Le Droit des Gens*, iii. 10, § 179, in the common English translation as edited by Chitty, 8vo., Lon., 1834).

At the same time it is generally held that the right can only be exercised under limitations of various kinds.

First, as to the right of the general, or of the sovereign for whom he acts, to compel any one subject to his authority to serve as a spy. Grotius, in the passage to which we have referred, admits that spies when caught are wont to be treated with extreme severity; and he adds, that this is sometimes done justly by those who have a manifestly just cause of war—by others, in the licence which the law of war tolerates (licentia illa quam dat belli jus); a useless distinction, upon which no practical rule can be founded. In fact, as Grotius himself notices, the custom is, when a spy is caught, to put him to death. Vattel attempts to assign the reason for this severity: 'Spies,' he says, 'are generally condemned to capital punishment, and with great justice, since we have scarcely any other means of guarding against the mischief they may do us.' This is making short work of the question of capital punishments; but what we have to attend to here is, Vattel's inference from the fact which he has stated. A man of honour, he proceeds to observe, always declines serving as a spy, as well from his reluctance to expose himself to this chance of an ignominious death, as because, moreover, the office cannot be performed without some degree of treachery: 'the sovereign therefore has no right to require such a service of his subjects, unless perhaps in some singular case, and that of the highest importance.' Such loose exceptions as that here stated abound in the writers on International Law, and detract very much from the practical value, as well from the scientific character of their speculations. In ordinary cases, Vattel therefore decides, the general must be left to procure spies in the best way he can, by tempting mercenary souls by rewards.

Secondly, the employment of spies is conceived to be subject to certain limitations in respect to the manner of it and the object attempted to be gained by it. 'We may lawfully endeavour,' says Vattel, 'to weaken the enemy by all possible means, provided they do not affect the common safety of human society, as do poison and assassination.' It is held accordingly, that the proper business of a spy is merely to obtain intelligence, and that such secret emissaries must not be employed to take the lives of any of the enemy, although that, done in another way, is commonly the main immediate object of the war. Yet it might be somewhat difficult to establish a clear distinction between what would be called an act of assassination by a spy, and many of those surprises of an enemy which, so far from being condemned or deemed dishonourable to the actors, have usually been admired—such, for example, as the famous (though possibly fabulous) exploit of Mucius when he sought the tent of King Porsenna. It will not do to rest upon the circumstance that Mucius exposed his life in the attempt; for that is what a spy always does, as much as any soldier who seeks reputation 'even in the cannon's mouth.' Neither can we well say that the circumstance of the spy disguising himself, and pretending to be what he is not, constitutes the ignominy of his trade, and distinguishes him from an honourable adventurer pursuing the same object. Mucius, besides assuming, as he must have done, the air of being an Etrurian, hid his sword, we are told, under his robe, and it may be argued that on the same principle he might have taken any other available precaution to conceal his intrusion or his purpose. Something like this latter distinction however is that which has been commonly taken: it has been maintained that an officer or soldier cannot be treated as a spy in any circumstances, if he had his uniform on when apprehended. See Martens, *Précis du Droit des Gens Moderne de l'Europe* (traduit de l'Allemand), Paris, 1831, liv. viii., ch. iv., § 274; where references are made to Bruckner, *De Explorationibus et Exploratoribus*, Jen., 1700; to Hannov., *Gel. Anzeigen*, 1751, pp. 383 et seq.;

and, in regard to the celebrated case of André in the American war, to Martens, *Erzählungen merkwürdiger Fälle*, i. 303; and to Kamptz, *Beyträge zum Staats und Völkerrecht*, tom. i., No. 3.

A question closely connected with the so-called lawfulness of employing spies, and indeed forming in one view a part of that question, is that of the lawfulness of soliciting the enemy's subjects to act as spies, or to betray him. Vattel discusses this matter in reference to considerations both of right and of honour or conscience. 'It is asked in general,' he begins, 'whether it be lawful to seduce the enemy's men, for the purpose of engaging them to transgress their duty by an infamous treachery.' It has been already stated that he lays down the principle that we may lawfully endeavour to weaken the enemy by any means not affecting the common safety of human society; and he determines that seducing an enemy's subject does not come under this exception. Such measures, accordingly, he observes, are practised in all wars. But still, he argues, they are not honourable nor compatible with the laws of a pure conscience; an evidence of which we have in the fact that generals are never heard to boast of having practised them. 'If such practices,' concludes Vattel, 'are at all excusable, it can be only in a very just war, and when the immediate object is to save our country when threatened with ruin by a lawless conqueror. On such an occasion (as it should seem) the guilt of the subject or general who should betray his sovereign when engaged in an evidently unjust cause would not be of so very odious a nature.' But who ever heard of a war that was not thought by those engaged in it to be a just war on their own side and an unjust war on the part of their adversaries? So that this distinction settles nothing. It is held however to be perfectly allowable in every point of view merely to accept the offers of a traitor. In this case, Vattel argues, 'we do not seduce him; and we may take advantage of his crime, while at the same time we detest it. Fugitives and deserters commit a crime against their sovereign; yet we receive and harbour them *by the law of war*, as the civil law expresses it.' If such offers have ever been rejected, as that of the physician of Pyrrhus, who offered to poison his master, was by the Romans, he holds the act to be one of magnanimity indeed, but yet as one which no general or sovereign is bound to imitate. Or, as Grotius has expressed it, such a course may evince loftiness of mind in those who pursue it, or their confidence of being able to compass their objects by open force, but has nothing to do with the question of what is lawful or unlawful. Martens holds, with still less qualification, that we cannot condemn as an illegitimate means of carrying on a war the corruption employed to seduce the officers or other subjects of the enemy, and to tempt them either to reveal a secret or to surrender a post, or even to get up a revolt; it is the business of each state, he argues, to protect itself from such attempts by a careful choice of the persons it employs in trusts, and by the severity of the penalties with which it punishes their treachery. 'But,' he adds, 'it is without doubt to overleap by a great way the bounds of the law of war, and to declare itself an enemy of the whole human race, for a nation to try to stir up every other people to revolt by a general promise of assistance, as was done by the French National Convention in their decree of the 19th of November, 1792.' Yet, wildly absurd as this decree was, its violation of the law of nations seems to have consisted merely in its not being confined to the case of such foreign countries only as the French republic might be then at war with. Unless indeed it was intended to be taken, as it could not fail to be, for a declaration of war against all existing governments.

The proper question as to the so-called law of nations with regard to spies, is what practices are sanctioned by the general usage of independent civilized nations. Such practices as are now permitted by such usage constitute a part of this so-called international law. Those practices which are not generally permitted or acknowledged are not yet a part of such law. Persons who have occasion to write or think on this subject will find that much of the indistinctness and confusion observable in the treatises on the law of nations will be removed if they will first form for themselves a clear conception of the proper meaning of the word law, and of the improper meanings which it has also acquired; and they will thus be enabled to give the necessary precision to those terms which are used so vaguely by writers on international law. [Law; Right.]

**SQUADRON**, the principal division of a regiment of cavalry: the numerical strength of a squadron has varied at different times, but at present it consists of one hundred and sixty men, of whom about one-sixth are not under arms. This body of men is divided into two troops, each of which is commanded by its captain, who has under him a lieutenant and a cornet. The word is supposed to be derived from 'squadra' (Italian), which is itself corrupted from the Latin word 'quadratum;' acies quadrata denoted a body of men drawn up in a square form. The term 'escadron' occurs in Froissart's 'Chronicles,' and probably it was very early used in the French armies to designate a body of cavalry.

The strength of an army, with respect to cavalry, is usually expressed by the number of squadrons in the field, as it is with respect to infantry by the number of battalions. Each regiment of cavalry consists of three or four squadrons; and when in line, one yard in the length of the front is allotted for each man and horse: the interval in line between every two squadrons is equal to one-quarter of the extent occupied by each squadron.

For the manner in which a regiment of cavalry is encamped, see Encampment.

**SQUA'LIDÆ**, a family of fishes of the section *Chondropterygii*. In this family, which includes the various species of sharks, the branchiæ are attached by their outer margin to the skin, and the water taken in for respiration makes its escape through narrow outlets corresponding in number to that of the interspaces between the branchiæ. The number of these openings is usually five. So far the present fishes agree with the Ray or Skate family (Raiidæ); but the peculiar rhomboidal form of the body renders it easy to distinguish the Rays, which moreover have a peculiar cartilage arising from the nasal part of the skull, and extending towards, or even meeting the anterior part of the crest of the pectoral. This character is pointed out by Messrs. Müller and Henle, who state that it is found in all the Ray tribe, and also in *Rhinobatus* and *Pristis*, whereas there is no trace of it in any shark.

In the sharks the body is elongated, and tapering gradually from the head to the tail, or but little dilated in the middle; the muzzle is rounded or pointed, and depressed, and projects over the mouth; the nostrils are situated on the under side of the muzzle, in the form of oblique openings, which vary somewhat in figure, according to the species. The fins generally consist of two dorsals, two large pectorals, two ventrals, an anal fin, and a caudal, the form of which is peculiar.

The portion of the tail of the shark which supports the tail-fin is almost always bent upwards at an obtuse angle with the body; the fin itself may be divided into three parts—a superior, an apical, and an inferior portion; that which runs along the upper surface is usually narrow; that on the under surface is broader, but decreases in width to its point of junction with the apical portion, which is more or less dilated at the extremity, and obliquely truncated. Such is the most common character of the tail and tail-fin in the present fishes, and one which is not found in any recent fishes not belonging to the Chondropterygian group.

The male sharks are smaller, and differ externally from the females in possessing two elongated appendages, one of which is attached to the hinder edge of each of the ventral fins, the uses of which are not known. Some species of sharks bring forth their young alive, whilst others are enclosed in oblong semitransparent horny cases, at each extremity of which are two long tendrils. These cases are frequently found on the sea-shore, and are called sea-purses, mermaids' purses, &c.; they are deposited, observes Mr. Yarrell, by the parent shark near the shore in the winter months. The convoluted tendrils, hanging to seaweed or other fixed bodies, prevent the cases being washed away into deep water. Two elongated fissures, one at each end, allow the admission of sea-water; and the young fish ultimately escapes by an opening at the end, near which the head is situated. For a short time the young shark continues to be nourished by the vitelline fluid contained in the capsule attached to its body by the connecting pedicle, till having acquired the power of taking food by the mouth, the remains of the ovum are taken up within the abdomen, as in birds and some other animals.

'A curious peculiarity has been observed in the young both of the sharks and skates during a very early stage of their existence. From each of the branchial apertures branchial filaments project externally; each filament contains a single minute reflected vessel, in which the blood is thus submitted to the action of the surrounding medium. The appendages are only temporary, and the blood of the fish is afterwards aerated by the true gills. This very interesting discovery, which, I believe, is of recent date, forcibly reminding us of the temporal external branchiæ in the young Batrachian reptiles in the tadpole state, has been observed by Mr. Richard Owen in the Blue Shark, *Carcharias glaucus;* by Mr. John Davy, in the Torpedo; and by Dr. Allan Thompson, of Edinburgh, in the Thornback. Cuvier had previously noticed it, and, in the *Règne Animal,* has referred to a figure, published by Schneider, of a very young shark in this condition, for which, regarding it as the normal state of the fish, that industrious pupil of Bloch had proposed the name of *Squalus ciliaris.*'*

The teeth of the Sharks are arranged in several series, one within the other, of which the outermost row is that in use; the other rows are decumbent, and serve to replace the foremost when injured. Their form varies much in the different species; and even those of the upper and lower jaw are often very dissimilar. Though very variable however, they most commonly exhibit modifications of a triangular form, are sharply pointed, and have the lateral edges sharp and frequently serrated. It is upon the modifications observable in the form of the teeth, the form of the snout, mouth and lips, and of the caudal fin; the existence or absence of the eyelid (*membrana nictitans*), spiracles, and of the small depression on the root of the tail; the situation of the branchial openings, and of the dorsal fins, &c., that the various divisions of the present family are formed.

The *Squalidæ* and *Raiidæ* have long occupied the attention of Prof. Müller and Dr. Henle, who have conjointly published an excellent work on these groups, 'Systematische Beschreibung der Plagiostomen.' The characters of the various genera into which the sharks are divided, as communicated by these gentlemen to the 'Mag. of Nat. Hist.' (vol. ii., pp. 33 and 88), are here given. At the head of the sharks these authors place the *Scyllia,* a group in which the species have the teeth small and pointed, and with one, two, or more lateral denticles; an anal and two dorsal fins; the first dorsal placed behind or opposite, but never before the abdominal fins. The spiracles are distinct in all, and tolerably large in most of them. The eyelid (*membrana nictitans*) is wanting. To this section belong, as it would appear, all the oviparous sharks.

*Scyllium,* Cuv.—This genus is restricted to such species as have the anal fin placed nearer to the head than the second dorsal fin. Eleven species are known, of which three are found on the British coast; the small spotted dog-fish (*Scyllium canicula*), the large spotted dog-fish (*Scyllium catulus*), and the black-mouthed dog-fish (*Scyllium melanostomum*), of Yarrell's 'British Fishes.'

*Pristiurus,* Bonap., differs from *Scyllium* in having a long snout, and also in possessing a series of larger scales, arranged like the teeth of a saw on the upper edge of the tail. Contains but one species.

*Chiloscyllium.*—In this genus the anal fin is placed farther back than the second dorsal, and the last branchial opening approximating to the fourth. The under lip is broad and membranaceous, and separated from the skin of the throat by a kind of furrow. The upper nasal valve bears a cirrhus. Four species are known.

*Hemiscyllium,* Müller and Henle.—Here the situation of the fins is the same as in *Chiloscyllium;* the nose and mouth as in Scyllium. One species.

*Crossorhinus,* Müller and Henle.—Remarkable for a great number of small membranaceous lobules situated between the nostrils and the first branchial opening. The mouth is nearly at the extremity of the muzzle. The two dorsal fins are placed towards the posterior end of the animal, the first of them being situated above, and a little behind the abdominal fins. This genus is founded on the *Squalus lobatus* of Bloch Schn., the only known species.

*Ginglymostoma,* Müller and Henle.—Has small spiracles; the two last branchial openings approximating to each other; the first dorsal fin above the abdominal fins; and the second dorsal opposite the anal. In adult specimens the inferior part of the fold bordering the corners of the mouth, is distinctly separated from the skin of the lower jaw by a vertical furrow. The number of lateral denticles to the teeth is four on each side. One species.

* Yarrell's 'British Fishes, ii., p. 369.

*Stegostoma,* Müller and Henle.—In this genus the first dorsal fin begins a little before the abdominal ones. The branchial openings are as in *Chiloscyllium.* A large and thick wreath or rim conceals the upper jaw, and the opening of the mouth, which is placed transversely: the nasal valves are reduced to lateral edges of this wreath. The teeth are in the form of trifid leaves. Type and only species of the genus, *Squalus fasciatus,* Bloch Schn.

The second division of sharks contains species having, like the *Scyllia,* an anal and two dorsal fins, and five branchial openings; but the first dorsal fin is always placed between the pectoral and abdominal fins.

A large group is distinguished by the possession of a *membrana nictitans,* by the situation of the second dorsal fin, which is opposite the anal one, and by the situation of the branchial openings, the last or two last of which are always placed above the base of the pectoral fins. They are divided as follows:—

A. *Without spiracles.*

*a. Teeth flat, sharp, the edges serrated or smooth.*

1. *Carcharias,* Cuv.—Teeth flat, sharp, and serrated on each side, either in the upper jaw only, or in both jaws. Spiracles are never met with in the adult specimens, though the rudiments of these organs may be observed in the fœtus of a few species. Twenty species of this genus are known. Three are recorded as occurring on the British coast.

2. *Scoliodon,* Müller and Henle, differs only in having the teeth of both jaws alike: the points of these teeth are directed towards the corners of the mouth; their edge is smooth, and they have a truncated protuberance, which is either smooth or indented on the exterior side of the base. Five species.

3. *Zygæna,* Cuv.—The species of this genus are remarkable for having the sides of the head greatly produced in a horizontal direction, from which circumstance they have received the names of hammer-headed sharks. The teeth are as in *Scoliodon,* but in adult specimens they are distinctly serrated. Three species are known: one has been found on the British coast.

These three genera have the valve of the intestine longitudinal and rolled; an incision near the extremity of the elongated upper lobe of the caudal fin, and a small dimple at the root of the fin.

*b. Teeth pointed, and with lateral denticles, as in Scyllium.*

1. *Triaenodon,* Müller and Henle.—Teeth with a denticle on each side, which on the exterior side of most of those of the lower jaw is double. Caudal fin, as in *Carcharias,* with a dimple at the root. One species.

2. *Leptocharias,* Andr. Smith.—Teeth numerous, one or two lateral denticulations on each side. The dimple near the caudal fin wanting, and the inferior lobe of the fin scarcely indicated. The nasal valve elongated into a cirrhus. One species.

B. *Possessing spiracles.*

*a.* Teeth, flat, sharp, serrated or not serrated.

1. *Galeocerdo,* Müller and Henle.—Teeth strongly serrated on the exterior edge, finely on the interior. Spiracles small. A dimple on the root of the tail: the upper lobe of the caudal fin elongated, with two incisions. Valve of the intestines short, as in *Carcharias.* Two Species.

2. *Loxodon,* Müller and Henle.—Teeth without serrature, as in *Scoliodon.* Spiracles very small. Valve of intestine, dimple of the tail, and caudal fin, as in the preceding genus; but the upper lobe of that fin with only one incision. One species.

3. *Galeus,* Cuv.—Teeth in both jaws serrated on the exterior edge, inclined outwardly. Tail as in *Carcharias,* but wanting the dimple. Valve of intestine spiral. One species known, and this frequents the British seas.

*b. Teeth pointed as in Scyllium.*

*Triakis,* Müller and Henle.—Teeth as in *Triaenodon.* Dimple of the tail wanting: the inferior lobe of the caudal fin not distinct. One species.

*c. Teeth pavement-like, or presenting a general continuity of surface, as in the Skates.*

*Mustelus,* Cuv.—Spiracles large. Inferior lobe of the caudal fin very short. *Membrana nictitans* rudimental. Valve of intestine spiral. One species known, and recorded as British.

The remaining genera have no trace of the *Membrana nictitans.*

Section* 2. *Lamnoidea.*—Branchial openings large, all

* Messrs. Müller and Henle regard the Sharks as forming an order, and the sections Scyllia and Lamnoidea as families.

situated before the pectoral fins. Spiracles small. Caudal fin in the form of a crescent, with a lateral keel and a distinct dimple, and the small anal and second dorsal fins opposite each other.

1. *Lamma*, Cuv.—Head pointed, conic; spiracles extremely small; teeth long, pointed, with two lateral denticles, indistinct or wanting in young individuals. The third tooth of the upper jaw, sometimes also the fourth or fifth, smaller than the rest. Two species, both of which occur on the British coast.

2. *Oxyrrhina*, Agassiz.—Teeth long and thick, like nails, without lateral denticles, the anterior ones introverted; the third tooth of the upper jaw small and short. Two species.

3. *Carcharodon*, Andr. Smith.—Teeth as in *Carcharias*, serrated on both edges. The third tooth of the upper jaw smaller. One species.

4. *Selachus*, Cuv.—Teeth very small, narrow, conic, and numerous; snout short. One species, the *Selachus maximus* of Le Pelerin. Basking Shark of Yarrell's 'British Fishes.'

5. *Rineodon*, Andr. Smith.—Teeth exceedingly small, pointed. Mouth at the apex of the snout.

The following three genera differ as much from each other as from the preceding group, and, in the opinion of Messrs. Müller and Henle, should in a system be regarded as the types of families.

*Triglochis*, Müller and Henle.—Branchial openings large, spiracles small, as in *Lamna*. The first dorsal fin stands before the abdominal fins: the second dorsal between the abdominal and anal fins, and they are all tolerably large. Teeth long, pointed, with one lateral denticle, or two on each side. This is probably the genus *Odontaspis* of Agassiz.

*Alopecias*.—Head, dorsal and anal fins, and spiracles, as in *Lamna*; but the branchial openings small, and the last above the pectoral fins; the upper lobe of the caudal fin extremely elongated. A dimple on the tail, but no lateral keel. Teeth sharp, triangular, without serrature or protuberance. Intestinal canal spiral. One species.

*Cestracion*.—Branchial openings as in *Alopecias*; second dorsal fin between the anal and abdominal ones, like *Triglochis*. Spiracles small. Teeth arranged in pavement; the anterior rows small and pointed. A bony spine before each dorsal fin. One species.

The third division of sharks comprises those species which, like the preceding divisions, have an anal fin, but they have only one dorsal. It contains two genera, which are distinguishable by the number of branchial openings. They are the *Hexanchus* and *Heptanchus* of Rafinesque. In the former genus there are six branchial openings, and in the latter seven.

In the fourth division there is no anal fin; the *membrana nictitans* is wanting, but the spiracles are present. It is divided into two groups, according to the presence or absence of certain bony spines. The first is called *Acanthorhinus* by De Blainville, and contains species which are provided with a bony spine in front of each dorsal fin. It is divided into four genera.

1. *Acanthias*, Bonap.—Teeth alike in both jaws, with a transverse edge, the point directed outwardly. Four species.

2. *Spinax*, Bonap.—Teeth in the lower jaw as in the preceding genus; teeth of the upper jaw with an elongated point in the middle, and two shorter points on each side. One species known, the Piked Dog-fish (*Spinax acanthias*) of Yarrell's 'British Fishes.'

3. *Centrina*, Cuv.—Teeth of the lower jaw nearly straight, leaf-like, with a serrated edge, and a flat triangular point; those of the upper jaw also straight, but more narrow, conic, pointed, and forming a cluster in the central portion of the *maxilla*. One species.

4. *Centrophorus*, Müller and Henle.—The lower teeth with a transverse edge indistinctly serrated, the point of each being directed towards the corner of the mouth: the point of the upper teeth is directed downwards; they are equilateral, and without any serrature. One species.

The group without spines to the dorsal fins (*Scymnus*, Cuv.) comprises three genera:—

1. *Scymnus*, Müller and Henle.—Teeth in the upper jaw straight and narrow; in the lower jaw crooked, pyramidal, equilateral. The first dorsal fin before, and the second behind, the abdominal fins. Two species, one of which, the Greenland Shark (*Scymnus borealis*), is occasionally found on the British coast.

2. *Læmargus*, Müller and Henle.—Fins situated as in the preceding genus. Lower teeth with a transverse edge, as in *Acanthias*; upper teeth narrow, conic, straight, or curved outwardly. Three species.

3. *Echinorhinus*, Blainv. (*Gonoidus*, Agassiz).—First abdominal fin opposite the abdominal fins. Teeth in both jaws broad and low, the edge nearly horizontal. The lateral edges with one or two transverse denticles. One species, described in the Supplement to Yarrell's 'British Fishes.'

The fifth and last division contains but one genus (*Squatina*), of which there are two species. They have no anal fin; the mouth is protractile and at the apex of the muzzle. The eyes are placed on the dorsal surface of the head, and not at the sides as in other sharks. The muzzle is obtuse, the body is broad and depressed, and the pectoral fins are very large. Both the dorsal fins are situated behind the ventrals. To this genus belongs the Angel-fish of British authors, the *Squatina angelus* of Dumeril, Cuvier, &c.

SQUAMA, in Botany, a scale, is a term applied to parts which, strictly speaking, are not bracts or leaves, and are arranged upon a plant in the same manner as the scales of fishes and other animals. Almost all the organs that are thus designated are parts of the plant which stand in the position of leaves, but are not developed sufficiently when seated on the stem to become bracts or true leaves, or, when forming parts of the flower or fruit, to become sepals, petals, stamens, &c. Examples of the squama are seen in those parts of the amentum or catkin which contain the organs of reproduction, and which, if further developed, would be called bracts; also in the carpellary leaves which constitute the hardened part of the fruit of Coniferæ; the undeveloped external leaves of the buds of most plants, &c.

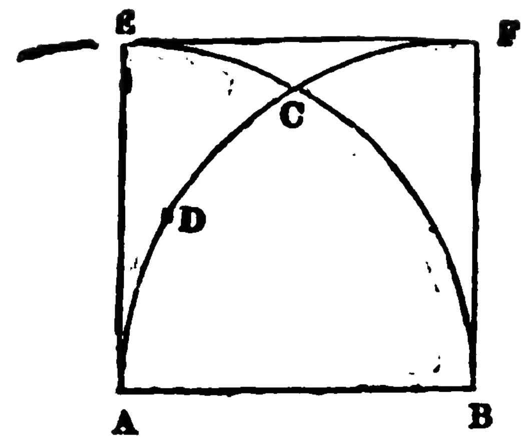
*Squamula*, the diminutive of the above term, has been applied in various senses. It is most frequently employed to designate the small internal organ which, in the flower of grasses, is placed nearest the seed.

SQUARE. We believe that the old English meaning of this word had reference only to the corners of a figure, or at most to right-angled corners. The old word for a square figure is a *four-square* figure; the carpenter's rule for drawing a right angle is called a T-*square* to this day. The French word équerre (antiently esquerre, originally derived, like the Italian *squadra*, from *quadratum*) is the immediate origin; and this (in French) means also an instrument for drawing a right angle. In Recorde's Ground of Arts, the earliest English geometry extant, he calls what is now a square by the name of *square quadrate* (*square*, right-angled, *quadrate*, four-sided figure); and it is not until he is considerably advanced in his work, that he seems to find out that he may drop the second word, and retain the first only. There was still an incorrectness, for a square figure should have meant one having all its angles right angles; that is, what we now call a rectangle, whether its sides were equal or not. To complete the proof of connexion between the square and the right angled corner, we may mention that before now a right-angled *triangle* has been called a *square*. In or about 1613, Thomas Bedwell published a work, of which the title was '*Trigonum* Architectonicum, the Carpenter's Squire.'

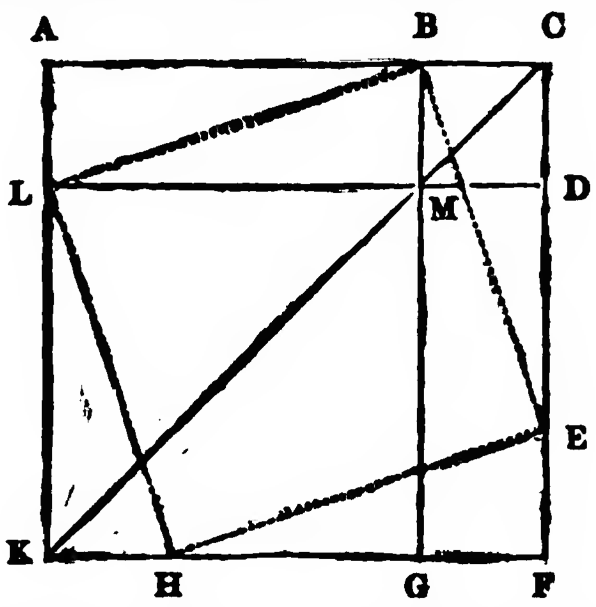
In geometry, a square means a four-sided plane figure with all its sides equal, and all its angles right angles. In algebra, it signifies the number produced by multiplying a number by itself. The reason of the double meaning is obvious enough. [RECTANGLE.] A square of seven units long contains $7 \times 7$ square units; so that the operation $7 \times 7$ is the arithmetic of finding the content of a square of seven units in length and breadth. We have spoken in the article just cited of the confusion which is caused by this double use of the word square; and proposed to correct it by speaking of the square *on* a line in geometry, and the square *of* a number in algebra. It has been the fashion of late years to publish what are called *symbolical* editions of Euclid, in which $AB^2$ is made to stand for the square *on* the line AB, because $a^2$ stands for the square *of* the number $a$. The learner who uses this species of symbol will not without great care avoid false reasoning in making the connection between geometry and algebra.

A square is divided by its diagonal into two isosceles right-angled triangles: its diagonals are equal, and bisect each other at right angles. The easiest way of drawing a square is to describe two circles on the side AB, and, bisecting AC in D, to make CE and CF equal to AD; the figure AEFB is then a square.

Of all similar figures, squares are those to the areas of which reasoning is most easily applied. If three similar




figures be described on the sides of a right-angled triangle, the sum of those on the sides is equal to that on the hypothenuse. This proposition is learned with reference to squares [HYPOTHENUSE] long before it can be proved with reference to similar figures in general: the consequence is, that the general proposition is almost overlooked by the previous occurrence of the particular case. We have noted in the article just cited the Hindu proof of this celebrated case; the simplest properties of the square may be made to give a more easy proof, founded on the same principle; it being remembered that the first four propositions of the second book of Euclid do not require the last two of the first book. The proof is as follows:—Let AB, BC be the sides of a right-angled triangle, and on their sum describe a square; make CE, FH, KL, each equal to AB. It is easily proved that LBEH is the square on the diagonal of the triangle; and it is made by subtracting four times the triangle from the whole square AF. But if four times the triangle be




subtracted by taking away the rectangles AM and GD, we have (Euc., ii. 4) the sum of the squares on the sides, which is therefore the same as the square on the diagonal.

**SQUARE ROOT**, the name given to a number with reference to its square. Thus, 49 being the square of 7, 7 is the square root of 49. When an integer has no integer square root, it has no square root at all in finite terms: thus 2 has no square root. But since 1·4142136 multiplied by itself gives very nearly 2, or has a square very near to 2, it is customary to say that 1·4142136 is very nearly the square root of 2: more properly, the square root of something very near 2.

The extraction of the square root came into Europe with the Indian arithmetic, the method followed by Theon and other Greeks (which was substantially the same) having been forgotten. The earliest extensive treatise on the subject is that of P. A. Cataldi (Bologna, 1613), though the books of algebra and arithmetic had then been long in the habit of giving the rule. The process presently given for finding the square root of a number in a continued fraction was first given (in a less easy rule) by the same Cataldi, who was thus the first who used continued fractions. This fact has been pointed out by M. Libri, since the article BROUNKER in this work was written.

The rule for the extraction of the square root is a tentative inverse process very much resembling division; and is contained under the general rule given in INVOLUTION AND EVOLUTION. The peculiar simplicity of this case however allows of a condensation of form, and makes the demonstration easy. The general rule just alluded to might be demonstrated on the same principle.

In order to turn the square of $a$ into the square of $a + b$, we must add to the former $2\,a\,b + b^2$, or $(2\,a + b)\,b$. This follows from

$$(a + b)^2 = a^2 + 2\,ab + b^2$$

An example will now show how the square root is extracted; first roughly, afterwards more skilfully in the choice of trials. Let the number be 104713. The square of 100 being 10000, which is much too small, we go on adding 100 to the square root, until no more hundreds can be added; all the while forming the squares by the rule, each square from the preceding. We then begin to add tens, forming the squares also, until the addition of one more ten would bring the square past 104713; we then add units, until either the square is exactly 104713, or the nearest to it. Or, instead of continual additions, we might subtract every number, as we get it, from 104713 until no more subtractions can be made. Both modes are exhibited in the following:—

| | | |
|---|---|---|
| $100^2 = 10000$ | 104713 | |
| $100\,(2\times100+100) = 30000$ | 10000 | |
| $200^2 = 40000$ | 94713 | $a$ |
| $100\,(2\times200+100) = 50000$ | 30000 | |
| $300^2 = 90000$ | 64713 | $b$ |
| $10\,(2\times300+10) = 6100$ | 50000 | |
| $310^2 = 96100$ | 14713 | $c$ |
| $10\,(2\times310+10) = 6300$ | 6100 | |
| $320^2 = 102400$ | 8613 | $d$ |
| $1\,(2\times320+1) = 641$ | 6300 | |
| $321^2 = 103041$ | 2313 | $e$ |
| $1\,(2\times321+1) = 643$ | 641 | |
| $322^2 = 103684$ | 1672 | $f$ |
| $1\,(2\times322+1) = 645$ | 643 | |
| $323^2 = 104329$ | 1029 | $g$ |
| $1\,(2\times323+1) = 647$ | 645 | |
| $324^2 = 104976$ | 384 | $h$ |

In the first column we feel our way, so to speak, by hundreds, by tens, and by units, up to the result that $323^2$ is too small, and $324^2$ too great; so that we see that 104713 has no square root. In the second column we go down from 104713, and subtracting the squares already formed in the first column, we come to the result that 104713 is 384 more than $323^2$, but less than $324^2$. The results of the second column are—

| | |
|---|---|
| $94713 = 104713 - 100^2$ | $2313 = 104713 - 320^2$ |
| $64713 = 104713 - 200^2$ | $1672 = 104713 - 321^2$ |
| $14713 = 104713 - 300^2$ | $1029 = 104713 - 322^2$ |
| $8613 = 104713 - 310^2$ | $384 = 104713 - 323^2$ |

The best method of making the trials depends upon the following circumstances:

1. A square number followed by an even number of ciphers, such as 1600000, is also a square number.

2. If $b\,(2\,a+b)$ is to be found as near as possible to R, and if $2a$ be considerable compared with $b$, the value of $b$ is near to that given by $b\times 2a = \text{R}$, or $b = \text{R} \div 2a$.

Taking the number 104713, and parting it into periods of two numbers each, we have 10, 47, 13, and 9,00,00 is the highest square belonging to a simple unit followed by ciphers, which can be contained in it. Choose 300 for the first part of the root, and we have 14713 for the remainder. If $b$ be the number of tens in the root, we have to make $10b\,(2\times300+10b)$ as near as we can to 14173, or, $10b$ not being much compared with 600, we must try $10b\times600 = 14713$, or $b = 14713 \div 6000$, whence 2 is the highest (perhaps too high, but that will be seen by the remainder). If $b = 2$, $10b\,(600+10b)$ is 12400, which, subtracted from 14713, gives 2313. The part of the root now obtained is 320, and if $c$ be the number of units, $c\,(2\times320+c)$ must be made equal, or as near as can be, to 2313. Now $c$ is very small compared with 640, and $c\times640 = 2313$ shows that $c = 3$ at most, giving $3\times643$, or 1929, to be subtracted from 2313, which leaves 384. The process may be written thus:—

$$\begin{array}{rr}
 & \dot{1}0\dot{4}7\dot{1}3\ (300+20+3 \\
 & 90000 \\
\hline
600 & )\ 14713 \\
20 & )\ 12400 \\
\hline
640 & )\ 2313 \\
3 & )\ 1929 \\
\hline
 & 384
\end{array}$$

which, omitting superfluous ciphers, is the one commonly used. We do not intend to dwell on the common process, which is in all the books, but confine ourselves to the explanation, which is frequently omitted.

We now take a longer instance, at full length, followed by a statement of its results:

```
            . . . . .
            290225296(10000
            100000000  7000
   20000)190225296       30
    7000)189000000        6
     34000)1225296
        30)1020900
     34060)204396
         6)204396
                 0
```

The following are the successive conclusions:—

$$290225296 - 10000^2 = 190225296$$
$$290225296 - 17000^2 = 1225296$$
$$290225296 - 17030^2 = 204396$$
$$290225296 - 17036^2 = 0$$

whence the given number is the square of 17036.

The rationale of the approximate extraction is as follows:—Suppose we wish to find, to four places of decimals, the square root of 1·74, that is, to find a fraction $a$, such that $a^2$ shall be less than 1·74, but that $(a+\cdot0001)^2$ shall be greater than 1·74. Give this fraction the denominator 1,00,00,00,00, which requires that its numerator shall be 1,74,00,00,00. This numerator is found, by the integer rule, to lie between $13190^2$ and $13191^2$, or 173976100 and 174002481. We have then—

$$(1\cdot3190)^2 = 1\cdot73976100$$
$$(1\cdot3191)^2 = 1\cdot74002481$$

which satisfy the conditions.

The common process of contraction, explained in books of arithmetic, has the following rule:—When the number of places in the divisor has so much increased as to exceed by 2, or thereabouts, the number of places yet remaining to be found, instead of proceeding with the complete operation, leave the remainder unaugmented by any new period, strike one figure off the divisor, and proceed as in contracted division. If R be the remainder, $a$ the part of the root found, $b$ that remaining to be found, we have $b\,(2a + b) = \mathrm{R}$. If $a$ be very large compared with $b$, $2ab = \mathrm{R}$ nearly, or $b = \mathrm{R} \div 2a$ nearly; now $2a$ is the *divisor* in the rule. The fact is that $b$ must lie between

$$\frac{\mathrm{R}}{2a} \text{ and } \frac{\mathrm{R}}{2a + \dfrac{\mathrm{R}}{2a}}$$

Processes of this sort are often best shown, as to mere operation, by an instance in which the numerical computation gives no trouble. The following is a complete instance of the rule, exhibited in finding the square root of 4444·444444, &c.:

```
         . .  . . .
         4444·444444, &c. (66·666666666667
         36
    126)844
        756
   1326)8844
        7956
  13326)88844
        79956
 133326)888844
        799956
1333326)8888844
        7999956
13333326)88888844
         79999956
13,3,3,3,3,3,2)8888888
               7999999
                888889
                800000
                 88889
                 80000
                  8889
                  8000
                   889
                   800
                    89
                    80
                     9
                     9
                     0
```

The given number is in fact $4444\frac{4}{9}$, which is the square of $66\frac{2}{3}$.

When R is the remainder, and $a$ the part of the root found, the remaining part of the root is the continued fraction [FRACTIONS, CONTINUED]

$$\frac{\mathrm{R}}{2a+}\;\frac{\mathrm{R}}{2a+}\;\frac{\mathrm{R}}{2a+}\;\frac{\mathrm{R}}{2a+}\;\&c.$$

But this is not a continued fraction of the most useful form, except when $\mathrm{R} = 1$. To reduce the remainder of a square root to a continued fraction in which all the numerators are units, proceed as follows: the process comes first and is followed by the explanation.

To extract the square root of 21—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | 1 | 3 | 3 | 1 | 4 | 4 | 1 |
| 1 | 5 | 4 | 3 | 4 | 5 | 1 | 5 |
| 4 | 1 | 1 | 2 | 1 | 1 | 8 | 1 |

Let the number be N, the integer part of its root $a$, and write under one another in the first column, $a$, 1, $a$. Proceed to form the second, third, &c., columns, each from the preceding, in the following way:—If $p$, $q$, $r$, be in one column (found), and $p'$, $q'$, $r'$, in the next (to be found), then—

1. $q'$ is $\dfrac{\mathrm{N}-p^2}{q}$, and is always integer.
2. $r'$ is the integer part of $\dfrac{a+p}{q'}$.
3. $p'$ is $q'r'-p$.

Thus for the second column we have $(21-16)\div1$, or 5, for the second row; the integer of $(4+4)\div5$, or 1, for the third row; and $1\times5-4$, or 1, for the first row. In the third column we have $(21-1)\div5$, or 4, for the second row; the integer of $(4+1)\div4$, or 1, for the third row; and $1\times4-1$, or 3, for the first row. In the fourth column we have $(21-9)\div4$, or 3, for the second row; the integer of $(4+3)\div3$, or 2, for the third row; and $2\times3-3$, or 3, for the first row, and so on. This process must, after a time, begin to repeat itself; as soon as this happens, the last row shows the integer of the square root, and the succession of denominators of the continued fraction, which must be repeated as often as is necessary to give the required degree of accuracy. Thus,

$$\sqrt{21}=4+\frac{1}{1+}\;\frac{1}{1+}\;\frac{1}{2+}\;\frac{1}{1+}\;\frac{1}{1+}\;\frac{1}{8+}\;\frac{1}{1+}\;\frac{1}{1+}\;\frac{1}{2+}\;\frac{1}{1+}\;\frac{1}{1+},$$
&c.

If we proceed with the continued fraction as in the article cited, we have for the successive approximations to its value

$$\frac{1}{1}\;\frac{1}{2}\;\frac{3}{5}\;\frac{4}{7}\;\frac{7}{12}\;\frac{60}{103}\;\frac{67}{115}\;\frac{127}{218}\;\frac{321}{551}\;\frac{448}{769}\;\frac{769}{1320},\ \&c.:$$

and $4\frac{769}{1320}$ only differs from $\sqrt{21}$ in the 8th decimal place. The use of this method is, not to extract the square root of any number which accidentally occurs, but to find convenient approximations, if possible, for square roots which frequently occur, and as to which it is therefore worth examination whether there may not be some common fraction which will serve the purpose as well as a decimal of considerable accuracy. For instance, we take $\sqrt{2}$ and $\sqrt{3}$, which represent the diagonals of a square and a cube having a unit for their sides. The processes are as follows:—

| | | | |
|---|---|---|---|
| 1 | 1 | 1, | &c. |
| 1 | 1 | 1, | &c. |
| 1 | 2 | 2, | &c. |

| | | | | | |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1; | &c. |
| 1 | 2 | 1 | 2 | 1, | &c. |
| 1 | 1 | 2 | 1 | 2, | &c. |

$$\sqrt{2}=1+\frac{1}{2+}\;\frac{1}{2+}\;\frac{1}{2+\ \&c.}\qquad \sqrt{3}=1+\frac{1}{1+}\;\frac{1}{2+}\;\frac{1}{1+}\;\frac{1}{2+},\ \&c$$

The successive approximations to the fractions are—

$$\frac{1}{2}\;\frac{2}{5}\;\frac{5}{12}\;\frac{12}{29}\;\frac{29}{70}\;\frac{70}{169}\;\frac{169}{408}\;\frac{408}{985},\ \&c.$$

$$\frac{1}{1}\;\frac{2}{3}\;\frac{3}{4}\;\frac{8}{11}\;\frac{11}{15}\;\frac{30}{41}\;\frac{41}{56}\;\frac{112}{153}\;\frac{153}{209}\;\frac{418}{571}\;\frac{571}{780},\ \&c.$$

Thus we immediately see a convenient mode of finding the diagonal of a square, derived from

$$\sqrt{2}=1+\frac{29}{70}=\frac{99}{70}=\frac{100-1}{70},\ \text{nearly,}$$

the excess of which aoove the truth is less than the 11830th part of the side. Thus to find the diagonal of a square of 769·23 feet we have

$$\begin{array}{r} 76923 \\ \underline{769\cdot23} \\ \text{'}70)\overline{76153\cdot77} \\ 1087\cdot911 \end{array}$$

which is too great by only about 6-hundredths of a foot.

The rule for extracting the square root of an algebraical quantity is very little needed, but is a remarkably good exercise in the operations of algebra. Arranging the square in powers of some one letter, the rule is identical with that for the square root of numbers in every point but this, that the new term is always found by dividing the *first term* of the remainder by the *first term* of the divisor. A couple of examples will suffice. Let it be required to find the square root of $1+2x+3x^2+4x^3+\ldots.$

$$\begin{array}{rl} & 1+2x+3x^2+4x^3+\ldots\ldots \quad (1+x+x^2+x^3+\ldots \\ & \underline{1} \\ 2+x) & 2x+3x^2+\ldots \\ & \underline{2x+\ x^2} \\ 2+2x+x^2) & 2x^2+4x^3+5x^4+\ldots. \\ & \underline{2x^2+2x^3+x^4} \\ 2+2x+2x^2+x^3) & 2x^3+4x^4+6x^5+7x^6 \\ & \underline{2x^3+2x^4+2x^5+\ x^6} \\ & 2x^4+4x^5+6x^6 \ \&c. \end{array}$$

Again, to find the square root of $1+x$:

$$\begin{array}{rl} & 1+x\left(1+\frac{x}{2}-\frac{x^2}{8}+\frac{x^3}{16}-\frac{5x^4}{128}+\ldots\right. \\ & \underline{1} \\ 2+\frac{x}{2}) & x \\ & \underline{x+\frac{x^2}{4}} \\ 2+x-\frac{x^2}{8}) & -\frac{x^2}{4} \\ & \underline{-\frac{x^2}{4}-\frac{x^3}{8}+\frac{x^4}{64}} \\ 2+x-\frac{x^2}{4}+\frac{x^3}{16}) & \frac{x^3}{8}-\frac{x^4}{64} \\ & \underline{\frac{x^3}{8}+\frac{x^4}{16}-\frac{x^5}{64}+\frac{x^6}{256}} \\ & -\frac{5x^4}{64}+\frac{x^5}{64}-\frac{x^6}{256} \end{array}$$

SQUATA'ROLA. [PLOVERS, vol. xviii., p. 282.]

SQUILL. [SCILLA.]

SQUILLA, the name of a genus of plants belonging to the natural order Liliaceæ. It is characterized by possessing 3 coloured spreading sepals; 3 petals very like them, but a little broader; 6 stamens shorter than the petals, with smooth filaments, and dilated at the base; a 3-parted ovary, which is surmounted with three nectariferous glands at the apex; a smooth simple style, with an obscurely-lobed stigma; a 3-cornered 3-celled capsule, with numerous seeds. This genus was constituted by Steinheil, and separated from the old genus Scilla, from which it differs in the possession of the nectariferous glands on the ovary, and other minor points.

*S. maritima*, the maritime squill, has large roundish ovate bulbs, half above ground, with integuments pale green or red; leaves appearing long after the flowers, broad, lanceolate, channelled, spreading, and recurved; scape two feet high, terminated by a dense long ovate raceme, bearing flowers of a pale yellowish-green colour, with a green stain along the middle of each segment. It is a native of the coasts of the Mediterranean, and is the Skilla (Σκίλλα) of Dioscorides.

*S. Pancration* is a smaller plant than the last. The bulb is about half the size, of a pale-green or red colour; the leaves are shorter, more acute, and narrower; the stem is more glaucous; the flowers smaller, and flower-stalks shorter, and the petals and sepals are spread fully out. According to Steinheil, this is the Pancration (Παγκράτιον) of Dioscorides, which acted much more mildly as a medicinal agent than the former species. By most writers this plant has been confounded with the former. See Steinheil, in 'Annales des Sciences Naturelles,' tom. vi., second series. Lindley, in the 'Flora Medica,' places Roxburgh's Indian Squill (*Scilla Indica*) in the genus Squil.a. This plant possesses the same sensible properties as the former species, and probably might also be used in medicine with the same success. [SCILLA.]

SQUILLA. [STOMAPODS.]

SQUILLA'CE. [CALABRIA.]

SQUILLERECHTHUS. [STOMAPODS.]

SQUINTING (*Strabismus*). It is a condition essential to correct vision that the axes of both eyes correspond in direction, and be turned simultaneously towards the object we regard. Now to ensure the fulfilment of this condition, the orbital muscles (motores oculorum) are so supplied with nervous influence, that we cannot will the movement of one eye without the other being called into involuntary and harmonious action. There are some individuals however whose optic axes are not parallel, and whose eyes do not move in harmony with each other; such persons are said to squint, or to be effected with strabismus. Squinting may take place either upwards, downwards, inwards, or outwards, or in the intermediate directions; it may also be confined to one eye; or may affect both. As the inward and outward varieties of squint are by far the most common, we shall devote the following remarks to them alone.

*Inward Squint, or Strabismus convergens*, is met with in three distinct forms: 1, single convergent strabismus; 2, double convergent strabismus; and 3, alternating strabismus. In the first form of the affection one eye is habitually turned more or less inwards towards the inner angle of the orbit, whilst the other maintains its natural position, and is capable of being directed to any object that the individual wishes.

On closing the sound eye, the inverted one then becomes strait, and can be turned in every direction nearly to the same extent as the other; but as soon as it is again opened, the one affected with strabismus revolves inwards, and there remains; or if it do move along with the good eye, yet never so as to permit the two axes to be pointed at the same object. Double convergent strabismus differs from the preceding in its affecting both eyes; the axis of each eye is inclined unnaturally inwards, as if the person were regarding some object placed close to his face. On directing his attention to distant objects, the eyes do not become parallel, but the one least affected (for one is always more so than the other) becomes strait, whilst its fellow preserves its former position, or is turned more strongly inwards. With regard to the relative frequency of strabismus in one or in both eyes, it is said to affect most frequently one eye only, and this the left. Thus in an analysis of 200 cases by Mr. Radclyffe Hall, 110 were of the left eye, 71 of the right, and only 19 of both eyes; and in 125 cases recorded by Mr. Liston, 67 were of the left eye, 54 of the right, and 4 of both eyes.

Mr. Elliot of Carlisle however questions the propriety of separating the above-described cases of strabismus into single and double, and we think with justice. He calls attention to a fact, previously pointed out by Fischer of Ingoldstadt in 1781, and again by Purkinje in 1825, viz. that the eye which is habitually strait when open squints when its lids are closed; while, as we have before seen, the squinting eye becomes straight, so that, in point of fact, it is merely a change of the squint from one eye to the other. Here then there is evidently an association in the movements of the two eyes, the position of the one being always dependent on that of the other, so that it cannot strictly be said the individual squints with one eye only. For these reasons Mr. Elliot purposes to confine the term single squint to those cases in which there is no association whatever in the motions of the two eyes; but the inverted eye remains fixed in the inner angle of the orbit, whether the sound one be open or closed.

Alternating Strabismus differs from the ordinary form of squint, in its affecting both eyes *equally*, though never both at a time. An individual thus affected appears to use either eye indifferently; and the change of inversion from one eye to the other is a voluntary act, independent of the opening or closing of the eyelids.

*Outward Squint, or Strabismus divergens.*—Nearly all that has been said in reference to convergent strabismus may be applied, mutatis mutandis, to divergent squint. In this form of the affection, one eye is more or less everted, whilst the other is directed straight forwards; the patient is likewise incapable of directing both eyes inwards simultaneously. These cases we believe to be most frequently of the alternating kind; that is, the individual can employ either eye singly, and bring it into the central axis, but then its fellow becomes everted. It is a more rare affection than the former one, and the deformity arising from it is seldom so obvious. Whether we regard strabismus as affecting one eye or both, it is certain that the vision of the one most distorted is nearly always imperfect, and usually in a direct ratio with the degree of distortion. Now we know that if impressions on the two retinæ are dissimilar in force, the mind disregards the weaker, and takes cognizance only of the stronger; so that a person who squints badly generally sees objects with the sound eye only. If the sight of both eyes is equal or nearly so, double vision results whenever both are employed together, because the images of objects do not fall on corresponding portions of the two retinæ [SIGHT]; and as the defect of sight is generally in a direct ratio with the degree of distortion, double vision is most frequently experienced in slight cases of squint.

*Causes.*—The inequality of power in the two eyes has been regarded by many as a cause of strabismus; the defective eye, it is said, 'instead of being fixed on the object before it, is left to wander from the true axis of vision.' When however we consider how numerous are the examples of unequal vision with the two eyes, yet unattended with squint, and the great and immediate improvement of sight which generally results from the operation for the removal of the defect, we may fairly question the influence of this cause in the production of strabismus. Among the remote causes which unquestionably contribute to this effect, may be enumerated convulsions, teething, the irritation arising from worms, ophthalmia, imitation, a habit of misdirecting the eyes, as by frequently looking at a mole on the nose, &c. The proximate cause resides in some affection of the muscles or nerves of the eyeball; either the balance of power between the former is lost, or the sympathy which exists naturally between the motor-oculi nerves of the two eyes is impaired.

*Treatment.*—This must depend upon whether the affection is of a temporary or permanent nature; in the former case it will be found to arise from some local irritation, and can be removed by suitable therapeutic remedies; in the the latter, an operation will generally be required. Among the different other plans of treatment which occasionally have proved successful, we may enumerate binding up the sound eye; the employment of spectacles having glasses of different power; blinders projecting in front of the temples, with a view of attracting the eyes outwards; electricity, &c. The operation for the cure of strabismus is said to have suggested itself first to Dr. Stromeyer, from witnessing the success of tenotomy in contractions of the limbs. Dr. Dieffenbach of Berlin however was the first who had the boldness to carry it into practice on the living subject. The operation consists in dividing the muscle by which the distortion is produced, and thus allowing its antagonist to draw the eye again into the centre of the orbit. Although most cases of strabismus may be either completely cured or very much bettered by this operation, it is proper to remark that in some, neither this nor any other plan of treatment is of any avail. Provided however that the subjects to be operated on are judiciously selected, and the surgeon qualified for the task, there is no operation within the whole range of surgery which is more simple, more free from danger, or more satisfactory in its results, than the one in question.

Readers who wish for more full information on the subject of strabismus are referred to the works of Mr. Lucas, Mr. Duffin, and Mr. Mackenzie; also to a very interesting practical paper on the same subject by Mr. Elliot, published in the 55th volume of the *Edinburgh Medical and Surgical Journal.*

SQUIRE, SAMUEL, D.D. (born 1714, died 1766), a learned prelate of the English church, and author of various works, was the son of an apothecary at Warminster in Wiltshire. He was educated in St. John's College, Cambridge, and became early in life chaplain to Dr. Wynne, bishop of Bath and Wells, by whom he was made chancellor of Wells and archdeacon of Bath. He was afterwards chaplain and private secretary to the duke of Newcastle. In 1750 he became rector of St. Ann's, Westminster. He had no other preferment, till in 1760 he was made dean of Bristol, and, in 1761, bishop of St. David's. His life was prosperous, but short: he died at the age of fifty-two. His principal published writings are:—'An Enquiry into the Nature of the English Constitution;' 'The Antient History of the Hebrews Vindicated;' two essays, 1, 'A Defence of the Antient Greek Chronology;' 2, 'An Enquiry into the Origin of the Greek Language;' an edition of Plutarch's treatise 'On Isis and Osiris;' 'An Essay on the Balance of Civil Power in England;' 'Indifference for Religion inexcusable;' and 'Remarks on Mr. Cart's Specimen of his General History of England.' There is also a Catechism by him, and a collection of sermons preached by him on public occasions. More may be read respecting him in Nichols's 'Literary Anecdotes of the Eighteenth Century,' vol. ii., p. 348.

SQUIRRELS, SCIURIDÆ, a family of RODENTIA. Mr. Swainson makes this family the fourth great division of the rodent animals, and he remarks that the strong resemblance which several of the American marmots (*Spermophilus*) have to squirrels, leads him to believe that the two groups naturally follow one another; a supposition which is, he observes, considerably strengthened by the subgenus *Tamias*, Ill., putting on as it were an intermediate form. With regard to these ground-squirrels, as he says they may be justly called, he adverts to the description of the habits and manners of two species (*Tamias Lysteri* and *Tamias quadrivittatus*) by Dr. Richardson, which two species live almost like marmots, and both construct burrows beneath the surface of the ground. Mr. Swainson remarks that some of the squirrels have short and rounded ears, but that the generality of the species have them tufted with a pencil of hairs, as a perfect example of which he refers to our common squirrel (*Sciurus vulgaris*). Mr. Swainson does not omit to notice the grace and liveliness that reign in the movements of these sprightly little animals. 'Their agility upon all occasions of motion,' says he, 'is very great; but when exerted to the utmost, it is truly surprising: so quick indeed do they bound from branch to branch, and so great is the rapidity with which they suddenly turn and wind about, that the eye, partly confused by the intervention of other objects, is frequently unable to follow their movements. The true squirrels, unlike those of the subgenus *Tamias*, live almost entirely in trees, and build their nests on a fork of the branches.'

Mr. Swainson then adverts to the flying squirrels (*Pteromys*), which are equally arboreal in their habits. 'These,' he writes, 'as their name implies, have an expansive skin, forming a sort of sail, between the fore and the hind feet, examples of which structure we also see among the marsupial or pouched quadrupeds of New Holland.' [MARSUPIALIA, vol. xiv., p. 460.] 'There are six species of *Pteromys* found in India, three in America, and one, common in Siberia, is likewise an inhabitant of Lapland. Of the habits belonging to the Oriental species, we know but little or nothing; but those of the Siberian *Pteromys* have been recorded by Pallas. It feeds principally on the young shoots of the pine-tree; and these, after being digested, preserve so much of their resinous quality, that the dung will burn with a bright flame and a strong scent of resin. Like the ordinary squirrels, this species lives entirely in trees, sits erect, feeds itself with the fore-paws, and takes prodigious leaps, assisted greatly by the expansive membrane between the legs, which acts as a support, to break the force of its descent. It appears however that the flying-squirrels are nocturnal animals, in which respect they differ essentially from the true squirrels, which are diurnal. Dr. Richardson, speaking of an American species, expressly states this:—'The *Pteromys Alpinus* of the Rocky Mountains lives in dense pine-forests, and seldom ventures from its retreat, except in the night.' Pallas, alluding to the Siberian species, asserts the same; and adds, that its eyes are provided with a nictitating membrane.' (*Classification of Quadrupeds.*)

This family then of Rodents, with very distinct clavicles, may be naturally and popularly divided into three groups, the True Squirrels, the Ground-Squirrels, aud the Flying-Squirrels.

*Family Character.*—Molars simple, with tuberculous crowns, five above, four below, on each side; the lower incisors very much compressed. Toes long, armed with sharp claws, four on the anterior and five on the posterior feet; anterior thumb very short. Tail long and tufted. Cheek-pouches in some. In others the skin of the sides extended between the anterior and posterior limbs.

*Geographical Distribution of the Sciuridæ.*—The geographic range of the Squirrels is very wide both in the Old and New World. None appear to have been discovered in Australia.

The *Sciuridæ* have been divided into two principal groups:—

A. Squirrels with free limbs.

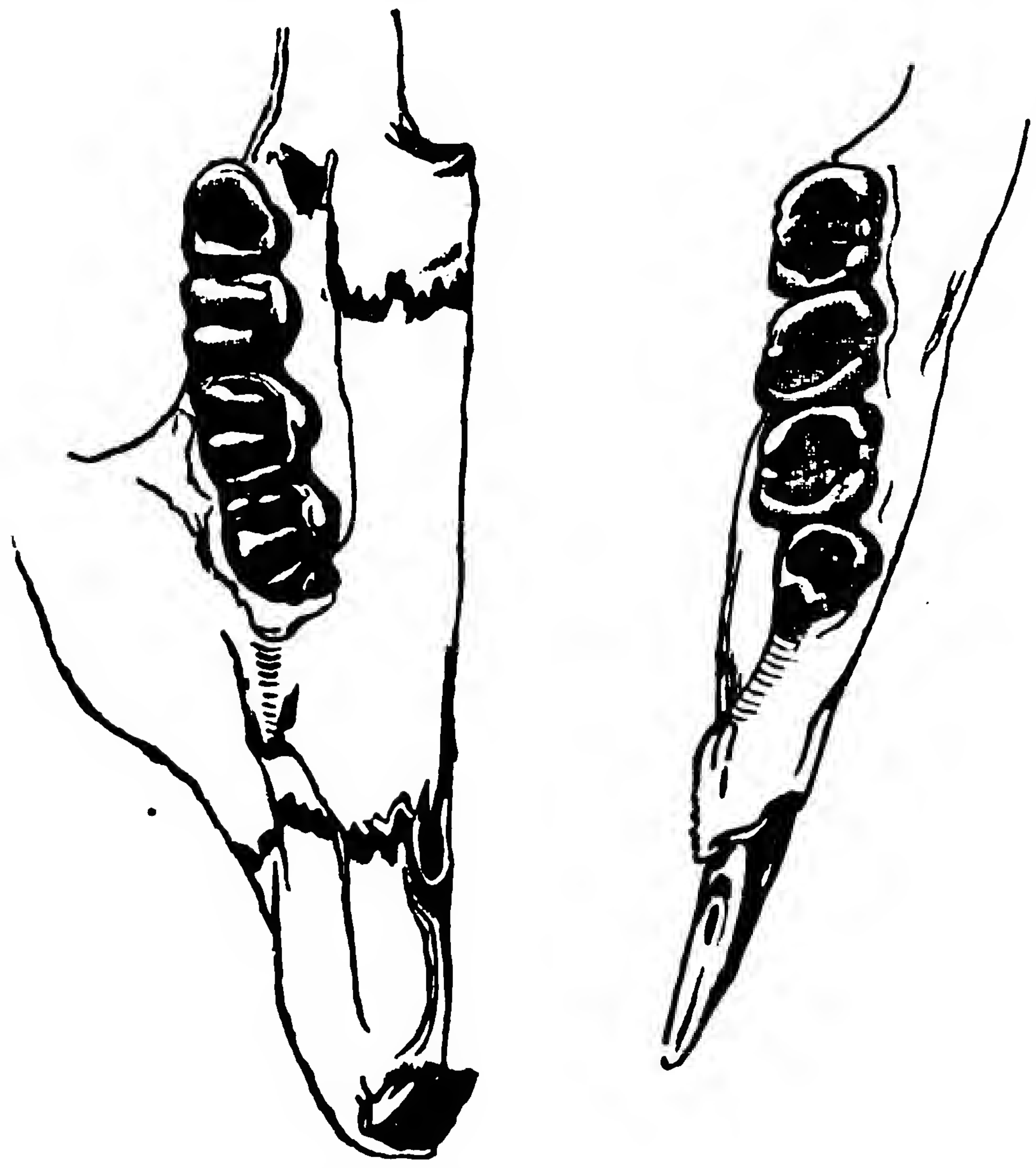
*Genera.—Tamias, Sciurus, Macroxus,* and *Anisonyx.*

B. Squirrels with their limbs invested in the skin of the sides.

*Genera.—Pteromys, Sciuropterus.*

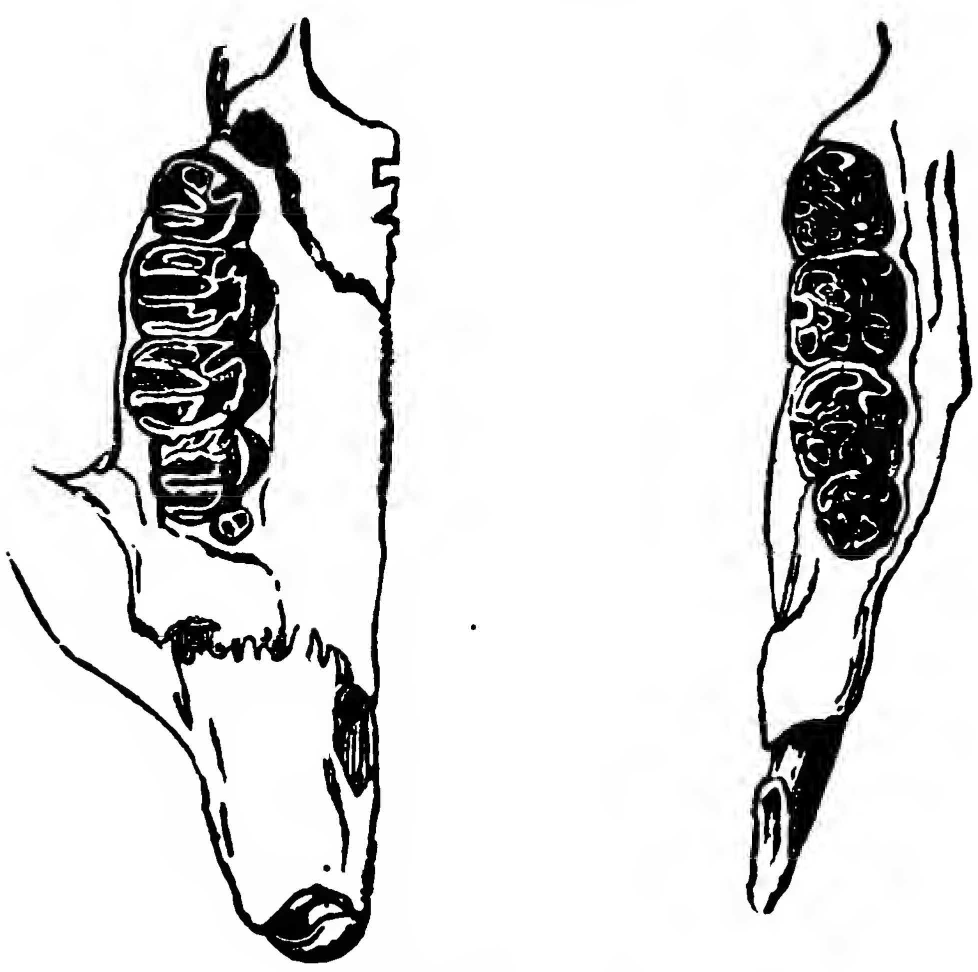
The following dentition is given by M. F. Cuvier for *Tamias, Sciurus, Macroxus,* and *Sciuropterus:—*

$$\text{Incisors } \frac{2}{2}; \text{ molars } \frac{5-5}{4-4} = 22.$$



Teeth of Tamias, Sciurus, Macroxus, and Sciuropterus

The same author has published the following modification as characteristic of *Pteromys*, the numbers of the teeth being the same with those of the genera above mentioned.



Teeth of Pteromys.

### General Characters.

*Tamias.* (Ground Squirrels.) Skull presenting a uniform curved line on its upper part when viewed in profile, and offering, when seen below, a very slender condition of all the anterior parts. Cerebral cavity but little extended, and advancing only to one half of the skull.

*Geographical Distribution.*—Europe, Asia, North America.

*Sciurus.* (True Squirrels.) A slight depression of the frontal bones, and a very slight posterior projection of the same; profile of the face very nearly straight; cranial cavity as long as two-thirds of the face. No cheek-pouches. Tail distichous.

*Geographical Distribution.*—Europe, Asia, India and Indian Islands, Africa, North America, South America, and West Indian Islands.

*Macroxus.*—Frontal bones very much depressed: nasal bones but little elongated; a deep depression between the cranium and the face. Tail round. No cheek-pouches.

*Geographical Distribution.*—Sumatra, India, Africa, and South America.

*Anisonyx.*—Teeth like those of the squirrels. No cheek pouches. All the feet with five toes; the two internal toes of the anterior feet very short. Claws very long. Tail distichous. A genus, considered as not certain, established by M. Rafinesque for the reception of animals approximating to the squirrels and the marmots, from which they differ in the number and form of the toes.

*Geographical Distribution.*—Columbia.

*Pteromys.*—Posterior part of the nasal bones a little convex; the frontal bones strongly depressed in their middle and rising slightly afterwards; the posterior parts of the head do not begin sensibly to curve downwards before the middle of the parietal bones; cerebral cavity small, only half the length of the head.

*Geographical Distribution.*—Asia, the Moluccas, the Philippine Islands, and Java.

*Sciuropterus.*—Differing from *Pteromys* in having the anterior part of the profile line of the head straight to the middle of the frontal bones, where it takes a curved direction, very much arched, without any intermediate depression. Occiput projecting; frontal bones elongated; and the capacity of the cranium comprising three-fifths of the length of the head.

*Geographical Distribution.*—Northern Asia and North America.

For Mr. Waterhouse's arrangement of the *Sciuridæ*, see Rodentia, vol. xx., pp. 61, 62.

### European Squirrels.

Examples,—*Tamias striatus.—Description.*—Upper part of the body yellow-brown, with five brown longitudinal stripes and two white ones on the upper parts; white beneath; lumbar region rusty, as well as the tail, which is blackish above, and bordered with black below. Length rather more than nine inches, including the tail, which measures about three inches.

*Habits, &c.*—Pallas states that this ground-squirrel burrows in woody districts, in small hillocks, or near the roots of trees; but never makes its nest in the trunks or branches of trees, like the common squirrels, although, when frightened from its hole, it climbs with ease, speedily making its way from branch to branch. The nest is reached by a winding tunnel, and there are generally two or three lateral chambers, for the stowage of winter food. It is allied in its habits to the hamster and *citillus* (*Spermophilus*), is connected with the latter by the convexity of its nose, and has cheek-pouches, but differs altogether in its manners from the tree-squirrels. The head is longer than that of the common squirrel; the ears are rounded and without tufts; the roundish hairy tail is seldom turned up; the body is slender, the extremities are shorter than those of the common squirrel, and the fur is very short, and not so fine. Its habits are diurnal, it does not become torpid in winter, and in these respects it approaches the true squirrels. It is not easily tamed.

Dr. Richardson remarks that the *Sciurus* (*Tamias*) *Lysteri* of Ray, the *Hackee* of the United States, *Ohihoin* of the Hurons, *Striped Dormouse* of Pennant, is considered by the author of the above description, and subsequent writers, to be the same with the Asiatic *Sciurus striatus;* but the Doctor adds that the descriptions given of the latter do not exactly correspond with American specimens, and that he is not aware that the identity of the species on the two continents has been established by actual comparison. He allows however that the observations of Pallas regarding the manners and form of the Asiatic animal apply exactly to the American one.

The *Hackee*, Dr. Richardson states, is common on the north shores of lakes Huron and Superior; but he does not believe that it exists in a higher latitude than the 50th parallel. Although very wild, it is, he says, fond of establishing its abode in the immediate vicinity of man, and multiplies greatly in cultivated places. (*Fauna Boreali-Americana.*)

*Sciurus vulgaris.—Description.*—Head thick, rounded posteriorly, flattened at the sides and on the forehead; nose prominent; eyes black, prominent, large, and placed rather high on the sides of the head; ears straight, large, terminated by a pencil of long hairs; cutting teeth of the upper jaw broader than those of the lower, which are almost pointed, and much flattened at the sides; grinding-teeth four above and below, with the addition of a rudimentary one, consisting of a single tubercle, and often deciduous, placed immediately before the others in the upper jaw; neck short, but distinct; body thick; back arched; tail long and very bushy, the hairs distichous; hinder legs very long, the heels touching the ground; fore-feet formed for holding food; fingers long, furnished with prominent cushions, and with long, sharp, curved claws. Colour above reddish-brown, beneath white. (Bell.)

The length of the common squirrel including the tail (which last measures about six inches three lines) is about fourteen inches nine lines. Mr. Bell, after stating that it is liable to considerable variety of colour, becoming grey in the northern regions, and quoting the passage in *Lachesis Lapponica*, which relates how the inhabitants of the Lapland Alps procure a number of this species in their grey or winter clothing for the sake of their skins, proceeds to remark that even in this country a certain degree of change takes place in the colour of the fur in spring and autumn. Mr. Blyth informed him of this fact. In summer the fur is coarser and more uniformly red, and the pencils of hairs on the ears are lost; in winter a greyish tint appears on the sides, the pencils on the ears are long and well developed, and the fur is softer and fuller. In July, and not till then, the summer change is perfect.

This is the *Ecureuil* of the French; *Scojattolo*, *Schiarro*, and *Schiaratto* of the Italians; *Hardu*, *Hardella*, and *Esquilo* of the Spaniards; *Ciuro* of the Portuguese; *Eichorn* and *Eichmermlin* of the Germans; *Inkhoorn* of the Dutch; *Ikorn* and *Graskin* of the Swedes; *Ekorn* of the Danes; and *Gwiwair* of the antient British.

*Geographical Distribution.*—Europe and the north of Asia.

*Habits, &c.*—'This animal,' says Pennant, 'is remarkably neat, lively, active, and provident; never leaves its food to chance, but secures in some hollow tree a vast magazine of nuts for winter provision. In the summer it feeds on the buds and young shoots, and is particularly fond of those of the fir and pine, and also of the young cones. It makes its nest of the moss or dry leaves, between the fork of two branches, and brings four or five young at a time. Squirrels are in heat early in the spring, when it is very diverting to see the female feigning an escape from the pursuit of two or three males, and to observe the various proofs they give of their agility, which is then exerted in full force.'

Their agility is indeed surprising; the rapidity with which they will run up a tree, or down, head first; the leaps which they will take from bough to bough, and from tree to tree, and the skill with which they dodge out of sight when pursued, baffle description. It is a very difficult thing to shoot a squirrel in motion. They have been seen, when hard pressed, and when the distance to the next tree has been beyond their most extravagant leaps, to throw themselves off, spreading abroad their limbs so as to make their body as parachute-like as possible to break their fall; and on reaching the ground without harm, bound along for the few intervening paces, and ascend the tree with a celerity almost too quick for the eye to follow. Their fondness for the shoots of the fir tribe make them ill neighbours to plantations of that race of trees, the leaders of which they bite off. When they have paired, they are generally much attached to their home and to each other, and a pair of squirrels, like a pair of carrion crows, will go on from year to year living and breeding in the same tree if undisturbed.

White mentions a curious instance of the transfer of the maternal affections of a cat, which had lost her kittens, to some young squirrels that were thrown upon her protection. 'A boy,' says he, 'has taken three little young squirrels in their nest, or drey, as it is called in these parts. These small creatures he put under the care of a cat which had lately lost her kittens, and finds that she nurses and suckles them with the same assiduity and affection as if they were her own offspring. This circumstance corroborates my suspicion, that the mention of exposed and deserted children being nurtured by female beasts of prey who had lost their young, may not be so improbable an incident as many have supposed; and therefore may be a justification of those authors who have gravely mentioned what some have deemed to be a wild and improbable story. So many people went to see the little squirrels suckled by a cat, that the foster-mother became jealous of her charge, and in pain for their safety; and therefore hid them over the ceiling, where one died. This circumstance shows her affection for these fondlings, and that she supposes the squirrels to be her own young. Thus hens, when they have hatched ducklings, are equally attached to them as if they were their own chickens.' (White's 'Selborne.')

In captivity the common squirrel is always in motion, but it is painful to see one of the most agile of animals condemned to tread the same unvaried round without advancing an inch. The number of cages made for this favourite mode of incarceration is very great.

*Sciuropterus Sibiricus.*

Before we proceed to describe this species, it may be desirable to give some notion of the organization which characterises the Flying-Squirrels generally.

'The group to which this attractive little animal belongs, says Mr. Bennett, in his description of the American *Pteromys Volucella*, 'are principally distinguished from the Common Squirrels by what is usually termed their flying membrane. This apparatus consists of a folding of the skin along either side so as to form broad lateral expansions, supported anteriorly and posteriorly by the limbs between which they are extended, and by peculiar bony processes arising from the feet. These expansions are not naked and membranous, like those of the Bats, but are actual continuations of the skin, clothed externally by a dense fur similar to that which invests every other part of the body. Neither do they serve, like the flying membranes of many of the Bats, the purposes of wings; their functions being limited to that of a parachute, giving to the animal a considerable degree of buoyancy, and thus enabling it to take leaps of almost incredible extent, through which it passes with the velocity of an arrow. The name of *Flying-Squirrels* is consequently founded on an erroneous assumption; but it may nevertheless be admitted as a metaphorical expression of their most distinguishing peculiarity.' (*Zoological Gardens.*)

*Description of Sciuropterus Sibiricus.*—Eyes full, the lids edged with black. Membranes extending to the base of the fore-feet, and forming a large wing-like expansion on each side. Tail full and rounded at the extremity. Body, above, of a fine grey colour, resembling the hue on the back of a sea-gull; beneath, pure white. Total length about 9½ inches, of which the tail, measured to the end of the hair, is five.

This is the *Mus Ponticus vel Scythicus* of Gesner; *Sciurus Petaurista volans* of Klein; *Sciurus volans* of Linnæus; *Sciurus Sibiricus volans* of Brisson; *Quadrupes volatilis Russiæ* of the *Acta Petropolitana*; *Polatucha* and *Letaga* of the Russians; *Polatouche* of the French; *Konige der Grauwerke* (King of the Squirrels) of the Germans; *Wiewiorka Lataica* of the Poles; and *European Flying-Squirrel* of English authors.

*Locality.*—Finland, Lapland, the Russian dominions from Livonia to the river Kolyma or Kowyona in the north-east of Siberia.

*Habits.*—This species haunts the woody mountainous country, feeding on the buds and fruit of the birch-trees and on the cones of the fir tribe. It is a solitary animal, and does not affect the company of others of its own kind, nor does it retire in the winter, at which season it wanders about. Its dwelling is in the hollows of trees, and its nest is generally made of moss from the birch. It raises the tail when at rest, but when it takes its flying leaps, extends that member.

### Asiatic Squirrels.

Examples,—*Tamias Palmarum.*

Mr. Bennett states that he is not satisfied with regard to the genus in which the *Palm-Squirrel* should be placed. It seems, he observes, as M. F. Cuvier has remarked, to form the type of a new one, intermediate between the tree-nesting and nut-cracking squirrels on the one hand and the burrowing and frugivorous *Tamias* on the other. There is much justice in these observations; but as this species approaches much nearer to *Tamias* than *Sciurus*, we think that the continental naturalists may be followed in arranging it under the former genus. The anterior part of the face is even more slender than that of a true *Tamias*, and contrasts strongly with the comparatively bluff visage of *Sciurus*.

*Description of Tamias Palmarum*.—Pennant thus describes the species: 'Squirrel with plain ears; an obscure pale yellow stripe on the middle of the back, another on each side, a third on each side of the belly; the two last at times very faint; rest of the hair on the sides, back, and head, black and red, very closely mixed; that on the thighs and legs more red; belly pale yellow; hair on the tail does not lie flat, but encircles it, is coarse, and of a dirty yellow barred with black. Authors describe this kind with only three stripes: this had five, so possibly they vary.' Length about 13 inches, of which the tail measures 6.

Vary they certainly do, for Mr. Bennett has figured two marked varieties in his *Zoological Gardens*. One was perfectly black, and exhibited no traces of the usual stripes. The other variety had red eyes, and appeared to be an albino: it was of a dull reddish white, marked with three very faint stripes of a still lighter hue. They were presented to the Zoological Society in 1828.

This species is the *Mustela Africana* of Clusius; *Sciurus palmarum* of Linnæus; and *Le Palmiste* of Buffon.

*Locality*.—India.

*Habits, &c.*—The *Palm-Squirrels*, which derive their name from being often seen on those trees, are common about Indian towns and villages, dwelling about the roofs of houses and old walls. The female lays her young in holes of the latter. They are great destroyers of fruit, but are very familiar, entering houses to pick up the crumbs. Pennant states that Governor Loten informed him that they lived much in the cocoa-trees, and were very fond of the *Sury*, or palm-wine, which is procured from the tree; from which it obtained, among the Indians, the name of *Suri-catsje*, or the little cat of the *Sury*.

Pennant adds that, according to Clusius and Ray, this species does not erect its tail like other squirrels, but has the faculty of expanding it sideways. The two noticed by Mr. Bennett ate sitting upright upon their haunches, and conveyed their food, which was entirely vegetable and consisted of bread chiefly, to their mouths between their fore-paws. He says that the tail is occasionally elevated in a vertical position, but seldom brought forward over the back.

*Sciurus maximus, the Malabar Squirrel.*

*Description*.—Upper parts and external surface of the limbs bright chocolate brown, which colour terminates abruptly, and is joined by the pale yellowish brown on the under parts, fore-arms, and internal surface of the limbs. Front of the fore-legs, neck, throat, face, and head between the ears, lighter in colour: a broad darker patch on the rest of the upper part of the head extends from the forehead to the middle of the nose. Back and shoulders sometimes deepening into black. Ears short, covered with long tufted hairs and brush-like; from the longer part of each ear a narrow line of deep brown passes downwards and backwards in an oblique direction. Whiskers scanty, long, and black. Claws incurved and strong, those of the anterior thumbs broad, short, and flattened. Tail distichous, the hairs expanding widely towards the extremity, bright chocolate-brown at the base, black in the middle, and chestnut in the extreme third part. Length about 33 inches, of which the tail measures rather more than one-half.

*Locality*.—The Malabar Coast.

*Habits, &c.*—Sonnerat appears to have been the first zoologist who observed this richly coloured species, the largest of the true squirrels. It haunts among palm-trees, and is stated to be very fond of the milky juice of the cocoa-nut, as well as of the solid part of the nut. In captivity it is tame and familiar; but it tries its teeth upon most substances that come within its power, and should be guarded against accordingly.

*Sciuropterus Sagitta* (*Sciurus Sagitta*, Linn.; *Pteromys Sagitta*, Geoff.).

*Description*.—Squirrel with a small rounded head; cloven upper lip; small blunt ears; two small warts at the outmost corner of each eye, with hairs growing out of them; neck short; four toes on the fore-feet; and instead of a thumb, a slender bone, two inches and a half long, lodged under the lateral membrane, serving to stretch it out; from thence to the hind-legs extends the membrane, which is broad, and a continuation of the skin of the sides and belly; the membrane extends along the fore-legs, and stretches out near the joint in a winged form: five toes on the hind-feet, and, on all the toes, sharp, compressed, bent claws: tail covered with long hairs disposed horizontally; colour of the head, body, and tail a bright bay; in some parts inclining to orange; breast and belly of a yellowish white; length from nose to tail, eighteen inches; tail, fifteen. (Pennant.)

*Locality, Habits, &c.*—Inhabits Java and others of the Indian islands. Leaps from tree to tree as if it flew; will catch hold of the boughs with the tail. Differs in size: that described by Linnæus was the size of our squirrel; that killed by Sir Edward Michelbourne in one of the Indian islands was greater than a hare. Nieuhoff describes this species under the name of the *Flying Cat*, and says the back is black; he has given two very good figures of it; one in his frontispiece, the other in the page he describes it in. (Pennant.)

This seems to be the *Sciurus maximus volans, seu Felis volans* of Brisson; *Le Taguan ou Grand Ecureueil volant* of Buffon.

In the descriptions of Pennant, above given, there are two points which deserve consideration: that which describes the animal as catching hold of boughs with its tail, and that which states its difference in size. The first is given on the authority of Sir Edward Michelbourne's voyage, in Purchas's *Pilgrims*, and should be received with caution. The second would lead to the conclusion that more than one species had been included under the name of the animal now under discussion.

We accordingly find that Dr. Horsfield, in his valuable *Zoological Researches in Java*, describes two Flying Squirrels (*Pteromys genibarbis* and *Pteromys lepidus*), both nocturnal in their habits, nearly approaching to *Sciuropterus Sagitta*. He describes the first as living on fruits; the second as found in the closest Javanese forests, where the height of the trees and the luxuriance of the foliage effectually conceal it. Some have thought these two were only one species. In the work last above referred to, Dr. Horsfield has given a *General Enumeration of Indian Sciuri* well worthy of the attention of the zoologist. He enumerates sixteen species of *Sciuri*; four of which were first described by himself. These do not include the *Flying Squirrels*.

### African Squirrels.

*Sciurus Getulus*.—*Description*.—Eyes full and black, with white orbits. Head, body, feet, and tail cinereous inclining to red: lightest on the legs: sides marked lengthwise with two white stripes: belly white: tail bushy, marked regularly with shades of black, one beneath the other: size of the common squirrel. (Pennant.)

This is the *Sciurus Getulus* of Caius and Linnæus; *Barbary* or *white-striped Squirrel* of Pennant; *Barbarian Squirrel* of Edwards; *Le Barbaresque* of Buffon.

*Locality and Habits*.—The north of Africa, especially Barbary, where it lives in trees, preferring those of the Palm tribe.

*Sciurus Cepapi*.—*Description*.—Ochrey-yellow above, slightly marbled with blackish-brown; sides of the body and feet ochrey-yellow; upper lip, superciliary stripe, and lower parts of the body white, belly tinged with yellow; tail distichous, ochrey-yellow varied with blackish-brown; ears short, with obtuse *apices*, the external margin notched near the point; eyes brown. Figure slender. Head small. Legs long. Tail depressed, narrow, slightly distichous, and pointed at its extremity. The tints vary in different specimens. Length 14 inches 9 lines, the tail being 7 inches long. Female resembling the male in colour and size. (Smith.)

*Locality*.—South Africa.

*Habits, &c.*—Dr. Smith, who named this species, and has described and figured it in his *Illustrations of the Zoology of South Africa*, observed it for the first time upon the immediate banks of the Limpopo River, in about 24° 20′ S. lat. It was occasionally discovered upon the ground, but more frequently upon trees; and when it happened to be surprised in the former situation, it invariably endeavoured to reach the latter, and, if successful, either attempted to conceal itself in the forks of the branches, or in holes, if any existed, in the trunks or other parts. Its flight, when on the ground, was effected with amazing rapidity, and the perpendicular ascent of the tree was accomplished with equal facility. Dr. Smith concludes by stating that it feeds by day, and, according to the natives, also by night, and that in all the specimens he obtained the stomachs were fully distended with berries, &c

AMERICAN SQUIRRELS.

*Tamias quadrivittatus; Four-banded Pouched Squirrel.* —*Description.*—Head long, tapering considerably from the eyes to the end of the nose, which is not, however, remarkably sharp. Mouth situated far back. Whiskers black and rather shorter than the head. Eye small when compared with a true squirrel. Ear erect, semi-ovate, obtuse, and flat, except a slight duplicature at the base of the anterior margin; it is covered on both sides with a coat of short hair. Cheek-pouches extending to the angle of the jaw. Body more slender than that of the squirrels in general. Five blackish lines and four alternating white ones occupy the whole back: sides reddish-brown, under parts grey: tail long and slender, exhibiting dusky and light-brown colours. Length 9 inches 9 lines; of which the tail measures 4 inches 3 lines.

This is the *Four-lined Squirrel* of Godman, and *Sassacka-wappiscoos* of the Cree Indians.

*Locality and Habits.*—Dr. Richardson, from whose long and accurate description the above characters are drawn, states that this diminutive Ground-Squirrel is common throughout the woody districts, as far north as Great Slave Lake, if not farther. It is found, he tells us, at the south end of Lake Winipeg, in lat. 50°, and, within that range, seems to replace *Sciurus Lysteri*. He refers to Mr. Say's observation of it on the Rocky Mountains, near the sources of the Arkansas and Platte; and to specimens brought by Mr. Drummond from the sources of the Peace River, which rises on the same ridge. 'It is,' says Dr. Richardson, 'an exceedingly active little animal, and very industrious in storing up provision, being generally observed with its pouches full of the seeds of leguminous plants, bents, and grasses. It is most common in dry sandy spots where there is much underwood, and is often seen in the summer-time sporting among the branches of willows and low bushes. It is a lively restless animal, troublesome to the hunter, and often provokes him to destroy it by the angry chirruping noise that it makes on his approach, and which is a signal of alarm to the other inhabitants of the forest. During the winter it resides in a burrow, with several openings, made at the root of a tree, and is never seen in the surface of the snow at that season. When the snow disappears, many small collections of hazel-nut shells, from which the kernel has been extracted by a minute hole gnawed in the side, are to be seen on the ground near its holes. Mr. Say states its nest to be composed of an extraordinary quantity of the burrs of *Xanthium*, portions of the upright *cactus*, small branches of pine-trees, and other vegetable productions, sufficient in some instances to fill a cart. On the banks of the Saskatchewan the mouths of their burrows are not so protected. The four-handed squirrel is, in common with the *Hackee*, named *Le Suisse* by the French Canadians, an appellation which, according to Father Theodat, arose from their skins being rayed with black, white, red, and grey, like the breeches of the Switzers who form the pope's guard. The same author informs us that they bite bitterly when taken. The tails of this kind of squirrel, particularly of the males, are often mutilated in their contests with each other, and they are very liable to be broken off in the attempt to catch them, so that it is very rare to attain a specimen with a perfect tail.' (*Fauna Boreali-Americana.*)

*Sciurus cinereus; The Grey Squirrel.*

*Description.*—Ashy grey on the upper surface and sides, each hair being marked by alternate rings of black and grey. Inner sides of the limbs and under surface of the body pure white. Tail nearly equal in length to the body, and when thoroughly developed, completely overshadowing it. Both surfaces of the tail similar in colour to the back and sides, the under surface being somewhat lighter; the long diverging hairs ringed in such a manner as to give the appearance of an external border of white, enclosing a broad band of greyish black. No decided tinge of brown on the muzzle, nor on the sides of the body, but a slight intermixture of that colour is visible on the muzzle on close examination. Ears covered with very short close-set hairs, without any appearance of the bushy pencils which surmount those of the common squirrel. Size one-third larger than the last-named species.

Such in substance is the very accurate description given by Mr. Bennett 'of two unquestionable specimens which exist among the numerous individuals' in the collection of the Zoological Society. The value of this description rests on the number of squirrels that are regarded by many zoologists as mere varieties of the species under consideration, which is the most common species in the United States.

*Locality.*—Nearly the whole of the United States of America: most abundant in Pennsylvania and the Carolinas.

*Habits, &c.*—The nest of the Grey Squirrel, which swarms in some of the localities where it is found, is made upon the extremities of branches of trees, and its food consists of buds, tender shoots, nuts, acorns, and grain. In winter the provident animal retires to hollow trunks where its stores have been laid up. The fur is sought after in the market, but the grey skins of the common squirrel are considered of more value. They are exceedingly destructive to the crops, especially of maize, and were proscribed accordingly. Pennant says that three pence per head was the reward for every one killed, and that such a number was destroyed in one year that Pennsylvania alone paid in rewards 8000*l.* of its currency.

'So much confusion,' says Dr. Richardson, in his description of the black squirrel (*Sciurus niger*, Linn.), 'has crept into the accounts of the American squirrels, that great uncertainty respecting the species alluded to by authors must exist until some resident naturalist favour the world with a good monograph of the squirrels of that country. The black squirrels have been considered by some to be a variety of the *Sciurus cinereus*, or of the *Sciurus vulpinus*, and by others have been referred to *Sciurus capistratus*. M. Desmarest describes a small black squirrel, which is distinguished from the large black variety of the masked squirrel by the softness of its fur. Pennant's black squirrel is evidently the *Sciurus capistratus* of later writers.'

'The squirrel,' continues Dr. Richardson, 'which is the subject of this article, is larger than the *Ecuruil gris de la Caroline* of M. F. Cuvier (lesser grey squirrel; Pennant, *Hist. Quad.*), and rather smaller than the "large grey squirrel" of Catesby. It is not an uncommon inhabitant of the northern shores of lakes Huron and Superior, where the greater and smaller grey squirrels are never seen, and is by far the largest squirrel existing on the eastern sides of the Rocky Mountains to the northward of the Great Lakes. It does not extend farther north than the 50th parallel of latitude, but its range to the southward cannot be determined until the species of American squirrels are better known. It is probable that it is not rare in the United States. There are at present (1829) two pairs of American grey squirrels in the menagerie of the Zoological Society, which differ from each other in size, and in the smaller kind (lesser grey squirrels) having a tawny-coloured belly. Both these kinds have, as was pointed out to me by Mr. Vigors, a peculiar wideness in the posterior part of the body, and a fulness of the skin of the flanks, being an approach to the form of a *Pteromys*. In the *Sciurus Hudsonius* (the *Chickaree*) the hind quarters are as slender and distinct from the flanks as in common European squirrels; and there does not appear to have been any peculiar extension of the skin of the flanks in the specimen of a black squirrel procured for me at Penetanguishene by Mr. Todd, surgeon to the naval depôt there.' The total length of this specimen was 26 inches, of which the tail, including the fur, measured 13. Dr. Richardson adds, that there is a specimen of rather larger dimensions procured at Fort William, on Lake Superior, and presented to the Zoological Society by Captain Bayfield. Dr. Richardson describes it as having a few white hairs scattered among the fur of the body, and rather more in the tail, and he adds, that Lewis and Clark mention their having met with grey squirrels on the Columbia, observing, that, from our ignorance of the species to which they belong, he could not admit them into his work (*Fauna Boreali-Americana*).

The well known industry of Dr. Richardson makes it important that these observations should be widely diffused, in the hope that some zoologist competent to the task may be induced to undertake it. He will have a tangled skein to unravel; but a well executed monograph would be highly valued by all who are interested in the subject.

A friend informs us from experience that the grey squirrel and black squirrel make excellent pies; the flesh tasted like that of the rabbit, but it was much more juicy.

Another friend states that the grey squirrel is a common dish in Virginia. It is usually broiled, and is very palatable.

*Pteromys Sabrinus*, var. *β. Alpinus*; *Rocky Mountain Flying-Squirrel.*

*Description.*—Yellowish brown above: tail flat, longer than the body, blackish grey; flying membrane with a straight border. Length 14 inches 3 lines; of which the tail, including fur, measures 6 inches 3 lines.

This is the *Pteromys Alpinus* of Richardson, *Zool. Journ.*, vol. iii., p. 519.

Dr. Richardson observes that this animal was discovered by Mr. Drummond, on the Rocky Mountains, living in dense pine-forests, and seldom venturing from its retreats, except in the night. Dr. Richardson had received specimens of it from the head of the Elk river, and also from the south branch of the Mackenzie. It approaches, he says, nearer to the *Pt. volans* of Siberia in the colour of its fur than to *Pt. Sabrinus*, but it has much resemblance to the latter in its form. It is, he adds, entirely destitute of any rounded process of the flying membrane behind the foreleg, and when its skull is compared with that of *Pt. Sabrinus*, the frontal bone between the orbits appears narrower. The size of its limbs and tail is also greater. These remarks were made by Dr. Richardson on a comparison of the specimens of this animal and of *Pt. Sabrinus*, which he at first received, and he was induced to think that they were specifically distinct; but having afterwards had an opportunity of examining a more complete suite of specimens from Hudson's Bay, doubts were excited on the subject, and although he thought it probable, from the distance between their respective localities, that they may prove eventually to be distinct, he considered it better, when he wrote, to describe them as mere varieties. He concludes by observing that, except that the size of both these species is considerably greater than that of *Pt. volans*, they might be united with that species without any great inconvenience.

Pteromys Alpinus, or Pteromys Sabrinus, var. *β.* (Richardson, *Fauna Boreali-Americana.*)

### Fossil Squirrels.

Fossil squirrels (*Sciurus*) occur in the Eocene period of the tertiary series of strata (first lacustrine period). They have been found in the gypsum quarries in the neighbourhood of Paris. Their remains have also been taken from the loam which fills the cavities of the gypsum in the valley of the Elster near Köstritz in Saxony. [Souslik.]

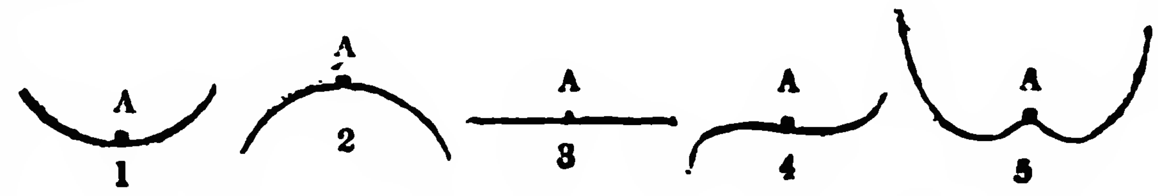
SRINAGHUR. [Serinaghur.]

STA'AVIA, a genus of plants of the natural family of Bruniaceæ, which was so named by Thunberg after Staat, one of the botanical correspondents of Linnæus. The genus consists of several small shrubs, which are indigenous at the Cape of Good Hope, and are remarkable for their flowers being arranged in heads resembling those of some of the Compositæ. Calyx with the lower part of its tube attached to the ovary. Petals 5, stamens 5, inserted into the calyx. Capsule crowned by the calyx, diœcious, cocci bivalved at the apex, and one-seeded. A few specimens are cultivated in our greenhouses, and may be propagated from cuttings in sand covered with a bell-glass.

STABLE. [Farm.]

STABLE AND UNSTABLE; STABILITY. A system is said to be stable when a slight disturbance of its actual condition would not produce a continually increasing effect, but one which finally ceases to increase, diminishes, becomes an effect of a contrary character, and so on, in an oscillatory manner. The ordinary vibration of a pendulum is an instance; the oscillation takes place about a stable position of equilibrium. We can give no instance of an unstable position; for by definition, such a thing is a mathematical fiction. Any disturbance, however slight, produces upon an unstable system an effect which continually increases: no unstable equilibrium therefore can exist a moment, for no system made by human hands can be placed with mathematical exactness in a given position. The pendulum of which we have just been speaking has a position of equilibrium exactly opposite to that about which it can oscillate, but no nicety of adjustment will retain it in that position: it may appear to rest for a moment, but will almost instantly begin to fall.

The following curves or lines are all such that, supposing them to be rigid matter, a molecule placed at A would rest:




In the first, a displacement to the right or left would produce nothing but oscillation, and the equilibrium is stable; in the second, neither displacement would be followed by any tendency to restoration, and the equilibrium is unstable; in the third, displacement would only be a removal to another position of rest, and the equilibrium is called indifferent. In the fourth, displacement to the right would be followed by restoration, but the velocity acquired in restoration would carry the molecule to the left, on which side there is no tendency to restoration: the equilibrium would then be permanently disturbed, and practically unstable; though it might be convenient to say that it is stable as to disturbances to the right, and unstable as to those to the left. In the fifth, the equilibrium at A is unstable, but if a push, however slight, were given to the molecule, it would obviously, by reason of the two contiguous stable positions, oscillate about A as if A were itself a stable position: and in the same manner a stable position, with an unstable one near to it, might, for a disturbance of sufficient magnitude, present the phenomena of an unstable position.

Now, suppose that the point A, instead of being a single molecule, is the centre of gravity of a system acted on by its own weight only; and let the curve drawn be the path of the centre of gravity, which, owing to the connection of the parts of the system with its supports, that centre is obliged to take. The phenomena of the single point still remain true: there is in every case a position of equilibrium when the system is placed in such a position that its centre of gravity is at A. In (1) the equilibrium is stable; in (2), unstable; in (3) indifferent; in (4), stable or unstable, according to the direction of disturbance; in (5), unstable, with results like those of stability. It is an error to state, as is frequently done, that there is no equilibrium in such a system except when its centre of gravity is highest or lowest; as is obvious from (3) and (4). The general proposition which *is* true is this—that a system acted on by its own weight is in equilibrium then, and then only, when its centre of gravity is placed at that point of its path which has its tangent parallel to the horizon, or perpendicular to the direction of gravity.

When a system is supported on three or more points, it is well known that there is no equilibrium unless the vertical passing through the centre of gravity cuts the polygon formed by joining these points. This must not be confounded, as is sometimes done, with a case of distinction between stable and unstable equilibrium; for it is a case of equilibrium or no equilibrium, according as the central vertical cuts or does not cut the base of the figure. Of course it is in the power of any one to say that stability means equilibration and instability non-equilibration: but such is not the technical use of these words in mechanics: stability and instability refer to equilibrium, stable equilibrium being that which would only be converted into oscillation by a disturbance, and unstable equilibrium that which would not be so converted.

Neither must the effects of friction or other resistances be confounded with those of a stable or unstable disposition. A ladder resting against horizontal ground and a vertical wall is maintained by friction; were it not for friction, there would not be rest in any position; and as it is, the angle which the ladder makes with the ground must not be too small. There is thus a set of positions, from the vertical one to a certain inclination, depending on the amount of friction, in all of which there is equilibrium; while in every other position there is no equilibrium. Again, when a bar rests on two inclined planes, without friction, there is a position of equilibrium which is really unstable: any displacement would throw the bar against one of the planes without any restoration. The stable position of equilibrium is found by inverting the position of the inclined planes, or turning their angle downwards, grooving them to support the ends of the bar, which are formed so as to be retained in the grooves. The bar will now, if left to itself, begin to oscillate about its position of equilibrium, unless it happened to be placed at first in that position. But introduce friction, and the upper position of equilibrium alters its character: a small displacement will not destroy the equilibrium. This is the effect of friction, which affords certain limits within which there is always equilibrium. For none of these cases must the words stability and instability be used in such manner as to confuse their popular with their technical sense.

We have already [SOLAR SYSTEM] pointed out what is meant by the stability of the solar system. When a system has a motion of a permanent character, it is stable if a small disturbance only produce oscillations in that motion, or make permanent alterations of too slight a character to allow the subsequent mutual actions of the parts to destroy the permanent character of the motion. Suppose a material body, for instance, to revolve about an axis passing through the centre of gravity unacted on by any forces except the weight of its parts. If this axis be one of the principal axes, the rotation on it is permanent, that is, the axis of rotation will continue unaltered, even though that axis be not fixed. The rotation however, though permanent, is not *stable* about more than two out of the three principal axes. Let the first rotation be established about the axis which has the greatest moment of rotation, or the least, and if a slight displacement or disturbance be given, which has the effect of producing a little alteration of the axis of rotation, that alteration will not increase indefinitely, but will only occasion a perpetual transmission of the rotation from axis to axis, all the lines lying near to the principal axis first mentioned. But if that axis be chosen about which the moment of inertia is neither greatest nor least, any disturbance, however slight, will continually remove the axis of rotation farther and farther from the first axis, near which it will not return until it has made a circuit about one of the other two principal axes.

For the mathematical part of this subject, so far as we give it, see VIRTUAL VELOCITIES.

STACHYS (from σταχύς, a spike), the name of a genus of plants belonging to the natural order Lamiaceæ, or Labiatæ. It has a 5-toothed, 10-ribbed, nearly equal, acuminate, subcampanulate calyx; a corolla with the tube as long as the calyx, or longer; upper lip erect, or spreading, a little arched; lower lip usually longer, spreading, and 3-lobed; the middle segment large, entire, or emarginate; four stamens; bifid style with stigmas at each apex; fruit an achenium. The species are very numerous, above 100 being enumerated. They are herbs or under-shrubs, with their flowers arranged in whorls. The majority of them are European plants.

*S. betonica*, common betony: stems erect, rather pilose; lower leaves on long petioles, and crenated; upper leaves sessile, toothed; uppermost ones linear, quite entire; whorls many-flowered; bracts ovate; corolla twice as long as the calyx. This species is the *Betonica officinalis* of Linnæus. It is now a species of the genus Stachys, but it was formerly a species of the genus Betonica; but the characters which constituted the difference between the latter and the former having been considered too trifling to constitute separate genera, the genus Betonica has been abolished by later botanists. The common betony is a native of Europe and some parts of Asia, inhabiting woods, heaths, and pastures. It is very plentiful in Great Britain. It was formerly much used in medicine, and is now a popular remedy for some complaints. When taken fresh it is said to possess intoxicating properties. The leaves have a rough bitter taste, and are slightly aromatic. The roots are nauseous and very bitter, and when taken, act as purgatives and emetics.

*S. lanata*, woolly woundwort: whole plant clothed with dense silky wool; leaves oblong, narrowed at both ends; floral leaves small, the upper ones of which are shorter than the whorls; whorls many-flowered; bracts linear-lanceolate, the same length as the calyx; calyx incurved, toothed; corolla woolly. This plant is a native of Europe, in the neighbourhood of the Mediterranean. Dr. Sibthorp found it in Laconia, where it is called σταχος by the modern Greeks. This plant is remarkable for its woolly covering, as well as the *S. Germanica* (German woundwort), on which account they have been introduced into our gardens. Many other species are covered with hairs so as to give them a powdery-looking woolly character, as the *S. Alpina*, *S. Italica*, &c.

*S. coccinea*, scarlet hedge-nettle: stem erect, clothed with soft villi; herbaceous ovato-lanceolate petiolate leaves; flowers six in a whorl; corolla pubescent, three times as long as the tube. This is the most beautiful species of the genus, having large dark scarlet flowers an inch in length. It is a native of Chili and Peru. It must be cultivated as a greenhouse plant, and is readily increased by cuttings or parting its roots.

*S. palustris*, marsh-woundwort, or clown's all-heal: stems erect, pubescent, herbaceous; leaves subsessile, oblong, crenated, wrinkled, hispid; whorls with 6 or more flowers; calyx with lanceolate acute teeth; corolla twice as long as the calyx. It has pale purple flowers, with a variegated lower lip of the corolla. This plant is a native of Europe, Asia, and North America. It is abundant in watery places, by road sides, in meadows, and corn-fields in Great Britain. It is called clown's all-heal by Gerard. The young shoots and the roots also, when cooked, form an excellent esculent. On the farm it is a weed that should be well looked after, as it exhausts the soil and increases very rapidly.

*S. sylvatica*, the hedge-woundwort, is another common British species, differing from the last in having stalked leaves which are cordato-ovate shaped. It inhabits woods, hedges, and shady places. This herb is very pungent, and has an unpleasant fœtid smell.

*S. Corsica*, Corsican woundwort: procumbent, pilose; leaves with petioles; flowers in 2-4-flowered whorls; corolla twice as long as the calyx, lower lip large. This is a pretty little plant worthy of cultivation. It has downy, rosy-white, or pink flowers, which are large for the size of the plant. It is a native of corn-fields in Corsica and Sardinia.

*S. lavandulæfolia*, lavender-leaved woundwort: leaves of the stem oblong, lanceolate with petioles, floral leaves sessile; whorls 2-6-flowered; teeth of calyx longer than corolla. It is a native of the Caucasus, in dry stony places. It is shrubby in its habit, and is well adapted for rock-work.

The whole of the species are easily cultivated in common garden soil. The herbaceous sorts may be increased by dividing their roots; the shrubby sorts, by cuttings; annuals may be sown in spring in an open border.

STACHYTARPHA (from στάχυς, a spike, and ταρφής, dense), the name of a genus of plants belonging to the natural order Verbenaceæ. It is known by its tubular 4-toothed calyx; hypocrateriform unequal 5-cleft corolla with a curved tube; 4 stamens, 2 of which are fertile. The species are natives of South America and the West India Islands. Many of them have been described as Vervains, but they are distinct from that genus. They are herbaceous or shrubby, and many of them are handsome plants.

*S. Jamaicensis*, Jamaica Bastard Vervain, is an undershrub, with scattered hairy branches; leaves nearly two inches long, oblong-ovate, coarsely and sharply serrated, quite entire at the base, with the midrib beset with hairs; the spike is dense, bearing flowers of a lilac colour, and having ovate bracts which are shorter than the calyx. This plant is a native of the West India Islands, and has there a reputation something like that which distinguished our common Vervain.

STACKHOUSE, THOMAS, born 1681, died 1752, a divine of the English church, and one of the first persons who wrote extensive works in theology for the booksellers, expressly for the purpose of sale among the less educated portions of the population. Of his birth, education, and early history, nothing appears to be known. The letters M.A. appear after his name on his monument, and in the title-pages of some of his books, but his name is not found in the lists of graduates of Oxford or Cambridge. We have his own authority for saying that he was in early life living at Amsterdam, and performing clerical duties there, but we look in vain in Mr. Stevens's work on the English and Scottish churches in Holland for any notice of him; and the first that is known of him when in England is, that he was curate at Richmond, as afterwards at Ealing and at Finchley, in all which places he was much respected. He
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tained a catalogue of the plants of Theophrastus, with a copious glossary and many valuable notes. In 1811 he published 'Illustrationes Theophrasti,' in which the plants of that author are arranged according to the Linnæan system, and the modern synonyms are given. He also published an essay on the Balsam and Myrrh trees, with remarks on the notices of them by modern travellers and antient writers, especially Theophrastus. He contributed two papers to the 'Linnæan Transactions,' one on the *Ulva punctata*, the other on the preparation of plants for herbaria. He died at Bath, in November, 1819.

STACKHOU'SIA, a small order of plants belonging to the syncarpous group of polypetalous Exogens. They are herbaceous plants, with simple, entire, alternate, sometimes minute leaves, with lateral very minute stipules. The flowers are arranged in spikes, each flower having three bracts. The calyx is 1-leaved, 5-cleft equal, tube inflated; petals 5, arising from the top of the tube of the calyx, the claws forming a tube which is longer than the calyx; stamens 5, arising from the throat of the calyx; ovary superior 3-5-lobed; fruit dry, with albuminous seeds and erect embryo. This order was constituted by Brown, and its nearest relations are with Celastraceæ and Euphorbiaceæ. From the first it differs in the possession of stipules, the cohesion of the petals, and the deep-lobed ovary; from the last, in the structure of their fruit, and in the position of their seeds. All the species are natives of New Holland. The only genus of the order at present is Stackhousia.

is a fort with a garrison, called the Schwinger Schanze, off which a royal cutter of four or eight guns is constantly stationed, for the purpose of collecting the duties levied by the Hanoverian government on all vessels passing up or down the Elbe. The original duties, which were regulated by a treaty in 1691, were light, but have been greatly increased, and the Hanoverian government acknowledges that they now produce about 33,000*l*., though it is stated by some that they yield as much as 45,000*l.* a-year. For this sum neither a light house nor other establishments advantageous to navigation are maintained. By the treaty of Vienna the navigation of all rivers from the sea to the highest navigable point is declared to be free of all imposts, except for the support of buoys, lights, or towing-paths; and the collection of the Stade duty is in direct contravention of this treaty. Negociations between England and Hanover are actually pending on the subject. The duties are rigorously collected, and the tariff embraces nearly seven thousand different articles. An erroneous insertion of 'cotton-twist' for 'cottons,' which made a difference of only seven shillings in the duty, subjected a ship on one occasion to 215*l.* fine and expenses. The average duty on each British ship which ascends to Hamburgh is about 18*l.*

STA'DIUM (ὁ στάδιος and τὸ στάδιον), the principal Greek measure of length, was equal to 600 Greek or 625 Roman feet, that is, to 606 feet 9 inches English. The Roman mile contained 8 stadia. The Roman writers often measure by stadia, chiefly in geographical and astronomical measurements. (Herod., ii. 149; Plin., *Hist. Nat.*, ii. 23 or 21; Columell., *Re. Rust.*, v. 1; Strabo, vii., p. 497.)

The standard length of this measure was the distance between the pillars at the two ends of the foot-race course at Olympia, which was itself called *stadium*, from its length, and this standard prevailed throughout Greece. Some writers have attempted to show that there were other stadia in use in Greece besides the Olympic. The only passages in which anything of the kind seems to be stated are one in Censorinus (*De Die Natali*, c. 13), which, as far as it can be understood, evidently contains some mistake; and another which is quoted by Aulus Gellius (i. 1) from Plutarch, but which speaks of the race-courses called stadia, not of the stadium as a measure.

The principal argument for a variety of stadia is that of Major Rennell (*Geog. of Herod.*, s. 2); namely, that when antient authors have stated the distances between known places, and a comparison is made between their statements and the actual distances, the distances stated by them are invariably found to be too great, never too small. Hence the conclusion is drawn that they used an itinerary stade shorter than the Olympic. If so, it is strange that the very writers who have left us these statements of distances have not said a word about the itinerary stade which they are supposed to have used, while several of them often speak of the Olympic stade as containing 600 Greek feet. But there is a very simple explanation of the difficulty, which is given by Ukert, in his *Geographie der Griechen und Römer* (i.; ii., p. 56, &c.). The common Greek method of reckoning distances, both by sea and land, was by computation, not by measurement. A journey or voyage took a certain number of days, and this number was reduced to stadia, by allowing a certain number of stadia to each day's journey. The number of stadia so allowed was computed on the supposition that circumstances were favourable to the traveller's progress; and therefore every impediment, such as wind, tide, currents, windings of the coast, a heavily laden or badly sailing ship, or any deviation from the shortest track by sea, and the corresponding hindrances by land, would all tend to increase the number of days which the journey took, and consequently the number of stadia which the distance was computed to contain. These circumstances, together with the fact that the Greek writers are by no means agreed as to the number of stadia contained in a day's journey, and other sources of inaccuracy which we know to have existed, furnish a satisfactory explanation of the discrepancies which we find in their statements of distances, both when compared with one another, and when compared with the actual fact, without there being any occasion to resort to the supposition of a stade different from the Olympic. Colonel Leake, who has recently investigated this subject (*On the Stade as a Linear Measure*, 'Journal of the Royal Geographical Society of London,' vol. ix., 1839), has also come to the conclusion 'that the stade, as a linear measure, had but one standard, namely, the length of the foot-race, or interval between the ἀφετήρια and καμπτήρ in all the stadia of Greece, and which is very clearly defined as having contained 600 Greek feet.'

The calculations of Romé de l'Isle and Gosselin respecting the various stadia which they suppose to have been used in Greece depend entirely upon the improbable assumption that the Greek astronomers were acquainted with the true length of a great circle of the earth.

When we come however to writers as late as the third century of the Christian æra, we do find stadia of different lengths. Of these the chief are those of 7 and 7½ to the Roman mile. (Wurm, *De Pond.*, &c., § 58.)

The following table, from the Appendix to Hussey's *Antient Weights and Money*, represents the supposed varieties of the Greek stadium :—

| | Yds. | Ft. | Inch. |
|---|---|---|---|
| Stade assigned to Aristotle's measurement of the earth's surface . . . | 109 | 1 | 2·26992 |
| Mean geographical stade, computed by Major Rennell . . . . . . . | 168 | 1 | 6 |
| Olympic stade . . . . . . . . | 202 | 0 | 9 |
| Stade of 7½ to the Roman mile . . | 215 | 2 | 2·4 |
| Stade of 7 to the Roman mile . . . | 231 | 0 | 5·124 |

2. The race-course for foot-races at Olympia was called stadium, as above mentioned, and the same name was applied to all other such courses.

The stadium consisted of a flat area, surrounded by raised seats, and was made either in a spot which had by nature the required shape, or in the side of a hill, or on a plain. In the last two cases the stadium was constructed by forming a mound of earth of the proper shape, and covering it with stone or marble for the seats. The second of these three forms was the most common. Of the third we have a fine example in the Panathenaic Stadium at Athens. [ATHENS.] The area of the stadium was oblong, terminating at one end in a semicircle. At the other end it was bounded by a wall, at the two extremities of which were the entrances, one on each side of the stadium. Here was the starting-place (ἄφεσις, γραμμή, ὕσπληξ, or βαλβίς), marked by a square pillar in the middle of the breadth of the area. Another such pillar was placed at the other end of the course, at the distance of a stadium from the former, and at or near the centre of the semicircular end of the area. This pillar marked the termination of the simple foot-race [OLYMPIC GAMES], but in the Diaulus the runners turned round it and went back to the starting-place; in the Dolichus they turned round both pillars several times, according to the number of stadia of which the course consisted. The end of the course was called τέρμα, βατήρ, τέλος, καμπτήρ and νύσσα. Halfway between these pillars stood a third. On the pillar at the starting-place was inscribed the word ἀρίστευε (*excel*); on the middle one, σπεῦδε (*hasten*); on the one at the goal, κάμψον (*turn*). The semicircular end of the area (σφενδόνη) was thus not used in the foot-race. Here probably the other gymnastic contests took place; for though the stadium was originally intended only for the foot-race, yet as the other contests came to be added to the games, they also took place in the stadium, except the horse-races, for which a separate course was set apart, shaped like the stadium, but larger: this was called ἱππόδρομος.

Among the seats which surrounded the area, a conspicuous place, opposite to the goal, was set apart for the three Hellanodicae, who decided the contests, and who entered the stadium by a secret passage. Opposite to them, on the other side of the stadium, was an altar, on which the priestesses of Demeter Chamyne sat to view the games. The area was ornamented with several altars and statues.

The position of the stadium was sometimes, but not always, in connection with the gymnasium.

Under the Romans many of the Grecian stadia were modified so as to resemble the amphitheatre.

There still exist considerable ruins of stadia: among the most remarkable of which are those at Delphi, Athens, Messene, Ephesus, and Laodicea.

(Pausanias, ii. 27, 6; vi. 20, 5, 6; ix. 23, 1; Müller's *Archäologie der Kunst*, sec. 290; Krause, *Die Gymnastik und Agonistik der Hellenen*, i., p. 131, &c.)

STADTHOLDER (*Statthalter* in German, *Stadhouder* in Dutch) means lieutenant or governor. The appellative Statthalter is used in the cantons of German Switzerland to denote the civil officer who is next to the landamman or chief magistrate. In the federal republic of the Seven United Provinces of the Netherlands, the stadhouder was himself the first magistrate or president of the Union. When several of the towns of Holland revolted against the tyranny of the Duke of Alba, the lieutenant of King Philip of Spain, they chose for their governor William, prince of Orange, swearing allegiance to him as the king's stadhouder, thus implying that they had revolted against the Duke of Alba and not against King Philip. But it was not until after the death of William, in 1584, that the three united provinces of Holland, Zealand, and Utrecht agreed to have one stadhouder in common, and appointed to that office Maurice of Nassau, son of the deceased William. (Puffendorf.) From that time the stadhoudership continued in the house of Nassau till the death of William III. in 1702, when the male line of William I. becoming extinct, the office remained vacant, and was considered as tacitly abolished. But in 1747, after a struggle between the republican and the Orange parties, the latter, having triumphed, proclaimed William IV., of a collateral branch of the Nassau family, hereditary stadhouder of the Seven United Provinces. His son William V. was expelled by the French in 1795, and resigned the stadhoudership by treaty with France in 1802, since which the office has not been revived, the republic of the Netherlands having been transformed into a kingdom. [NASSAU, HOUSE OF; NETHERLANDS.]

**STAEL, ANNE GERMAINE DE**, born at Paris in 1768, was the only child of Necker, the wealthy Genevese banker, and afterwards minister of finance to Louis XVI. Her mother, a Swiss lady, was a woman of considerable acquirements, and her house was resorted to by the men of learning or of wit who lived in Paris. Madame Necker began very early to subject her daughter to a systematic and laborious course of study, until the physicians prescribed relaxation as absolutely necessary for her daughter's health. Mademoiselle Necker, being now left to follow her own taste, applied herself to literary composition, for which she had a natural facility. Her first essays were some tales and plays, which were soon forgotten. In 1788 she published a work of higher pretensions, 'Lettres sur les Ouvrages et le Caractère de J. J. Rousseau,' which began to attract public attention. About this time she was married, through her mother's management, to the Baron of Stael Holstein, the Swedish ambassador at Paris, a nobleman of high character and attainments, but disproportionately older than herself. This marriage however gave her rank and independence; and when the French Revolution broke out, and her parents had retired to Switzerland, the baron's diplomatic character was a protection to his household, and Madame de Stael remained at Paris through the first storms of that period. Her warm imagination was at first captivated by the bright prospects of a revolution which promised the reform of abuses, but her generous nature soon shrunk from the sight of the more frightful abuses which took the place of the old ones. She wrote several articles on the factious conduct of the various parties, and upon their total disregard of the true meaning of liberty. Madame de Stael felt for the oppressed, who were at that time the nobles, the priests, and the royal family. She interested herself especially for the royal family; and she even ventured to publish a defence of the Queen Marie Antoinette, then upon her trial, 'Réflexions sur le Procès de la Reine,' August, 1793. But the triumph of the terrorists drove her at last out of Paris, to seek refuge in other countries. After the fall of the terrorists Madame de Stael returned to Paris, where she became the leader of a distinguished circle of literary men and politicians. Being anxious for the preservation of something like order and individual security, she gave the support of her influence to the existing government of the executive directory. But that government, without morality, sincerity, or dignity, was dying a natural death, when Bonaparte, after his return from Egypt, extinguished it by a bold manœuvre, and established a military dictatorship in its place. Madame de Stael appears to have disliked and mistrusted Bonaparte from the first, and her salon became the opposition club of the time. She is said to have encouraged Benjamin Constant and other members of the tribunate in their opposition to the projects of law presented by the executive, and to have publicly applauded them for their independent speeches. When the concordat with the pope was under negotiation, Madame de Stael loudly expressed her disapprobation, professing to see in it a new device of Bonaparte's growing tyranny. About the same time, being on a visit to her friends in Switzerland, she was supposed to have encouraged her father to publish his last work, 'Dernières Vues de Politique et de Finance,' in which he descanted against the government of a single man. The work was forbidden in France. At last Bonaparte, first consul, sent Madame de Stael an order to quit Paris, and not to come within forty leagues of it. Strange as it may seem, Madame de Stael, wealthy and independent, was sorely grieved at this prohibition; and she and her friends exerted themselves, though in vain, to have the order recalled. Bonaparte is said to have replied, that he left the whole world open to Madame de Stael, except Paris, which he reserved to himself. (Thibaudeau; Las Cases.) For Madame de Stael however the salons of Paris were her own element; she felt the want of applause, and of literary and fashionable celebrity; for she had as much ambition as Bonaparte himself, though of a different and more innocuous kind. She went first to Switzerland, and then travelled through Italy, where she gathered materials for her 'Corinne,' which is a poetical description of Italy in the shape of a novel. The work was much admired: it is eloquent and impassioned; and the authoress has sketched with great truth many peculiarities of the Italian character and habits, which had been overlooked, or misrepresented or caricatured by other travellers. Madame de Stael had already published a novel in 1803, entitled 'Delphine,' which, though powerfully written, is a work of very questionable morality, and she felt herself obliged to write an apology for it in her 'Réflexions sur le But moral de Delphine.' 'Corinne' displays a purer morality, and produces a much more elevating impression on the mind. As a work of fiction however it is decidedly weak: the plot is defective in arrangement, and deficient in dramatic power. The authoress has endeavoured to embody in some of her characters the national characters of their respective countries; she has succeeded in some, and has certainly failed in others. But as a descriptive work, a work of glowing and impassioned eloquence, on some of the most interesting topics with which man is concerned, religion, poetry, the beauties of nature, history, and love, as a poetical picture of a most poetical country, 'Corinne' has the highest merits, and they are of a permanent character.

After having published her book upon Italy, Madame de Stael, still debarred from Paris salons and Paris society, proceeded to visit and study a very different country—Germany, and after her return she composed her work 'De l'Allemagne,' in which she described the feelings, the literature, and the habits of the German people. This work was printed at Paris in 1810. The authoress was not allowed to go to Paris herself, but she was residing either at her seat at Coppet on the banks of the lake of Geneva, or in some provincial town of France forty leagues from the capital. The MS. was submitted to the censors, according to the existing laws, and after several passages had been expunged, the publication was authorised; 10,000 copies were struck off, when suddenly the whole stock was seized at the publisher's, by gendarmes sent by Savary, Napoleon's minister of police, and suppressed by his order. Madame de Stael, who was staying at Blois, received at the same time order to quit France immediately. She retired to Coppet in Switzerland, whence she remonstrated with Savary against this arbitrary proceeding, which was illegal even according to the new law of Napoleon, as the minister might have seized a work which he considered dangerous, even after the censors had permitted its being printed, but he had no right to destroy it, being bound to refer the matter to the council of state. (Thibaudeau, *Empire*, c. 69.) Madame de Stael understood or imagined that one reason for this severity was her having omitted to mention the name of the emperor Napoleon and his invincible armies, which, Savary said, had become so familiar with Germany. Madame de Stael wrote from Coppet to Savary, saying that she did not see how the emperor and his armies could be introduced with propriety in a work purely literary. Savary's answer is characteristic of the man and the times; and it was prefixed by Madame de Stael to a new edition of her work in 1813. 'You must not seek for a cause of the order which I have signified to you in the silence which you have kept respecting the emperor in your last work, for there was no place in it worthy of him. Your exile is a natural consequence of your constant behaviour for years past. I have thought that the air of France was not suitable to you, for we are not yet reduced so low as to seek for models among the nations which you admire. Your last work is not French; and I have stopped its publication. I regret the loss which the bookseller will suffer in consequence, but I could not allow it to appear.' Independently of Madame de Stael's political opposition to Napoleon's arbitrary government, there was a decided antipathy between her turn of mind and literary taste and that of France in her time. French literature ever since the time of Louis XIV. had become exclusive and intolerant; it looked down upon the literature of other countries as semi-barbarous, and the national vanity had raised round itself a kind of Chinese wall of pedantic criticism, which had withstood all the storms of political and religious change. It suited the policy and the taste of Napoleon to encourage this feeling of overweening vanity, for as France was to be, according to him, the mistress of all Europe, and was to dictate laws to all nations, it was proper that the language and literature of France should be considered superior to those of all other countries. Madame de Stael, by extolling the literary productions of the Germans and English, had run against all the predilections and aspirations of the French and of Napoleon; and therefore Savary said, and said truly at the time, that 'her work was not French.' In the end however her work has become French, and her example has had a most beneficial influence upon French literature.

Madame de Stael remained for a time at Coppet, closely watched, even on Swiss ground, by the omnipresent French police. She was forbidden to stir more than ten leagues from her residence in any direction, and her friends were prohibited from visiting her, but at last she contrived to escape from thraldom, and went to Russia on her way to England; for at that time a person from the Continent wishing to reach England must find his way to it through the extremities of Europe. She has given an account of her wanderings and the petty but galling persecution to which she was subject, in her 'Dix Années d'Exil,' a work which, bating some egotism and exaggeration, may be useful to those who wish to form an accurate idea of Napoleon and his principles of government.

During her residence at Coppet, Madame de Stael, who had been many years a widow, became acquainted with M. de Rocca, of an old family of Geneva, whom she married privately. He was also an author, and published a book on the French war in Spain.

In 1814, after Napoleon's abdication, Madame de Stael returned to Paris, where she, Benjamin Constant, and her other old friends belonged to what was called the Constitutional party, which supported the charter of Louis XVIII. and a bonâ fide representative government, in opposition to the Bonapartists, who were conspiring for Napoleon, to the old revolutionists, who still dreamt of a republic, and to the ultra royalists, who wished to restore the absolutism of the antient monarchy. The return of Napoleon from Elba decided the question for the moment. Madame de Stael remained at Paris, and, as well as Benjamin Constant, appeared to be reconciled to Napoleon, thinking that he must now accommodate himself to a constitutional system of government. After his second fall, she returned to Switzerland, and seemed to have weaned herself from active politics. She occupied herself with preparing her last work for the press, 'Considérations sur la Révolution Française,' published after her death, which took place July 14, 1817. She was buried in the family tomb at Coppet. Her son, the Baron de Stael, who died in 1827, made himself known in France, under the Restoration, by his philanthropy, his attachment to constitutional liberty, and by some works of unpretending merit; among others, his 'Lettres sur l'Angleterre,' published in 1825.

Madame de Stael's book on the French revolution is one among the crowd of works on that all important subject which deserves to go to posterity. The authoress, being the daughter of Necker, and personally acquainted in early youth with the principal characters of that great drama, was well qualified to record in her after-life the reminiscences of that singular period. In her work she lays bare without bias the springs of action of the different individuals, and exposes the whole internal working of the political machinery, which people from the outside could not accurately understand. She had been, in fact, 'behind the scenes,' and she was afterwards raised by experience above the vulgar admiration of the crude experiments of the pretended republicans of France. Still her work is not comprehensive; it wants unity of purpose; it is rather a commentary, a book of remarks on the French revolution, than a history of that great event. Her principal object, and it is on her part an amiable one, though somewhat egotistical, was to justify the political conduct of her father M. Necker, an honest but certainly not a first-rate statesman, and one who was totally unfit for the exigencies of the times. Yet in other respects her work has much merit; it is written in a temperate and impartial tone, it bends to none of the short-lived powers of the times, and it exhibits philosophical as well as political acuteness. 'If she had,' says her friend Benjamin Constant, 'painted individuals more frequently and more in detail, her work, though it might have ranked lower as a literary composition, would have gained in interest.' Some of her characters, especially of the earlier period of the revolution, such as Calonne, Brienne, Mirabeau, Pethion, are most graphically sketched.

Madame de Stael wrote several other works. That 'On the Influence of the Passions,' published in 1796, although it contains many acute remarks, partakes of the unsettled morality of the times, being written just after the period of the reign of terror. In it she reflects upon the fearful vision that had just passed, and this work ought to be read as an appendage to her later work on the French revolution. She wrote also 'Réflexions sur le Suicide;' 'Essai sur les Fictions;' and several tales and other minor compositions. She contributed a few articles to the 'Biographie Universelle,' among which is that on 'Aspasia.' Her works have been collected and published in 17 vols. 8vo., Paris, 1830. As a literary person she was the most distinguished woman of her age. She was open to the weaknesses of ambition, but she was always independent, honest, and sincere.

STAFF, in Music. The five parallel lines and the four spaces between the lines, on which notes and other musical characters are placed, are, collectively, called the *Staff*.

STAFF, MILITARY. In the British empire this consists, under the king and the general commanding-in-chief, of those general, field, and regimental officers to whom is confided the care of providing the means of rendering the military force of the nation efficient, of maintaining discipline in the army, and regulating the duties in every branch of the service.

Besides the commander-in-chief, his military secretaries and aides-de-camp, the general staff consists of the adjutant and quartermaster-generals, with their respective deputies, assistants, and deputy-assistants; the director-general of the medical department, and the chaplain-general of the forces. The staff of the Ordnance department consists of the master-general and lieutenant-general, with their deputies and assistants; the inspector of fortifications, and the director of the engineers. The head-quarters for the general staff are in London. There are also, for the several military districts into which Great Britain is divided, inspecting field-officers, assistant adjutants-general, and majors of brigade, together with the officers attached to the recruiting service. The head-quarters for Scotland are at Edinburgh. For Ireland, besides the lord-lieutenant and his aides-de-camp, the chiefs of the staff consist of a deputy-adjutant and a deputy-quartermaster-general, with their assistants. Their head-quarters are at Dublin; and there are, besides, the several officers for the military districts of that part of the empire. Lastly, in each of the colonies there is a staff graduated in accordance with the general staff of the army, and consisting of the general commanding, his aides-de-camp, military secretaries, and majors of brigade, an inspecting field-officer, a deputy-adjutant, and a deputy-quartermaster-general.

The adjutant-general of the army is charged with the duty of recruiting, clothing, and arming the troops, superintending their discipline, granting leave of absence, and discharging the men when the period of their service is expired. To the quartermaster-general is confided the duty of regulating the marches of the troops, providing the supplies of provisions, and assigning the quarters, or places of encampment.

All military commanders of territories or of bodies of troops in Great Britain, Ireland, or in foreign stations, transmit periodically to the adjutant-general of the army circumstantial accounts of the state of the territory and of the troops which they command; and the reports are regularly submitted to the general commanding-in-chief.

The staff of a regiment consists of the adjutant, quartermaster, paymaster, chaplain, and surgeon.

The duties of a military staff, as a branch of tactics, may be said to have originated in modern Europe during the reign of Louis XIV., when armies of great numerical strength were opposed to each other. The difficulty of finding subsistence for such vast bodies of men induced the generals to form them into grand divisions, which were quartered in different parts of a country. The art of war then began to consist in a great measure in making combined movements of troops, and in the choice of strong positions; and the Maréchal de Luxembourg is said to have been chiefly distinguished for his skill in conducting the operations of warfare on this principle. Maréchal Puysegur, who began to serve in 1677, observes that before his time, except the rules of fortification, no theory or established principles relating to the art of war had been given; and he appears to have been the first who, by actual observations of a country, made himself acquainted with the facilities which it afforded for marching or encamping. He states that this duty had till then been omitted entirely or negligently performed, the knowledge of the roads and positions being obtained only from the reports of officers who had accidentally made observations, or from the accounts of the country-people; and he adds that often, when a march had commenced, or an encampment had been formed, the army was compelled to change its route or abandon the position on account of impediments in the one or the unfitness of the other.

The first establishment of a permanent military staff (état major, as it was called) was made in France in 1783, about the conclusion of the Revolutionary war between Great Britain and the United States of America. The officers who held the highest rank in it were considered as assistant-quartermaster-generals, and their deputies as captains. The first duties consisted in collecting the reports, the orders and instructions which had formerly passed between the generals of the French armies and the minister of war, together with the plans of the ground on which the most important actions had taken place; and from these documents it was endeavoured to acquire a knowledge of the causes of success or defeat as far as these depended on the dispositions of the troops and the nature of the ground. The persons who were allowed to enter the department of the état major were such as, to a knowledge of the general theory of military tactics, added that of topographical surveying, and who were skilful in the art of representing on a plan the features of ground so as to present to the eye at once a view of its capabilities as a military position, and of the facilities which it might afford for the march of troops with their artillery and stores.

About the year 1800 the British government first formed a particular school for the purpose of instructing officers in the art of surveying ground in connection with that part of tactics which relates to the choice of routes and of advantageous positions for troops. These officers were independent of the master-general of the ordnance, and served under the orders of the quartermaster-general or adjutant-general; they were called staff-officers, and were selected from the cavalry or infantry after having done duty with a regiment at least four years. They were first employed in Egypt, where they rendered considerable service; and the school was afterwards united to the Royal Military College, which had been then recently instituted for the instruction of cadets who were to serve in the cavalry or the infantry of the line. At that institution a limited number of officers, under the name of the senior department, continue to be instructed in the duties of the staff, and in the sciences connected with the military art.

During the war in Spain, from 1808 to 1813, the staff-officers were constantly employed, previously to a march or a retreat, in surveying the country at least one day's journey in front of the army. After the death of the duke of York, the staff corps ceased to be kept up, and for several years it was reduced to a single company, which was charged with the duty of repairing the military canal at Hythe. This company was afterwards incorporated with the corps of sappers and miners.

The duties of officers belonging to the quartermaster-general's staff are very different from those of the military engineers; the latter are employed in the construction of permanent fortifications, batteries, and field-works; while the former survey ground in order to discover roads, or sites for military positions, for fields of battle, or quarters for the troops. The education of a staff-officer is such as may qualify him for appreciating the military character of ground: for this purpose he learns to trace the directions of roads and the courses of rivers or streams; and in mountainous countries to distinguish the principal chains from their ramifications, to examine the entrances of gorges, and to determine the heights of eminences or the depths of ravines. He has besides, to acquire a facility in determining or estimating the resources of a district with respect to the means it affords of supplying provisions or quarters for the troops. [RECONNOISSANCE.]

The staff-officer ought also to know how to correct the illusions to which the eye is subject in examining ground, from the different states of the air, and the number and nature of the objects which may intervene between himself and those whose positions are required. He ought to be able to estimate the number of men whom a visible tract of ground can contain, and to form a judgment concerning the dispositions and stratagems which it may permit an army to put in practice.

STAFFA. This small basaltic island, lying west of the larger trap masses of Mull, once difficult of access in open boats only, may now, during the summer, be visited in well-equipped steamers from Oban and Tobermorie, and on the same day the voyager may land on Iona.

Staffa is entirely composed of amorphous and pillared basalt: the pillars have in many parts of the rugged coast yielded to the action of the sea, and permitted the formation of caves, some of them uncommonly picturesque, which are generally arched over by what seems to be amorphous trap rock, but really is often prismatised in an irregular manner. The island has a very irregular and unequal surface, affording poor pasture. On this detached narrow surface are boulders of granite resembling the red rock of Ross in Mull.

Staffa, since it was almost discovered in 1772, by Sir Joseph Banks, who in his letter to Pennant notices very accurately the mineral structure and the picturesque caverns and cliffs, has been visited and described by many persons of eminence. M'Culloch (*Geology of the Scottish Isles*) has published very elegant drawings of Fingal's Cave and several other points of picturesque and geological interest, and two of the best prints which we have seen of Fingal's Cave are those engraved by direction of the late Thomas Allan, Esq., and published in the article 'Geology' of the *Encyclopædia Britannica*.

Skirting in a boat the coast of Staffa, the frequent caves and ranges of pillars, erect, or curved beneath a huge entablature of rock, and the regular pavement formed by the angular sections of the pillars, astonish the spectator.

The Boat-Cave, Mackinnon's or the Cormorant Cave (it is much frequented by these birds), and Fingal's Cave, may in ordinary weather, be explored in a boat, and a landing may be effected on Buachaillé (Boo-cha-la), the Herdsman's Isle, which is remarkable for its arched columns of basalt.

Fingal's Cave may be entered on foot, on the south side, along a rugged pavement of pillar-tops. Looking out from near the extremity, the eye is delighted with the bright prospect of Iona, through the long dark vista of the cave; above, the roof is formed partly of pillar-sections, and partly of the already mentioned amorphous trap; the sides are straight vertical prisms of basalt, washed at their base by a deep and often tumultuous sea.

The following measures in this celebrated spot are taken from Sir J. Banks's letter already referred to:—

| | Feet. | Inch. |
|---|---|---|
| Length of Fingal's Cave, from rock without | 371 | 6 |
| Length of Fingal's Cave, from pitch of the arch | 250 | 0 |
| Breadth of Fingal's Cave, at mouth . . | 53 | 7 |
| Breadth of Fingal's Cave, at farther end . | 20 | 0 |
| Height of arch at mouth . . . . | 117 | 6 |
| Height of arch at end . . . . | 70 | 0 |
| Height of an outside pillar . . . | 39 | 6 |
| Height of one at the north-west corner . | 54 | 0 |
| Depth of water at the mouth . . . | 18 | 0 |
| Depth of water at the bottom of the cave . | 9 | 0 |

Direction of the cave north-east by east (magnetic).

On a careful survey of the rocky cliffs of Staffa, we see that the basaltic mass may be considered in three parts—a subjacent amorphous and lava-like mass, 11, 17, or 20 feet exposed, on which (especially beyond the north-west side of Fingal's Cave), the pillars, 30, 50, 54, 55 feet high, rest, and these are covered by a seemingly amorphous but really irregularly prismatic entablature, 30, 50, and 66 feet in thickness (Banks's measures). The tops of the pillars are usually in a nearly regular plane declining to the south-east, and their bases are also in a surface nearly parallel. The section of the pillars is rarely triangular or quadrangular, generally pentagonal or hexagonal. Some of them are 2 feet in diameter, others as small as 1 foot, 9 inches, or even 6 inches. They are less regularly jointed than those of the Giant's

Causeway, and most frequently the joint surfaces are concave in the lower stone. Zeolitic minerals occur sparingly in the basalt and in the interstices of the pillars.

(Pennant's *Tour in Scotland*, including Banks's *Letter to Pennant*, 1772; Neceer, *Voyage en Ecosse*, 1821; M'Culloch's *Western Isles of Scotland*.)

STAFFORD, Duke of Buckingham. [BUCKINGHAM.]

STAFFORD, WILLIAM HOWARD, VISCOUNT, was the second surviving son of Thomas, twentieth earl of Arundel (the collector of the Arundelian Marbles), by his wife the lady Alathea Talbot, daughter of Gilbert, seventh earl of Shrewsbury: he was born on the 30th of November, 1612. He was thus uncle to Thomas, the twenty-second earl of Arundel, who was restored, after the return of Charles II., to the dukedom of Norfolk, which had been forfeited by his great-great-grandfather.

Burnet, who knew Lord Stafford in his last days, says, 'He was a weak but a fair-conditioned man; he was in ill terms with his nephew's family; and had been guilty of great vices in his youth, which had almost proved fatal to him.'

While he was known as Sir William Howard, K.B., he married Mary, sister of Henry, thirteenth Baron Stafford; which Henry died, unmarried, in 1637, when his barony descended to his distant relation Roger Stafford, a person who appears to have sunk to the lowest class of the people, though the great-grandson of the famous Edward Stafford, third duke of Buckingham, and also of Margaret Plantagenet, the unfortunate countess of Salisbury, and niece of King Edward IV. Roger's sister was married to a joiner at Newport, in Shropshire, and they had a son who lived in that town, following the trade of a cobbler. Nor had the elder branch of the family, in which the title remained for several generations, been always much more honourably matched: Roger's uncle, Edward, the eleventh lord, indeed married a daughter of the earl of Derby; but his son, Edward, the twelfth lord, chose to share his title with his mother's chambermaid; and from her, through a son, who died during the life of his father, were sprung the thirteenth baron, Henry, already mentioned, and his sister, who became the wife of Sir William Howard.

Upon the death of his brother-in-law, Sir William Howard immediately assumed, or at least claimed, the title of Baron Stafford, in right of his wife, a claim which, in any circumstances, certainly could not have been sustained at that day. But it was soon discovered, and admitted on all hands, that the true heir to the barony survived in the person of Roger Stafford, although he had hitherto gone by the name of Fludd or Floyd. Roger however was induced, no doubt for a consideration, to submit his title to the dignity, on the 5th of December, 1637, to the decision of the king, 'upon which submission,' it is stated, 'his majesty declared his royal pleasure that the said Roger Stafford, having no part of the inheritance of the said Lord Stafford, nor any other lands or means whatsoever, should make a resignation of all claims to the title of Lord Stafford, for his majesty to dispose of as he should see fit.' A deed of surrender was accordingly enrolled on the 7th of December, 1639; and, although such a resignation of a peerage has since been decided to be illegal, the king now considered himself at liberty to dispose of the dignity. On the 12th of September, 1640, Sir William Howard was created baron, and his wife baroness Stafford; and on the 11th of November following Lord Stafford was made a viscount, that being found to be the only way of giving him as high a precedency as the former barons. Roger is supposed to have died unmarried in the course of the same year.

Lord Stafford had been bred a strict Roman Catholic, and during the civil war he adhered to the royal side. After the Restoration, according to Burnet, 'he thought the king had not rewarded him for his former services as he had deserved; so he often voted against the court, and made great applications always to the earl of Shaftesbury. He was on no good terms with the duke [of York]; for the great consideration the court had of his nephew's family made him to be the most [more ?] neglected.' He does not however appear to have ever made any figure in parliament down to the time when all the Roman Catholic peers, twenty-one in number (besides three who conformed), were excluded from the House by the act of the 30th of Char. II., st. 2, to which the royal assent was given on the 30th of November, 1678.

Under date of 18th June, 1670, Evelyn records in his 'Diary' that he met Lord Stafford at a dinner party at Goring House (the town residence of Lord Arlington); when, he says, 'Lord Stafford rose from table in some disorder because there were roses stuck about the fruit when the desert was set on the table, he having such an antipathy to them as once Lady St. Leger had; and to that degree that, as Sir Kenelm Digby tells us, laying but a rose upon her cheek when she was asleep, it raised a blister; but Sir Kenelm was a teller of strange things.'

Lord Stafford is only remembered in history as the last and most distinguished of the numerous victims whose lives were sacrificed in the tragedy of the Popish Plot. [OATES, TITUS.] In his first examination before the Commons, on the 23rd of October, 1678, Oates mentioned Stafford as the person who had been appointed by the general of the Jesuits to the office of paymaster of the army. Two days after, Stafford rose in his place in the House of Lords, and stated that he was informed there was a warrant issued out from the lord chief justice of England to apprehend him, and submitted himself to their lordships' judgment. Burnet says, 'When Oates deposed first against him, he happened to be out of the way, and he kept out a day longer; but the day after he came in and delivered himself, which, considering the feebleness of his temper and the heat of that time, was thought a sign of innocence.' Before the House rose he intimated that he should surrender to the warrant; and after being consigned in the first instance to the prison of the King's Bench, he was ultimately, on the 30th, committed to the Tower, along with the other accused noblemen, the earl of Powis, and the Lords Petre, Arundel, and Belasyse.

On the 5th of December, a message was brought from the Commons by Sir Scrope How, who informed their lordships that he was commanded to impeach Lord Stafford of high treason and other high crimes and misdemeanours. Three days after the earl of Essex laid before the house an information which had been sworn on the 24th before two magistrates of the county of Stafford by 'Stephen Dugdale, Gent., late servant of the Lord Aston, of Tixhall,' who asserted therein that in the beginning of September of the preceding year, he had been promised a large reward by Lord Stafford and a Jesuit of the name of Vrie or Evers, if he would join in a conspiracy to take the king's life. The prorogation of the parliament at the end of the month, and its dissolution a few weeks after, prevented any further proceedings being taken until after the assembling of the new parliament in the beginning of March, 1679. On the 18th of that month the lords' committee of privileges, to whom the question had been referred, reported their opinion 'that, in all cases of appeals and writs of error, they continue and are to be proceeded on *in statu quo*, as they stood at the commencement of the last parliament, without beginning *de novo*;' and on the following day the house, after debate, agreed to this report. The commons sent up their articles of impeachment against the five lords on the 7th of April; and on the 16th Lord Stafford put in his answer, in which he protested his entire innocence of the crimes laid to his charge. Another prorogation, followed by a dissolution, took place in the end of May; and the new parliament did not meet for the despatch of business till October, 1680. During all this time the accused lords had lain in the Tower; and meanwhile the plot had been propped up by the testimony of Bedloe, Dangerfield, Turberville, Denis, and other new witnesses. At last, on Tuesday, the 30th of November (his birth-day), Lord Stafford, selected, according to Sir John Reresby, as being 'deemed to be weaker than the other lords in the Tower,' was brought to the bar of the House of Lords, assembled as a court of justice in Westminster Hall, to take his trial, the lord chancellor, Lord Finch (afterwards earl of Nottingham), presiding as lord high steward. Reresby and Evelyn were both present, and have both given us an account of the scene. A singular circumstance mentioned by Evelyn is, that Stafford's two daughters, the marchioness of Winchester being one of them, were with him in his box, as well as the lieutenant of the Tower, the axe-bearer, and the guards.* He remarks also that just forty years before, when Lord Strafford was tried in the same place, the lord steward was the present prisoner's father (the late earl of Arundel). Reresby says it was the deepest solemnity he ever saw. Besides Oates and Dugdale, who repeated their former evidence with additions or variations, Turberville swore that Stafford had

* In the printed 'Diary' at this place (vol. i., p. 496, 4to edit.), the prisoner is by mistake called Lord Strafford throughout.

also offered him a reward to kill the king. The trial lasted seven days. Reresby says that the prisoner so far deceived those who counted upon a poor defence, 'as to plead his cause to a miracle.' Burnet also, who, we have seen, had no high opinion of Stafford's strength of mind, admits that he 'behaved himself during the whole time, and at the receiving his sentence, with much more constancy than was expected from him.' When the votes of their lordships were taken, on Tuesday, the 7th of December, 31 voted Not Guilty, and 55 Guilty. (*State Trials*, vii., 1293-1576.) Four of the Howards, his relations, namely, the earls of Carlisle, Berkshire, and Suffolk, and Lord Howard of Escrick, condemned him; the only one of his own family who voted for his acquittal was Lord Arundel (sitting as Lord Mowbray), the son of the duke of Norfolk.

Within two days after his condemnation he sent for Burnet and the bishop of London, to whom he made the most solemn protestations of his innocence. 'I pressed him in several points of religion,' says Burnet, 'and urged several things which he said he had never heard before. He said these things on another occasion would have made some impression upon him; but he had now little time, therefore he would lose none in controversy: so I let that discourse fall. I talked to him of those preparations for death in which all Christians agree; he entertained these very seriously, much above what I expected from him.' However, he was desirous of saving his life, if it could be done; and he told Burnet, that if that would obtain his pardon, he could and would discover 'many other things that were more material than anything that was yet known, and for which the duke [of York] would never forgive him.' Upon this being reported to the House of Lords, he was immediately sent for; when 'he began,' says Burnet, 'with a long relation of their [the Catholics'] first consultations about the methods of bringing in their religion, which they all agreed could only be brought about by a toleration. He told them of the earl of Bristol's project; and went on to tell who had undertaken to procure the toleration for them; and then he named the earl of Shaftesbury. When he named him, he was ordered to withdraw; and the lords would hear no more from him.' It is pretty evident from all this that he really had nothing of any consequence to tell. 'He was sent back,' continues Burnet, 'to the Tower; and there he composed himself in the best way he could to suffer, which he did with a constant and undisturbed mind: he supped and slept well the night before his execution, and died without any show of fear or disorder. He denied all that the witnesses had sworn against him.' He was executed on Tower Hill on the morning of Wednesday the 29th of December. When his majesty's writ was found to remit all the rest of the sentence except the beheading, the two republican sheriffs, Bethel and Cornish, professed to feel scruples as to whether they were warranted in acting upon it; but the Commons at last stepped in and settled the matter by resolving 'That this House is content that the sheriffs of London and Middlesex do execute William, late Viscount Stafford, by severing his head from his body only.' Lord Russell is stated to have 'stickled for the severer mode of executing the sentence;' and it is said that when Charles, three years after, granted a similar commutation of punishment when his lordship was sent to the scaffold, his majesty observed, 'He shall find that I have the privilege which he was pleased to deny in the case of Lord Stafford.'

A bill to reverse the attainder of Lord Stafford passed the Lords in 1685, but did not obtain the assent of the Commons. In 1688 his widow was created by James II. countess of Stafford for life, and her eldest son Henry, earl of Stafford, with remainder to his brothers John and Francis, and their heirs male; but the earldom became extinct by the death of John Paul, the fourth earl, in 1762. In 1800 certain proceedings were instituted on behalf of Sir William Jerningham and the lady Anastasia Stafford Howard, daughter of William, second earl of Stafford, and great-granddaughter of the attainted lord (who died a nun at Paris in 1807, at the age of 85), as conjoint heirs, with a view of establishing the existence of the barony of Stafford, on the ground that (as above stated) it had been conferred not only upon Sir William Howard, but also upon his wife, and that therefore it descended to her heirs, notwithstanding the forfeiture of her husband. But this claim was not prosecuted. At length however on the 17th of June, 1824, an act of parliament was passed reversing the viscount's attainder; and the following year Sir George William Jerningham, Bart., was admitted to have established his claim as heir to the barony (which had been granted with remainder to the heirs of Sir William Howard and his wife), through their granddaughter Mary, who married Francis Plowden of Plowden, Esq., in the county of Salop, and was the maternal grandmother of Sir William Jerningham.

STAFFORD. [STAFFORDSHIRE.]

STAFFORDSHIRE, a midland county of England, bounded on the north-east by Derbyshire, on the east for a very short distance by Leicestershire, on the south-east by Warwickshire, on the south by Worcestershire, on the south-west and west by Shropshire, and on the north-west by Cheshire. The form of the county is irregular; its greatest length is from north to south, from Ax-edge Common, at the junction of the three counties, Cheshire, Derbyshire, and Staffordshire, to the neighbourhood of Bewdley (Worcestershire), 60 miles; the greatest breadth at right angles to the length, is from the junction of the Dove with the Trent, below Burton, to the neighbourhood of Market-Drayton (Shropshire), 38 miles. The southern border of the county is very intricate; the counties of Warwick, Worcester, Salop, and Stafford being very much complicated: a portion of Worcestershire, including the town of Dudley, is entirely insulated by Staffordshire, and a detached portion of Staffordshire is entirely surrounded by Worcestershire. The area of the county is estimated at 1184 square miles. The population at the time of the different enumerations was as follows:—1801, 239,153; 1811, 295,153; increase in ten years, 21 per cent.: 1821, 345,895; increase 17 per cent.: 1831, 410,512; increase 19 per cent: 1841, 510,206; increase 24·2 per cent. The last enumeration for 1831 (which we retain to facilitate comparison with counties previously described) gives 347 inhabitants to a square mile. In respect of size it is the eighteenth of the English counties, being smaller than Gloucestershire, but larger than the county of Durham. In amount of population (in 1831) it is the seventh, being next to Kent; and in density of population the fifth, being exceeded in this respect only by the metropolitan counties of Middlesex and Surrey, and the counties of Lancaster and Warwick. Stafford, the county town, is 125 miles north-west of the General Post-office, London, in a direct line; or 143 miles by the Birmingham and Grand Junction railways.

*Surface and Geology.*—The northern is the highest part of the county. It consists chiefly of wild moorlands, formed by long ridges extending from north-west to south-east, separated from each other by deep dells or by valleys watered by the tributaries of the Trent, and gradually subsiding towards the banks of that river. The principal summits are—Cloud-end, Biddulph Moor, Mow Cop (1091 feet above the level of the sea), Wicken Stones, Gun Moor, Bunster hill (given in Shaw's *History of Staffordshire* at 1200 feet), and High Roches, all in the northern part of the county toward the Cheshire border; Moredge, Caldon Low, Ecton hill, Ramshaw Rocks, Wever hill (1154 feet, as marked in Arrowsmith's 'Map of England;' or 1500 feet according to Shaw), and Swinecote or Swinscoe hill, are also in the northern part, but nearer to the Derbyshire side. On the eastern side of the county, between Abbots Bromley and Burton-upon-Trent, are the high grounds of Needwood Forest; and south of the Trent, toward the centre of the county, between Stafford and Litchfield, are the high grounds of Cannock Chase, one part of which (Castle Ring) is 715 feet high.

On the south-eastern border, between Walsall and Sutton Coldfield, is Bar Beacon, an elevation of 653 feet; and between Dudley and Hales Owen are the Rowley hills, given by Shaw at 900 feet. These Rowley hills are the prolongation of the heights which rise to the south-east of Wolverhampton, and skirt the valley through which the Birmingham Canal Navigations pass.

The western side of the county is occupied by a tract of high ground, which separates the waters that flow westward by the Severn into the Atlantic from those which flow eastward by the Trent and the Humber into the North Sea. Ashley heath, on this range of high land, has an elevation of 803 feet, as marked in the map to Priestley's 'Navigable Rivers.' The heights, where not otherwise expressed, are from the 'Ordance Survey.' Those from Shaw's 'Staffordshire' are probably much too great.

The lowest spots in the county are probably the bank of the Severn at Over Arley, at the south-west extremity of the county, and the bank of the Trent, at the junction of the Dove, on the eastern border. These are given by Shaw at 60 feet and 100 feet respectively above the level of the tide of the Thames at Brentford.

Nearly the whole of the county is included in the great red-marl or new red-sandstone district of central England. The northern part is indeed beyond the limit of this formation; and there are some insulated districts occupied by the coal-measures or other subjacent formations, which rise through the red-marl. The higher grounds of Needwood Forest and Cannock Chase, as well as those which separate the basin of the Trent from that of the Severn, consist of this (red-marl) formation. Gypsum is quarried in Needwood Forest and in the adjacent part of the valley of the Dove. The pure white gypsum, or that slightly streaked with red, yields plaster of Paris, which is much used in the potteries for moulds; selected blocks are turned, or otherwise converted into ornamental articles. The commoner sorts are used for coarser purposes, as flooring, building walls, &c. Limestone is quarried near Newcastle, in the pottery district. Brine-springs abound near the Trent, particularly at Weston, near Stafford, where salt-works have been established. In the neighbourhood of Litchfield the red-marl is covered by alluvial deposits of red sand or gravel.

The Dudley or South Staffordshire coal-field extends from Cannock Chase to the Worcestershire border near Stourbridge, about 20 miles in length from north by east to south by west; and from King's Swinford to Soho, near Birmingham, 10 miles in breadth from west to east. The dimensions indeed include not only the coal-field itself, but the Rowley hills, which are composed of transition and other rocks, by which it is intersected. These hills consist of two different formations: the north-western part, between Wolverhampton and Dudley, consists of four oblong insulated hills, all of transition limestone, in arched or saddle-shaped strata. Against the sides of these hills the coal-beds crop out, and become flatter as they recede from them. The millstone grit, carboniferous limestone, and old red-sandstone are not found in connection with this coal-field, but the coal measures rest immediately on a transition rock. The hills south-east of Dudley consist of one mass of basalt and amygdaloid, round which the coal-measures do not crop out, as round the limestone, but preserve their usual level in approaching it. The basalt is very pure, and is locally termed Rowley rag. It is quarried for mending the roads and paving the streets of Birmingham. It is supposed that this mass of trap rock is connected with a vast dyke penetrating the carboniferous strata, and overlying (as it is found to do) their edges. Trap rock (greenstone) is found in that part of the coal-field near Walsall; it is apparently part of a thick vertical greenstone dyke, with a wedge-shaped prolongation penetrating the adjacent carboniferous strata. The coal of the southern part of the Dudley field is distinguished by the occurrence of an extensive bed called the Main-coal, 30 feet thick, but this dips to the south, and crops out at Bilston. In the northern part of the field seams of coal are found four, six, and eight feet thick, which appear to be subjacent to the main coal. On the east side of the coal-field, near Walsall, the transition limestone again rises, and the carboniferous beds crop out against it. At Beaudesert, at the northern extremity of the field, cannel coal is obtained.

In the northern part of the county another coal-field (the Pottery coal-field) occurs, of triangular form. It extends from Lane-end in the Potteries to Congleton in Cheshire, where is the vertex of the triangle, 13 miles in length from south by east to north by west. Its greatest breadth, which is in the southern part, forming the base of the triangle, is 8 or 10 miles. A short distance to the east of this is the Cheadle coal-field, so called from the town of Cheadle, which lies near its south-western border. This small coal-field appears to be an insulated basin, the strata dipping towards Cheadle as a centre, and resting upon millstone grit. In the southern part, near Cheadle, the coals are thicker and of better quality than in the northern part of the field. From the dip and outcrop of the strata on the northern part of the Pottery coal-field, it appears to be also an insulated basin, but it is not ascertained whether on the south side the strata crop out so as to show this decisively; or whether they are terminated by a fault, or covered by the red-marl and other superior beds. There are thirty-two beds of coal in this field, generally from three to ten feet thick.

A prolongation of the South Lancashire coal-field extends into the northern part of the county about Flash, where are several coal-works. The Warwickshire coal-field just touches the border near Tamworth.

The coal-works of the county are very numerous and important; in the south they supply the iron and other hardware manufactures of Birmingham, Dudley, Wolverhampton, Wednesbury, Bilston, Walsall, &c.; and furnish fuel to the neighbouring counties to a considerable distance, and in the north they supply the fuel to the Pottery district. Perhaps the neighbourhood of Birmingham is the cheapest district for coals in England, and the consumption is prodigious. From their small value, they are worked in a very wasteful manner; one-third is left in the pit, as being two small to be worth the cost of removal, and is speedily destroyed by the weather; the pillars left standing probably amount to another third. Ironstone is abundant in the Dudley coal-field.

The high moorlands of the northern part of the county consist partly of millstone grit and shale; partly of carboniferous or mountain limestone. The millstone grit occupies the central and western portion, cropping out from beneath the Pottery and Cheadle and South Lancashire coal-fields, and overspreading the intervening country. The mountain limestone district comprehends the eastern moorlands, and extends across the upper valley of the Dove into Derbyshire. There are several lead-mines and copper-mines in this district.

*Hydrography, Communications, &c.*—The county belongs almost entirely to the basin of the Humber. The Trent, the most important tributary of that æstuary, rises from three springs near the northern border of the county, near Knypersley Hall; and runs in a southerly direction through the Potteries 12 miles, to Trentham, the seat of the Duke of Sutherland. From thence it runs 18 miles, still to the south-east, by Stone and Rugely, being joined above the latter by the river Sow. From Rugely the Trent bends eastward 10 miles to the junction of the Tame and the Mease, and then turning to the north-east runs 8 miles to Burton, where it becomes navigable; and 2 or 3 miles below Burton quits the county altogether. Its whole length in the county or upon the border (for from the junction of the Mease it is a border stream separating Derbyshire from Staffordshire) may be estimated at about 50 miles.

The principal tributaries of the Trent are the Lyme from Newcastle-under-Lyme, the Sow, the Blyth, the Tame, the Mease, and the Dove. The Lyme joins the Trent on the right bank, not far from its source. The Mease has only a part of its course on the border of the county.

The Sow rises about 5 or 6 miles north-west of Eccleshall, near the western border of the county, and flows to that town, near which it receives one or two tributary brooks; it then continues its course 3 or 4 miles to the junction of the Meese brook, which rises near the Sow, and has a course nearly parallel to it, but of rather greater length, and joins it on its left or north-east bank. From the junction of the Meese, the Sow flows, still south-east, 6 miles through the town of Stafford to the junction of the Penk, receiving by the way the Clanford brook on the right bank. The Penk, the most considerable affluent of the Sow, rises a little to the north-west of Wolverhampton, and flows 20 miles northward through Penkridge into the Sow, which it joins on the right bank. From the junction of the Penk, the Sow flows eastward 4 miles into the Trent, which it joins on the right bank. Its whole course is about 19 or 20 miles: it is not navigable.

The Blyth rises about four miles east of Hanley in the Potteries, and flows south-south-east 23 or 24 miles into the Trent, which it joins on the left bank, 5 miles below Rugely.

The Tame rises in Essington-Wood, 4 miles north-west of Walsall, and flows 15 miles south-east, passing between Walsall and Wednesbury to Aston, a suburb of Birmingham, where it receives on the right bank the brook Rea, which flows through Birmingham itself. From the junction of the Rea the Tame flows eastward 8 miles, to the junction of the united streams of the Cole from Coleshill, 16 miles long, and the Blyth (about the same length) from Solihull, which join the Tame on the right bank. The Tame then turns northward and flows about 19 miles, by Tamworth, where it receives the Anker on the right bank, into the Trent, which it joins on the right bank; its whole course is about 42 miles, partly in Warwickshire, but chiefly in Staffordshire.

The Dove rises near the northern extremity of the county, and flows south-south-east by or near Longnor, Ashbourn (Derbyshire), and Uttoxeter, into the Trent below Burton, dividing through nearly its whole course the counties of Derby and Stafford: its length is nearly 45 miles. It is not navigable. The upper part of its course is through the beautiful scenery of Dovedale on the border of the Peak. It receives some tributaries, of which the Manifold and the Churnet belong to Staffordshire. The Manifold, about 9 miles from its source, sinks into the ground, and after a subterraneous course of 4 miles rises again near Ilam, a mile or two before its junction with the Dove; its tributary, the Hamps, sinks in like manner, and the junction of the two streams takes place underground. The length of the Churnet is about 25 miles; it rises on Biddulph Moor, 5 miles north-west of Leek, and soon after expands into a sheet of water or lake, from the lower end of which it continues its course by Leek, Cheddleton, Oakamoor, Alveton (or Alton), and Rocester, a little way below which it joins the Dove.

The western border of the county belongs to the basin of the Severn, which flows for about two miles across the south-western corner of the county, near Over Arley. About 14 miles of the course of the Stour (which rises near Hales Owen (Salop), and joins the Severn at Stourport) are on or within the southern border of the county, to which its tributary, the Smestow, which rises near Wolverhampton, wholly belongs. The Mees, which joins the Tern, an important affluent of the Severn, rises in Staffordshire. It passes through Aqualate Mere (*Aqua lata*, i.e. broad-water), a small lake about a mile long, and nearly half a mile wide, near Newport, in Salop.

The rivers abound with fish, such as pike, trout, grayling, chub, perch, &c. Salmon are caught in the Severn, and occasionally in the Trent; and there are a few instances on record of sturgeon being taken in the latter river.

The canals of this county are numerous. The most important is the Trent and Mersey, or, as it is sometimes called, the Grand Trunk canal. This canal, commencing in the Trent at the junction of the Derwent in Derbyshire, enters the county near the junction of the Trent and Dove, and follows the valley of the Trent through the heart of the county, to Stoke in the Potteries, from whence it continues its course north-west to the Mersey, at Runcorn Gap. About 50 miles of its course, including the Harecastle tunnel, 2880 yards long, on the summit-level between Burslem and Church Lawton in Cheshire, belong to Staffordshire. It passes near Burton-upon-Trent, where there is a cut to the river Trent, Rugeley, Stone, and Stoke, Hanley, and Burslem in the Potteries.

The Birmingham canal and the Birmingham and Liverpool Junction canal may be regarded as forming another important line, entering the county near Birmingham, and passing through the iron and coal district, by Dudley and Wolverhampton, and then running north-west into Shropshire. The length of this line may be estimated at about 32 miles. The first part of it, from Birmingham to the Staffordshire and Worcestershire canal, in the neighbourhood of Wolverhampton, is included in the Birmingham Canal Navigations (first act obtained A.D. 1766), and is remarkable for the great number of short cuts or branches to the coal-pits or iron-works of the district; there are longer branches to Wednesbury, almost useless from a part of it having fallen in, and to Wolverhampton. The first act for the Birmingham and Liverpool Junction canal, which commences in the Staffordshire and Worcestershire canal, was obtained A.D. 1826; and the canal was in course of execution at the publication (A.D. 1831) of Priestley's 'Historical Account of Navigable Rivers and Canals.'

These two main lines of canal navigation may be considered as belonging to the county at large: the following appertain to the coal and iron districts of South Staffordshire.

The Staffordshire and Worcestershire canal was executed under an act obtained A.D. 1766. It commences in the Severn at Stourport, and, after passing by a tunnel under the town of Kidderminster, it enters Staffordshire near the village of Whittington, follows the valleys of the Stour and the Smestow, passes near Wolverhampton, in the neighbourhood of which is its summit-level, and then follows the valleys of the Penk and the Sow, until it joins the Trent and Mersey canals, near the junction of the Sow and the Trent. Its length in this county is nearly 40 miles. It passes near the towns of Penkridge and Stafford; and intersects the line of the Birmingham canal and the Birmingham and Liverpool Junction canal, which both terminate in it about a mile from each other. The trade on this canal is very great: the iron and other hardwares of Birmingham, Dudley, Wolverhampton, and the neighbourhood, and the coals of the adjacent coal-field, are conveyed by it to the remoter parts of the county of Stafford, and to the counties of Worcester, Gloucester, and others adjacent to the Severn.

The Stourbridge canal (first act obtained A.D. 1776) commences in the above canal at Stewponey, and extends to the town of Stourport. This canal is short. The Dudley canal (first act A.D. 1776) commences in the Birmingham and Worcester canal (which, though not in this county, is connected with the Birmingham canal noticed above), and proceeds to Dudley. A part only of the line is in Staffordshire. A cut unites it with the Stourbridge canal, and consequently with the Staffordshire and Worcestershire canal.

The first part of the Coventry canal (first act A.D. 1768), viz. from its commencement in the Trent and Mersey canal at Fradley Heath to Fazeley near Tamworth, 11 miles in length, belongs to this county. At Fazeley it unites with the Birmingham and Fazeley canal (first act A.D. 1783), which forms a part of 'the Birmingham Canal Navigations,' and of which only a small part is in Staffordshire.

The Wyrley and Essington canal (first act 1792) consisted at first of a short line running south-south-east from Wyrley Bank to Birch Hill near Walsall; with a cut westward to the Birmingham canal near Wolverhampton. Subsequently (by act of 1794) another cut was made eastward to the Coventry canal between Fradley Heath and Fazeley: and these two cuts may now be regarded as constituting the principal line. There are one or two branches, the longest is to the lime-works at Hay Head near Walsall; and the extremities of the original main line are now virtually branches.

The Newport branch of the Birmingham and Liverpool Junction canal belongs partly to the west side of the county: it extends from the main line at Norbury near Eccleshall, by the town of Newport (Salop), to the Shrewsbury canal near Wellington (Salop). Its length is 10 miles, of which about 4 miles are in this county.

In the northern part of the county is the Caldon canal (acts obtained A.D. 1776-1802), which is a branch of the Trent and Mersey canal, extending from the main line at Hanley in the Potteries north-eastward to the neighbourhood of Leek, to which town there is a cut; and from thence south-eastward to Uttoxeter, in the valley of the Dove.

The Newcastle-under-Lyme (or Lyne) canal is a short canal from the Trent and Mersey canal at Stoke-upon-Trent to Newcastle-under-Lyme. The Gresley canal (private property) is another short canal, and extends from the Apedale coal-works to Newcastle-under-Lyme. The Newcastle-under-Lyme Junction canal unites these two. The act for the Gresley canal was obtained A.D. 1775, for the Newcastle canal A.D. 1795, and the Junction canal A.D. 1798.

There are several railways in the county. Some of those of earliest formation are connected with the canals above described, to which they convey coal or other minerals. The Grand Junction railway (from Birmingham to the Manchester and Liverpool railway at Newton) passes through the county from the neighbourhood of Birmingham, by or near the towns of Walsall, Bilston, Wolverhampton, Penkridge, and Stafford, and through the Potteries into Cheshire. About 50 miles of its length are in Staffordshire. This railway was constructed and is managed under acts obtained A.D. 1829 to 1840, and was opened throughout in July, 1837.

The Birmingham and Derby Junction railway crosses the east side of the county from the neighbourhood of Tamworth to the neighbourhood of Burton. The acts for this were obtained A.D. 1836 to 1840, and the line was in great part opened A.D. 1839. It is carried by a viaduct nearly a quarter of a mile long over the rivers Tame and Trent near their junction.

The Birmingham and Manchester railway (acts obtained 1837 and 1839) commences at Manchester, and was to have passed by a new line through the Potteries, but this part has been abandoned; and it is to unite with the Grand Junction line at Crew in Cheshire, so that as a distinct line it has no connection with Staffordshire.

The principal coach-road in the county is the parliamentary road from London to Holyhead, which enters Staffordshire at Soho, near Birmingham, and runs through Wednesbury, Bilston, and Wolverhampton, a few miles beyond which it enters Shropshire. The Chester and Holyhead road enters the county at Tamworth, and runs by Lichfield, Rugely, Wolseley Bridge, Stafford, Eccleshall, and Knighton, into Shropshire. The London and Liverpool road, branching from this at Wolseley Bridge, runs through Stone and Newcastle-under-Lyme into Cheshire. The road from London by Derby to Manchester crosses the northern part of the county through Leek. The road from Birmingham to Derby, part of the line which connects the south-western with the northern counties, passes through Lichfield and Burton-upon-Trent. All these, before the formation of railways, were mail-coach roads. Other roads are too numerous for notice.

On the whole, there is perhaps not one of the midland counties better provided with the means of communication than Staffordshire; and this is the more remarkable, as, with the exception of the Trent, and that only for a very few miles, it has not a single navigable river. All the means of communication, with this trifling exception, are works of art, and have been for the most part called forth by the mineral wealth of the county and its two great branches of manufacturing industry, the iron-manufacture of the south and the potteries of the north.

*Agriculture.*—The air of this county is sharp in comparison with those which are situated to the south of it, and at the same time the county is more subject to continued rains, which make the crops later and the harvest more precarious. The quantity of rain which falls in the neighbourhood of London during the year is equal to twenty or twenty-one inches on an average, but in Staffordshire the average is about thirty-six inches. From this it is apparent that the heavy soils, and those which are situated on impervious subsoils, require very complete draining before they can be made productive, whatever may be the natural fertility of the surface. The western parts of England are in general more rainy than the eastern; and in this respect Staffordshire must be reckoned with the former. One cause of this are the high lands which traverse the country, and arrest the vapours which blow from the Atlantic. The middle and southern portions of the county are comparatively flat, and have only gently undulating hills. This portion also contains the most fertile lands, and is in the best state of cultivation.

The county is estimated to include a surface of 780,800 acres, of which in round numbers about 150,000 are in roads, wastes, and woods. The remainder, or about 630,800, are productive as arable land or pasture, in which last must be included all the parks around the habitations of noblemen and gentlemen of fortune, of whom there are a considerable number in the county. The proportion of the arable land to the pasture is nearly as five to one. Of the first, two-fifths consist of clays and heavy loams; two-fifths of gravelly and sandy loams, and one-fifth of light gravel and sand, chiefly good turnip land, but not so productive of wheat. An excellent vein of marl lies near Stafford Castle and Eccleshall. The Trent traverses a great portion of the county, and receives the tributary streams of the Dove, which is noted for its fertile banks; it also receives the waters of numerous other streams which have been already mentioned. The Severn touches the southern part of the county, and receives the waters of the Stour and Smestall. There are rich meadows on the banks of all these streams.

There are estates in Staffordshire of all sizes, from that of the rich man with a rental of 10,000*l.* per annum and more, to the small yeoman who lives by the cultivation of a spot of ground which has been the property of his forefathers for many generations. The hired farms are likewise of all sizes. Leases of farms for fourteen and twenty-one years are common.

In the Agricultural Report of the county, published in 1796, it is stated that the large farmers use broad-wheeled waggons, in which six horses, harnessed two and two, draw a load of three or four tons. The improved roads now-a-days enable the farmer to draw by means of single-horse carts upwards of six tons, or double the old load, with the same number of horses.

The ploughs commonly used in Staffordshire are those which have two unequal wheels attached to the beam, and which are also known by the name of Rutland ploughs. They can be so adjusted that they require no ploughman to hold them, excepting when they are to be turned into a fresh furrow. Double ploughs, making two furrows at once, are likewise used where the soil is very light and loose. Other modern implements, such as scarifiers, drills, and horse-hoes, are introduced on the larger farms, especially those in the hands of proprietors and cultivated by experienced bailiffs.

The mode of cropping the land, which till of late partook of the old system of getting as many crops of corn as it was thought the land would yield, and then recruiting its exhausted powers by fallows or pasturing for several years, has now in a great measure been changed for the more rational plan of giving strength first, and keeping it up by judicious management, so as to have always abundant crops and a clean surface. Where turnips and green crops can be raised, which is now the case with almost every soil which is well drained, they form the basis of the system. The use of lime and marl, which becomes every year more common in this county, improves the texture; and crushed bone and other substances, which are of easy carriage and have a powerful effect on vegetation, produce good crops of turnips, and greatly economize the manure from the farm-yards.

The natural meadows along the banks of the rivers are rich and productive, being continually renovated by the depositions of fine mud in floods; but they have also the inconvenience of being sometimes flooded at a time when the grass is fit for the scythe or already cut, in which cases much loss is sustained. The Dove, which brings down from the hills many particles of calcareous matter, which it deposits where the banks are low and flat, is noted, as we observed before, for its rich meadows, which has given rise to a saying, 'rich as Dove;' and, 'In April Dove's flood is worth a king's good.' The finest natural grasses are found on its banks. When the waters of the Dove are diluted by other streams, the fertilizing effect of its floods diminishes.

There is not much land in this county devoted to the grazing of cattle, or to extensive dairies, but many fine beasts are fatted in stalls on turnips, hay, and oil-cake, chiefly for the sake of the manure. The breed most esteemed is that of the short-horns, and few others are to be met with on the principal farms. In an ox the propensity to fatten is the great desideratum, in a cow the richness and abundance of milk, and likewise the continuance of it in the cow till within a short time of calving. To unite these qualities in one animal, or in any breed, has been generally found a hopeless task; and the prudent dairyman seeks in his cows the points which denote good milkers, and not those that indicate a tendency to fatten. It is generally allowed that when the object is to rear an ox to fatten, the breed should differ from that which produces the best milch cow; no cow having yet been found to excel in both qualities of fattening readily and giving much rich milk. Experience teaches the dairyman what cows are most profitable on his pastures, and his principal care is to rear heifers from his best cows by a bull noted for producing good milkers. There are some excellent cows which it would be difficult to class with any particular breed; some have the horns long, some short, and some are without horns; but they all have deep chests, wide hips and flanks, large udders, and prominent milk-veins; a fine tail with a good brush of hair as the end, is a point usually looked for in a good cow.

The original Staffordshire sheep has been either superseded by more useful breeds, or has been changed and improved by crossing. Every breed is to be met with which is in any repute; and good farmers will vie with southern competitors in their Leicesters and South-downs. The number of sheep kept on the land under the present system is vastly greater than it was under the old, and while more corn is raised, more beef and mutton are also produced for the market.

The farm-horses in Staffordshire are active and strong, and in general well kept. The labourers are industrious, and where their employers take some pains to encourage good conduct, they are sober and honest. Whenever the farmer seems indifferent to the moral conduct of those who work for him, he can only expect to suffer in his interest from his own want of attention to this duty.

The Staffordshire hog of the old breed is coarser than the Berkshire or Essex, but much pains have been taken to introduce better pigs, and with considerable success. The

Chinese and Neapolitan breeds have, as elsewhere, been of great use in producing an animal that will fat readily, with small bone and compact form.

The principal fairs in Staffordshire are—

Abbots Bromley, Mar. 6, May 22, Sept. 4; Barton, May 3, Nov. 28; Betley, April 30, July 31, Oct. 29; Bilston, Whit-Mon., Mon. bef. Mich.; Brewood, May 9, Sept. 19; Burslem, Sat. bef. Shrove Tues., Easter or Whit Sun., Sat. on or after June 24, Sat. bef. Ember week, Dec. 26; Burton-upon-Trent, Feb. 2, Apr. 5, H. Thurs. Oct. 29, first Tues. in Sept. (cheese); Cannock, May 8, Aug. 24, Oct. 18; Cellar-head (near Leeke), May 6, Nov. 7; Cheadle, Jan. 7, Mar. 25, H. Thurs., July 4, Aug. 21, Oct. 18; Eccleshall, Th. bef. Mid-Lent, H. Thurs., Aug. 16, first Frid. in Nov.; Fazeley, 2nd Mon. in Jan., Feb., Apr., Sept. Dec., third Mon. in July, Aug., Nov., last Mon. in May and June, Mar. 21, first Mon. after Old Mich.; Gnossall, May 7, Sept. 23; Hanley, Feb. 9, Mar. 30, May 18; cattle-market second Tuesday in every month; Hayward Heath, November 18; Holy Cross, Apr. 10, Sept. 11; Ipstones, Mar. 25, Nov 9; Kinfare, sec. Tues. in May and Dec.; Lane-end and Longton, Feb. 14, May 29, July 22, Nov. 1; Leek, W. bef. Feb. 13, W. in Easter-week, May 18, W. in Whits.-week, July 3, 28, W. after Oct. 10, Nov. 13, W. aft. Christmas-day, sec. Mon. in Mar. and Sept., third Mon. in Nov.; Lichfield, Ash Wed., May 12, Frid. in the week aft. St. Sim. and St. Jude; Frid. after Twelfth-Day; Longnor, Feb. 12, Apr. 2, May 4, 17, 21, Aug. 5, Oct. 8, Nov. 12; Newcastle, Feb. 11, Apr. 1, May 20, July 8, Sept. 16, Nov. 4; Newcastle-under-Line, Jan. 13, Feb. 10, Mar. 2, Mar. 30, Apr. 20, May 18, June 8, July 13, Aug. 10, Sept. 14, Oct. 12, Nov. 2, Dec. 7; Pattingham, Apr. 30; Penkridge, Apr. 30, Sept. 3, Oct. 10; Rugeley, third Thurs. in Apr., Oct. 21, sec. Tues. in Dec., June 2, and 3, 4, 5, 6 (horse-fair); Sandon, April 4, Nov. 14; Shenstone, last Mon. in Feb.; Stafford, Tues. bef. Shrove Tues., May 14, Sat. bef. St. Peter's day, June 29, July 10, Sept. 16, 17, 18, Dec. 4; Stone, Tues. aft. Mid-Lent, Shrove Tues., Whit-Tues., Aug. 5, 26, Tamworth, last Mon. in Jan., first Mon. in Mar., Apr. 5, May 4, July 26, first Mon. in Lent, Oct. 24, Dec. 15; Tutbury, Feb. 14, Aug. 15, Dec. 1; Uttoxeter, St. Magdelene's day, May 6, July 31, Sept. 1, 19, Nov. 11, 27; Walsall, Feb. 24, Tues. bef. Mich.; Wednesbury, May 6, Aug. 3; Woolverhampton, July 10; Yoxhall, Feb. 12, Oct. 18.

*Divisions, Towns, &c.*—Staffordshire is divided into five hundreds, as follows:—

| Hundred. | Division. | Position. | Area. Acres. | Population. 1831. |
|---|---|---|---|---|
| Cuttlestone or Cuddleston | Eastern | Central | 65,400 | 17,096 |
| | Western | W. | 40,100 | 9,822 |
| Offelow or Offlow | Northern | E. | 78,260 | 27,399 |
| | Southern | S.E. | 95,640 | 92,121 |
| Pyrehill or Pirehill | Northern | N.W. | 116,520 | 93,251 |
| | Southern | Central | 89,380 | 27,012 |
| Seisdon | Northern | S. | 42,050 | 86,530 |
| | Southern | S.W. | 39,330 | 10,761 |
| Totmonslow | Northern | N. | 93,920 | 22,853 |
| | Southern | N.E. | 75,690 | 23,667 |
| | | | 736,290 | 410,512 |

We have included the city of Lichfield in the northern division of Offlow hundred, the borough of Stafford in the southern division of Pyrehill, and the borough of Newcastle-under-Lyme in the northern division of the same hundred. The density of the population in the Potteries (Pyrehill hundred, northern division), and still more in the iron and coal districts of the south (Offlow hundred, southern division; and Seisdon hundred, northern division), is obvious at a glance. The population in these three divisions is very nearly 700 to a square mile; in the iron district, taken alone, it exceeds that; while in the agricultural districts it is only about 185 to a square mile.

Staffordshire contains the county town and borough of Stafford; the city of Lichfield; the old boroughs of Newcastle-under-Lyme, and Tamworth; and the new parliamentary boroughs of Stoke, Walsall, and Wolverhampton; and the market-towns of Bilston, Burslem (included in the borough of Stoke), Burton-upon-Trent, Cheadle, Eccleshall, Hanley, and Lane End, included in the new borough of Stoke, Leek, Longnor, Rugely, Stone, Tunstall (included in the borough of Stoke), Uttoxeter, and Wednesbury. Some of these are described elsewhere. [BILSTON; BURSLEM; BURTON; LICHFIELD; NEWCASTLE-UNDER-LYME; STOKE; TAMWORTH; WALSALL; WOLVERHAMPTON.]

The town of Dudley, which was made a parliamentary borough by the Reform Act, is in an insulated part of Worcestershire, in the midst of the Staffordshire iron-district, to which virtually it belongs. [DUDLEY.]

Abbots Bromley, Betley, Brewood, Cannock, Penkridge, and Tutbury, were formerly market-towns.

Stafford is in the hundred of Pyrehill (southern division), on the north bank of the Sow. We are not aware that there is any historical notice of this place before the year 913, when Ethelfleda, 'lady of Mercia,' built a fort here to keep the Danes of the neighbourhood in check. (*Saxon Chronicle.*) The early history of the town is obscure. In 'Domesday' it is mentioned under the names of Statford and Stadford, and is called a borough. There was a castle near it in the middle ages. In the civil war of Charles I. the Royalists, after the capture of Lichfield Close by the Parliamentarians, retired to Stafford; and an indecisive battle was fought at Hopton Heath, two or three miles from the town, March 19, 1643, in which the earl of Northampton, the Royalist commander, was killed. The town, which was walled, was subsequently taken by the Parliamentarians under Sir Wm. Brereton: the castle was also taken, but at a later period. The walls have been so entirely demolished, that no trace of them remains. The castle, which is a mile and a half south-west of the town, in Castle Church parish, has been rebuilt quite of late years, or is now rebuilding. The principal line of building in the town is formed of two streets, called Gate Street and Gaolgate Street, in which are two openings, Market Square and Gaol Square. The line is prolonged northward through what appears to have been a suburb, by Near and Far Foregate Streets; and southward by the suburb of Forebridge, separated from the town by the Sow. The town is well supplied with water, and the streets are paved and lighted under the provision of a local act, except some, which are exempt from the operation of the act, and are kept in repair by the corporation. The houses are in general well built, mostly of brick, roofed with slate. Over the Sow is a neat bridge. There is another bridge, called Broad Eye Bridge, west of the town. The county-hall is a spacious building of stone, occupying one side of the Market Square. The county gaol and house of correction and the county infirmary are on the north side of the town; and the county lunatic asylum is on the north-west side: the last is a spacious building, well adapted to the purposes of the establishment, which is admirably conducted. There are two churches. St. Mary's, formerly collegiate, is a large and fine cross-church, with an octagon tower at the intersection of the nave and transept: it consists of a nave and two aisles, a chancel with side aisles, and a transept, which is 100 feet long and 25 feet broad. Most of the piers and arches of the church are of early English date, or belong to an early period of the decorated English style: there are some good windows of the decorated period, but the east window and some others are of perpendicular character. The upper part of the tower is of late date. The church of St. Chad is smaller, and has a chancel of Norman architecture, with an east window of modern date, a modern nave, and a tower, between the nave and chancel, of perpendicular character. Owing to the friable nature of the stone, the ornamental work of this tower is going to decay. There is a Roman Catholic chapel in the suburb of Forebridge, and there are meeting-houses for Methodists of different connections, Independents, and Quakers.

The borough comprehends the parishes of St. Mary and St. Chad (which are united for secular purposes), and has an area of 2510 acres: the population, in 1831, was 6956. The suburb of Forebridge is in the parish of Castlechurch, in the eastern division of the hundred of Cuttlestone, which parish had, in 1831, a population of 1374; but what portion is to be assigned to Forebridge we have no means of ascertaining. The principal manufacture of the town is that of shoes, which, in 1831, employed 800 men: the shoes are chiefly for the London market or for exportation. A considerable quantity of leather is tanned in or round the town. The market is on Saturday; and there are five yearly fairs, chiefly for horses and cattle. The Staffordshire and Worcestershire Canal and the Grand Junction Railway pass near the town.

The assizes and quarter-sessions for the county are held in the town; also the court of election for the members for the northern division of the county, for which it is also a polling-station.

Stafford has sent members to parliament since 23 Edward I. By the Boundary Act the suburb of Forebridge was added to the previously existing borough for parliamentary purposes. The number of voters in 1835-6 was 1271, viz. 421 ten-pound householders, and 850 freemen: in 1839-40 it was 1265, viz. 390 ten-pound householders, and 875 freemen. The corporation was dissolved by the result of some legal proceedings, A.D. 1826; but a new charter was speedily obtained, which is now (except where altered by the Municipal Reform Act) the governing charter. By the Municipal Reform Act the extended parliamentary boundary was adopted for municipal purposes, and the borough was divided into two wards: it has six aldermen and eighteen councillors, and a commission of the peace. The borough quarter-sessions and court of record have fallen into disuse, and there is no borough gaol: offenders are sent to the county for trial. Petty-sessions are however held.

The living of St. Mary's is a rectory, of the clear yearly value of 221*l*., with a glebe-house: that of St. Chad is a perpetual curacy, of the clear yearly value of 85*l*.

There were in the borough, exclusive of the suburb of Forebridge, in 1833, five dame-schools, with about 80 children of both sexes; a well-endowed free grammar-school, with 16 boys; a national school, with 100 boys and 90 girls, and six other day-schools, with 133 boys and 58 girls; four boarding and day-schools, with 106 boys and 39 girls; and three Sunday-schools, with 711 children.

Cheadle is in the hundred of Totmonslow (southern division), 14 miles north-north-east of Stafford. It is called Cedla in 'Domesday.' The town is just within the moorland district of North Staffordshire, and is situated in the midst of hills, whose former barrenness has been covered by recent plantations of timber-trees. Several roads converge at the town, which is irregularly laid out, and consists of indifferently built houses. It is supplied with water from the Tean brook, which flows near it, and ultimately joins the Churnet. Close to the town, on the west and north-west, are hills which command a tolerably extensive prospect; and one of which, Monkhouse, affords a favourite walk. The church has suffered much from mutilation and alteration: the east end has been a good specimen of decorated English architecture; but the arch of the fine east window has been altered, and the tracery mutilated: there are some good windows of decorated character. There are places of worship for Roman Catholics, Wesleyan Methodists, Methodists of the New connection, and Independents. The area of the parish is 5730 acres: the population in 1831 was 4119, of which one-fourth or one-fifth was agricultural. Brass wire and tape are manufactured, and nearly 100 men were in 1831 employed in coal-mines in the parish. The market is on Friday, and there are four yearly fairs. The Caldon canal passes along the valley of the Churnet two or three miles east of the town, and a railroad has been made from the collieries in the immediate neighbourhood of the town to the canal. The living is a rectory in the archdeaconry of Stafford, in the diocese of Lichfield and Coventry, of the clear yearly value of 438*l*., with a glebe-house: the rector presents to the perpetual curacy of Oakamoor chapel, which is a dependency of Cheadle. There were in the parish in 1835, one infant-school, partly supported by subscription, with 44 boys and 56 girls; a day-school, with a small endowment, with 40 boys and 20 girls; eleven other day-schools, with 189 boys and 171 girls; and five Sunday-schools, with 351 boys and 365 girls, besides 53 adults.

Eccleshall is in the northern division of Pyrehill hundred, 7 miles north-west of Stafford. The manor belonged antiently to the bishop of Lichfield, and is called Ecleshelle in 'Domesday,' where the owner is termed Episcopus de Cestre, Bishop of Chester, the see having been just before removed from Lichfield to Chester, where however it remained only a short time. The bishops had a mansion here, which in the reign of John was by the king's licence made an embattled castle. It was garrisoned by the Royalists in the civil wars of Charles I., and stood a siege before it was taken by the Parliamentarians: it was subsequently repaired, and is still the bishop's residence. The town is on a gently rising ground, on the south bank of the river Sow, and consists of well and regularly built houses. The church is a large antient building. There is an Independent meeting-house. The area of the parish is 20,930 acres, divided into twenty townships, and one chapelry (Chorlton): the population in 1831 was 4471: the town division contains 1850 acres, with a population in 1831 of 1285. The market is on Friday; and there are four yearly fairs for sheep, cattle, and horses. The living is a vicarage, of the clear yearly value of 170*l*., with a glebe-house, in the archdeaconry of Stafford and diocese of Lichfield. There were in 1833, in the whole parish, eight day or boarding and day schools, with from 207 to 227 children of both sexes; besides a day and Sunday national school, with 221 children daily, and 297 on Sunday, and two Sunday-schools, with 72 children.

Hanley and Lane-End are noticed elsewhere. [STOKE.]

Leek is in the northern division of Totmonslow hundred, 23 miles north-north-east from Stafford. The town is pleasantly situated on an eminence the streets are well paved, and lighted with gas. The church, which stands on an eminence, is an old building, and has a tower with eight pinnacles. It contains, amid many alterations and additions some antient work worthy of notice. There are places of worship for Quakers, Independents, and Wesleyan Methodists. The area of the parish, which extends into the southern division of the hundred, is 34,370 acres: the population, in 1831, was 10,780; the township of Leek and Lowe (in which the town stands) contained 6374 inhabitants. The chief manufacture of the town is of silk, especially ribands; 559 men were, in 1831, employed in manufactures, besides women and children. The Caldon Canal passes near the town, with which it communicates by a short cut. The market is on Wednesday, and there are seven yearly fairs, chiefly for cattle. The living is a vicarage, of the clear yearly value of 218*l*., with a glebe-house; and the vicar presents to three of the four perpetual curacies of the chapels in the parish. There were, in 1833, in the township seventeen day or boarding and day schools (one of them having a school-house and a trifling endowment), with 244 boys and 171 girls; and five Sunday-schools, with 761 boys and 796 girls. There was antiently a Cistertian abbey, called Dieulacres, a short distance north of the town, the yearly revenues of which at the dissolution were 243*l*. 3*s*. 6*d*. gross, or 227*l*. 5*s*. clear. There are some remains of the buildings. Lord Chancellor Parker, first earl of Macclesfield, was a native of Leek.

Longnor is in the northern division of the hundred of Totmonslow, 33 miles north-north-east of Stafford, through Leek. The town is on the north-east bank of the river Manifold near its source, and is very small. It has a neat chapel, a stone edifice, with a lofty pinnacled tower, and a place of worship for Wesleyan Methodists. The chapelry of Longnor is a subdivision of the parish of Allstonefield, and has an area of 850 acres; the population, in 1831, was 429. There is a market on Tuesday, and there are eight yearly fairs. The perpetual curacy of the chapel is in the gift of the vicar of Allstonefield; its clear yearly value is 102*l*. The chapelry contained, in 1833, two dame-schools, with 40 children; one day-school, having a small endowment, with 30 children, chiefly boys; and one Sunday-school, with about 100 children.

Rugely is in the eastern division of Cuttlestone hundred, nine miles east-south-east from Stafford on the road to Lichfield. The town, which is near the north-eastern border of Cannock Chase, is irregularly laid out, but is remarkably clean and of respectable appearance; some of the streets of later formation are lined with houses of a superior character. The church has been rebuilt of late years, but the tower and chancel of the old church still remain: the chancel is used for a school-room. There is an Independent meeting-house; and at Brereton, about a mile south-east of the town, is a Wesleyan chapel. The parish has an area of 7120 acres, with a population, in 1831, of 3165. There are some iron-works in the town, and at Brereton, in the parish, are some coal-pits. The market is on Tuesday, and there are three yearly fairs, one a large horse-fair, and another a large horse, cattle, and sheep fair. The Grand Trunk canal passes the town; and the Trent, which however is not here navigable, flows about a quarter of a mile to the north-east of it. There is a railroad from the Brereton coal-pits to the canal. The living is a vicarage, in the peculiar jurisdiction of the dean and chapter of Lichfield, of the clear yearly value of 213*l.*, with a glebe-house. There were in the parish, in 1833, two dame-schools, with 40 children; a well-endowed grammar-school with 48 boys; another school, with a small endowment, with 60 boys; a national school, and a charity school with 24 boys and 125 girls; six other day-schools, with 30 boys, 15 girls, and 64 children of sex not distinguished; two boarding and day schools, with 52 girls and 17 boys; and two Sunday-schools, with 210 children.

Stone is in the southern division of Pyrehill hundred, seven miles north by west of Stafford. There was a very antient monastery at this place, founded, it was said, by Wulfhere, king of Mercia, or his queen Ermenilda, in honour of his two sons, whom, before his own conversion, he had murdered for embracing Christianity. Wulfhere is said to have placed secular canons here; but these being dispersed, some nuns occupied the place, who were removed in the time of Henry I. to make room for some regular canons of St. Austin from Kenilworth Priory, to which this house was for a time a cell, but afterwards became independent. The yearly revenue at the dissolution was 129*l.* 2*s.* 11*d.* gross, or 119*l.* 14*s.* 11½*d.* clear. The town is on a rising ground on the left or north-eastern bank of the Trent, over which, on the Stafford road, there is a bridge; the principal street is along the road from London to Liverpool, and is paved. The church is a modern building at the south-east end of the town, and near it are some remains of the antient monastery. There are places of worship for Independents and Wesleyan Methodists. The parish, including the chapelry of Normicott, has an area of 20,030 acres; the population, in 1831, was 7808. The principal branch of industry is shoemaking, and there are some breweries and mills. The Grand Trunk canal passes near the town. The market is on Tuesday, and there are five great markets or fairs in the year. The living is a perpetual curacy of the clear yearly value of 214*l.*, with a glebe-house: there are three chapels in the parish. There were, in 1833, twenty day or boarding and day schools, with 425 boys, 301 girls, and 44 children of sex not stated; one of them was a national school, with 120 boys and 90 girls, and several of the others were assisted by endowment or contribution. There were also three Sunday-schools, with 355 boys and 306 girls.

Tunstall is described elsewhere. [STOKE-UPON-TRENT.]

Uttoxeter is in the southern division of Totmonslow hundred, 13 miles north-east from Stafford. The etymology of the name (which is popularly shortened in pronunciation into Uxeter) is uncertain; it is written Wotochshede in 'Domesday.' Uttoxeter stands on a rising ground near the river Dove, which here separates Staffordshire from Derbyshire, and is crossed by a handsome stone bridge. The town is irregularly laid out; the three principal streets meet in the market-place; the houses are generally well built. The church has been rebuilt of late years, but the lofty tower and spire of the former edifice remain: there are places of worship for Wesleyans, Baptists, Independents, and Quakers. The parish has an area of 8920 acres, and had, in 1831, a population of 4864. There are a number of iron-forges round the town, and the neighbourhood contains much fine grazing-land. The market is on Wednesday, and is well attended: there are several yearly fairs. The Caldon Canal ends at Uttoxeter. The living is a vicarage, of the clear yearly value of 136*l.*, with a glebe-house. There were in the parish, in 1833, a day and Sunday national school, with 80 boys and 56 girls in the week, and about 50 children in addition on Sundays; fourteen other day-schools, one of them having a small endowment, with 163 boys and 191 girls; and two Sunday-schools, with 143 boys and 137 girls.

Wednesbury (commonly pronounced Wedgebury) is in the southern division of Offlow hundred, 19 miles south-south-east from Stafford, in the centre of the four great towns, Birmingham and Wolverhampton, Walsall and Dudley. The name is supposed to incorporate that of the Saxon god Woden: the same element appears in Wednesfield in this neighbourhood. Ethelfleda, 'Lady of Mercia,' sister of Edward the Elder, built a castle here, A.D. 914. The town is called in 'Domesday' Wednesberie. It stands on the slope of a hill, and is irregularly laid out. The church occupies the summit of the hill, where Ethelfleda's castle formerly stood: it is a tolerably spacious building, consisting of a nave with side aisles, a chancel, a chapel on the south side at the eastern end of the nave, and a western tower. The east end of the chancel is a semi-octagon, and is, with most other parts of the church, of perpendicular character. The western tower is square, with four pinnacles, and a lofty octagonal spire: it has a peal of eight bells. There are some antient wooden seats, and a curious moveable wooden reading-desk in the church. There are places of worship for Independents, and for Wesleyan and Primitive Methodists. The area of the parish is 2190 acres: the population in 1831 was 8437. The town is in the heart of the coal and iron district; and a considerable manufacture is carried on of fire-arms, gas-pipes, chains, spades and shovels, locks and keys, hinges, bridle-bits, stirrup-irons, buckles, horse-shoes, coach-ironmongery, screws, files, edge-tools, and machinery. On a rivulet near the town are some corn-mills, and in the neighbourhood numerous coal-pits. There are several branches of the Birmingham canal navigations near the town. The market is on Friday, and there are two yearly fairs. The living is a vicarage, of the clear yearly value of 301*l.* There were in the parish, in 1833, three infant or dame schools, with 49 boys and 37 girls; seven day-schools, with 207 boys and 86 girls (one of these, with 110 children, was supported by private subscription); and four Sunday-schools, with 628 boys and 609 girls.

Abbots Bromley is in the southern division of Pirehill hundred, 12¾ miles east of Stafford, on the road from Uttoxeter to Lichfield. It consists chiefly of one long straggling street of tolerably neat houses, mostly built of brick. The church has been much modernized, but retains some antient portions of decorated English or perpendicular character, and a Norman doorway. The tower is surmounted by a lofty spire. There is an antient building formerly used as a market-house; but the market has been discontinued for several years. The area of the parish is 8360 acres; the population in 1831 was 1621, more than half agricultural. The shoe-manufacture, which was formerly carried on, has declined, but there is some malting carried on. There are a free-school and an almshouse in the village.

Betley is in the northern division of Pyrehill hundred, about 23 miles north-north-west of Stafford, through Stone and Newcastle. It is a neatly built place, in a cheerful situation. The market has been given up for several years, and the population of the whole parish (the area of which is 1480 acres) was, in 1831, only 870. There are considerable market-gardens round the village, from which Newcastle is supplied with vegetables. There are two national schools, one of them with a small endowment.

Brewood is the eastern division of Cuttlestone hundred, 10½ miles south-by-west of Stafford. The parish has an area of 11,950 acres; the population in 1831 was 2799. At that time 278 men were employed on the Birmingham and Liverpool canal, which passes close to the village; and 191 men in the manufacture of stock-locks. The village is neatly built, near the west or left bank of the river Penk. The market, which was on Friday, has been discontinued; but there is one yearly fair for cattle. The church has a fine spire, and some other parts of the building are in a good style. There are Independent and Wesleyan meeting-houses. There is a grammar-school with a good endowment. There was formerly a Benedictine nunnery here, the clear yearly revenue of which at the dissolution was 11*l.* 1*s.* 6*d.*

Cannock is in the eastern division of Cuttlestone hundred, about 9½ miles south-south-east of Stafford. The parish has an area of 11,970 acres, with a population in 1831 of 3116; about 87 men were employed in coal-mines, and 71 in manufactures chiefly of edge-tools. Cannock is a small place, and the market has been for many years given up. It gives name to the adjacent extensive waste, Cannock Chase, formerly covered with oaks. Besides the parish-church there are places of worship for the Independents and Wesleyan Methodists. There are several schools in the parish: one a day-school with a small endowment; another a large national school, with a school-house a little out of the village on the Penkridge road.

Penkridge is in the eastern division of Cuttlestone hundred, 6 miles south of Stafford. Some antiquaries, among whom are Camden, have identified this town with the Pennocrucium of the Antonine Itinerary; others fix the site of Pennocrucium at or near Stretton, a township of Penkridge parish, near the line of Watling-Street. The names of Pennocrucium and Penkridge appear to embody the same element Penk, which is the name of the stream near which both Penkridge and Stretton stand. The village consists of two principal streets along the Wolverhampton and Cannock roads, leading down the bridge over the Penk, before reaching which they unite: the lower part of the village is subject to frequent inundations. The church is mostly of perpendicular character; but some parts are of older date, especially the east window, which is of decorated English character, and has fine tracery. The whole parish, with the townships of Hatherton and Kinvaston in Wolverhampton parish, comprehends an area of 18,020 acres, and extends into the western division of the hundred. The population in 1831 was 2991. The market, which was on Tuesday, is now given up. There are three yearly fairs: one of them a large cattle-fair, and another a large horse-fair. There is a national day and Sunday school, and several private day-schools.

Tutbury is in the northern division of Offlow hundred, about 22 miles east of Stafford through Uttoxeter, on the bank of the Dove, which separates Staffordshire from Derbyshire. There is said to have been a fortress here in the Saxon times: at any rate, one was occupied by Henry de Ferieres or Ferrars, to whom the Conqueror had granted large possessions in Staffordshire. The castle is mentioned in 'Domesday;' and Tutbury, there called Toteberie, is described as a borough with a market. This Henry founded a Benedictine or Cluniac monastery (authorities differ as to which it was), the possessions of which were largely augmented by his successors, and were valued at the dissolution at 244*l.* 16*s.* 8*d.* gross, or 199*l.* 14*s.* 10*d.* clear yearly value. Robert de Ferrars, earl of Derby, one of the descendants of Henry, having joined the earl of Leicester and the other insurgent barons in the war against Henry III., lost his castle of Tutbury, which was taken by Prince Edward; and, in consequence of his subsequent second rebellion, forfeited to the king, by whom it was bestowed on his son Edmund Crouchback. It was subsequently inherited by John of Gaunt, who rebuilt a great part of it, and lived here in great splendour. It was afterwards united with the duchy of Lancaster to the crown, and was one of the places of confinement of Mary Queen of Scots. In the great civil war it was held by the Royalists, and was not taken till the spring of 1646, soon after which it was in great part demolished. The honour of Tutbury comprehended several lordships, manors, towns, villages, and hamlets.

The village of Tutbury is on the slope of the hill that overhangs the valley of the Dove. The ruins of the castle are on the brow of the hill, and are sufficient to show its former magnitude: some parts are of perpendicular and others of earlier date. The 'church is the nave of a much larger building; the north arches are walled up, and the south wall of the south aisle is mostly of later date, with perpendicular windows; the present east end is the arch of the centre tower walled up, and part of the transept pier remains; the piers and arches are Norman, a simple and bold example. The west door, and the arch of a window over it, are very fine: the door is much enriched with beakhead, zigzag, and other Norman enrichments, and part of the arch is worked in gypsum, the ornaments very delicately cut, and retaining much of their original sharpness. The font is a good one, of perpendicular character, but mutilated. The church is a valuable Norman specimen.' (Rickman.) There is a low tower, chiefly of Norman character, at the south-west angle. There are places of worship for Independents and for different branches of the Methodists. The parish has an area of 4110 acres, with a population, in 1831, of 1553. Some cotton-spinning is carried on. The market, formerly on Tuesday, has been given up. There is an endowed school. Tutbury was remarkable for an antient and barbarous custom called 'bull-running,' which consisted of chasing a bull with a soaped tail, turned out antiently by the prior of Tutbury, and subsequently by the grantee of the priory lands. The custom has been abolished for several years. A somewhat similar custom has long existed at Stamford in Lincolnshire. [Stamford.] Tutbury was, early in the present century, the scene of a remarkable imposture: a woman of the name of Ann Moore professed to live with taking any nourishment. She was watched, but without being detected, and her profession of entire abstinence gained credit for six years. At length a stricter watch was kept, and at the end of nine days (April or May, 1813) she was obliged to acknowledge the imposition, and that she had occasionally taken food. The case was however remarkable for the small quantity of nourishment which was taken by her.

There are several villages in Staffordshire, especially in the iron-district, whose manufacturing importance entitles them to special notice.

Sedgley is in the northern division of Seisdon hundred, on the road from Wolverhampton to Dudley, about 3 miles from each: the parish is included in the parliamentary borough of Wolverhampton; it had in 1831 a population of 20,577. [Wolverhampton.]

West Bromwich is in the southern division of Offlow hundred, between Birmingham and Wednesbury, but nearer the latter. The church contains some good antient work. There are meeting-houses for Wesleyans and Independents. The parish has an area of 5380 acres, with a population, in 1831, of 15,327, of whom 1318 men were employed in the manufacture of iron for the forge or workshop, and above 1000 in coal-pits, or in other works connected with these great branches of industry. Sandwell park, one of the seats of the earl of Dartmouth, is near West Bromwich; it occupies the site of a small Benedictine priory. There were, in 1833, two national schools, an endowed day-school, a Catholic school partly supported by subscription, and several private schools.

Kingswinford, or more correctly King's Swinford (Swinford Regis) is in the northern division of Seisdon hundred, about 3 miles or 3½ miles from Stourbridge (Worcestershire), on the road to Wolverhampton. It belonged to the crown at the time of the Domesday Survey, hence its designation of King's Swinford. The old church has some antient portions deserving of notice; and there has been a new church built at Wordsley in the parish, about a mile and a half from the village. There is an Independent chapel at Brierley hill. There are some remains of a Roman camp in the parish; and Holbeach House, where the leaders in the Gunpowder plot were taken, is also in the parish. The area of the parish is 7130 acres: the population in 1831 was 15,156; of whom 500 men were employed in the manufacture of iron goods in great variety; 400 in coal and iron mines; and 1200 in labour of other kinds not agricultural. There were, in 1833, two subscription day and Sunday schools, beside a number of private day-schools and several Sunday-schools.

Tipton is in the southern division of Offlow hundred, about a mile and a half north-north-east of Dudley, in the heart of the iron and coal district. Its importance is quite of modern date, having advanced with those branches of industry to which its situation is adapted. There are numerous coal and iron works, which gave employment, in 1831, to 2200 men. The goods manufactured are similar to those made at Wednesbury. The population of the parish at that period was 14,951: the area of the parish is 3020 acres. Several branches of the Birmingham canal navigations pass through the parish. The old church having become dilapidated, a new church, a neat and commodious brick building, was some time since erected in its place, and the old one allowed to become a ruin; and within the last three or four years, an additional church has been completed. The Wesleyan Methodists and the Independents have each a chapel. There were in the parish, in 1833, six national schools, three for boys and three for girls, attended by nearly 900 children in the week, and by 200 in addition on Sunday. These schools were partly supported by endowment and subscription. There were several Sunday-schools, in which nearly 2200 children in addition were taught. Tipton is also called Tibbington.

Rowley-Regis is in the northern division of Seisdon hundren, about three miles south-east of Dudley. The church contains some good antient work; and there is a place of worship for Baptists. The area of the parish is 3670 acres; the population in 1831 was 7438, of whom 130 men were employed in coal-pits, and above 1000 men in iron-works and the connected branches of industry; the manufactures are similar to those of Wednesbury. There are two day-schools with small endowments, beside private and Sunday schools.

Darlaston is in the southern division of Offlow hundred, a mile and a half north-west of Wednesbury. It has coal-pits and iron-mines, and manufactures of hardware. There are a parish church, a brick building of the sixteenth century, and Independent and Wesleyan meeting-houses. A branch of the Birmingham canal navigations passes near the village. The parish has an area of 770 acres. The population in 1831 was 6647, of whom 678 men were employed in manufactures, chiefly or wholly of iron and hardwares, and 357 men in coal-pits and quarries. There are two national schools, which are partly supported by subscription. There is a township of Darlaston in the parish of Stone, which is sometimes confounded with this.

Handsworth is in the southern division of Offlow hundred, about two miles north-west of Birmingham. The church has been mostly rebuilt; only the tower and a small part of the wall of the antient edifice remain. In the church are monuments to Messrs. Boulton and Watt, the well-known manufacturers of Soho. Soho park and works are in this parish. The area of the parish is 7720 acres. The population in 1831 was 4944, of whom 112 men were engaged in manufactures. The Roman Catholic College of St. Mary Oscott is in the parish; and there are a charity-school and a national-school, besides several private schools. Harborne lies in the same division of the same hundred, and about the same distance as Handsworth south-west of Birmingham. The church is a modern building, but some of the antient buttresses and the tower of the older structure remain: the tower is of late perpendicular date. The parish, including the chapelry of Smethwick, has an area of 4000 acres: the population, in 1831, was 4227, of whom above 330 men were employed in manufactures.

Amblecoat, in the parish of Old Swinford (the greater part of which parish is in Worcestershire), close to Stourbridge; Clent, in a detached portion of the county, south of Stourbridge; Kinfare, west of the same town, Wombourne, and Tettenhall, all near the south-western border of the county, and in the hundred of Seisdon, participate more or less in the iron and hardware manufacture, which gave employment in them, in 1831, to 500 men.

Norton-in-the-Moors, in the neighbourhood of Burslem, participates in the coal-works and earthenware manufactures of the Pottery district. The parish has an area of 3940 acres: the population, in 1831, was 2407, of whom 40 were engaged in manufacture, and probably 200 in coal-pits. At Checkley, or rather at the hamlet of Tean in Checkley parish, two miles and a half south-east of Cheadle, on the road to Uttoxeter, is a considerable tape-manufactory: the population of the parish, in 1831, was 2247, of whom 106 men were employed in manufacture, and 42 in stone-quarries. Some cotton-spinning is carried on at Yoxall, near Burton-on-Trent.

*Divisions for Ecclesiastical, Legal, and Parliamentary purposes.*—The county of Stafford is in the diocese of Lichfield, and constitutes the archdeaconry of Stafford. It is divided into four rural deaneries, as follows:—

| Deaneries. | | Rectories. | Vicarages. | Perp. Curacies. | Chapelries. | Donatives. | Chapels not classified. | Total. |
|---|---|---|---|---|---|---|---|---|
| Lapley and Treizull . . . . | S.W. | 10 | 10 | 24 | 3 | 0 | 4 | 51 |
| Leeke and Alton, or Alveton . . | N.E. | 9 | 9 | 19 | 0 | 2 | 0 | 39 |
| Newcastle and Stone . . . | N.W. | 15 | 18 | 36 | 5 | 0 | 0 | 69 |
| Tamworth and Tutbury. . . | S.E. | 13 | 15 | 34 | 4 | 0 | 0 | 66 |
| | | 47 | 47 | 112 | 12 | 2 | 4 | 225 |

The number of benefices is somewhat less than appears from the above statement (which we borrow from Cox's 'Clergy List,' 1841), owing to some unions having been formed. The residence of the bishop of Lichfield is at Eccleshall.

Staffordshire is in the Oxford circuit: the assizes and quarter-sessions are held at Stafford, where is the county gaol and house of correction. It is said to be capable of holding 325 prisoners in separate cells, and 546 when more than one sleeps in a cell. (*Inspectors' of Prisons Third Report.*) This prison is conducted with care and judgment, and neatness and good order reign almost throughout. There are treadwheels for grinding corn, supplying the prison with water, and cleansing the prison drains; and beside this hard labour, several trades are carried on. (*Ibid.*) There is a county lunatic asylum at Stafford.

The number of representatives returned to parliament by the county and places within it was before the Reform Act ten:—viz. two knights of the shire, and two members each for the city of Lichfield and the boroughs of Newcastle-under-Lyme, Stafford, and Tamworth. By the Reform Act the county was formed into two divisions, and two members allotted to each. The northern division contains the whole hundreds of Pyrehill and Totmonslow, and the northern division of the hundred of Offlow: the place of election is Stafford; and the polling-stations are Stafford, Leek, Newcastle-under-Lyme, Cheadle, and Abbots' Bromley. The southern division comprehends the southern division of Offlow hundred, and the whole hundreds of Cuttleston and Seisdon; the place of election is Lichfield, and the polling-stations are Lichfield, Walsall, Wolverhampton, Penkridge, and King's Swinford. Wolverhampton, Stoke-upon-Trent, and Walsall were made parliamentary boroughs; the first and second to return two members each, the last to return one member. The whole number of representatives sent from the district was thus increased from ten to seventeen.

The constituency at the two periods, 1835-6 and 1839-40, was as follows:—

| | 1835-36. | 1839-40. |
|---|---|---|
| Staffordshire, North | 17,154 | 10,020 |
| „ South | | 8,469 |
| Lichfield . . . . | 914 | 876 |
| Newcastle . . . . | 1,003 | 1,031 |
| Stafford . . . . | 1,271 | 1,265 |
| Stoke-upon-Trent . . | 1,445 | 1,623 |
| Tamworth . . . . | 531 | 501 |
| Walsall . . . . | 679 | 837 |
| Wolverhampton . . . . | | 2,643 |

*History, Antiquities, &c.*—In the earliest period of authentic history Staffordshire appears to have formed part of the territories of the Cornavii, or Carnabii. Under the Romans it was comprehended in the province of Flavia Cæsariensis. The antient roads, Watling Street, Ryknield Street, and the Via Devana (Deva or Chester road) crossed this county.

Watling Street entered it at Faseley, near Tamworth, and ran west-north-west a little to the south of Cannock and Penkridge into Shropshire. The turnpike-road from London to Shrewsbury falls in with Watling-Street on Cannock Chase, and coincides with it through the remainder of its course in this county. The Roman towns of Etocetum and Pennocrucium were on this line of Watling street: the first was at Wall, about two miles south-south-west of Lichfield; the second probably near Stretton, in Penkridge parish, and two or three miles south-west of Penkridge village. At Wall, according to Shaw's account (*Hist. of Staffordshire*), are some remains of walls enclosing two acres of land, called the Castle Croft. Great quantities of foundation stones, pavements of Roman bricks, and other antiquities, have been dug up here. Wall is at the intersection of Ryknield and Watling streets. Pennocrucium we are inclined to fix on the river Penk, near Stretton; this position accords tolerably well with the distances in the Antonine Itinerary from Uriconium (Wroxeter, Salop) and Etocetum, and does not require the corrections which are necessary if Pennocrucium is fixed (as some have proposed) at Penkridge.

Ryknield-Street entered the county across the Dove near Burton, and ran south-west by Burton and Alrewas to Etocetum or Wall, where it crossed Watling-Street; and turning more towards the south, ran by Sutton-Park and Perry-barr common into Warwickshire and Worcestershire. The Ad Trivonam (On-Trent) of Richard of Cirencester, may be fixed between Branston and Burton-upon-Trent.

The Via Devana entered the county across the Trent near Ad Trivonam, and appears to have passed by Uttoxeter, and through the Pottery district into Cheshire. Chesterton, two miles north-west of Newcastle, was probably a Roman station; but we doubt whether it was the Mediolanum of Antoninus and Richard, as some have supposed. The name of Uttoxeter (compare Wroxeter and Exeter) would incline us to suppose that it had been the site of a Roman station, but the form in which the name appears in 'Domesday' (Wotochshede) is not favourable to the supposition.

A Roman road appears to have led from Watling-Street at Etocetum north-west through Chesterton, where it crossed the Via Devana into Cheshire. Another road, running westward from Little Chester, near Derby, crossed the Dove, and ran towards Cheadle: it probably joined the Via Devana.

There are traces of camps or other military works supposed to be Roman at Ashwood, near King's Swinford; at

Moreton, between Stafford and Aqualate Mere; at Oldbury, between Birmingham and Dudley; at Aldridge, between Sutton Coldfield and Walsall; and in Arley wood, near Over Arley on the Severn. Roman antiquities have been discovered in various places, especially a large quantity of silver coins at Rowley Regis. There are traces of a bank, ditch, and pallisade, running for a considerable distance northward from Etocetum or Wall.

There are some antient camps, of which it is doubtful if they are British, or belong to the Saxon or Danish periods. One of these, called Castle Old-ford or Old-fort, near Stonall, about four miles south of Lichfield, is very conspicuous. There are others in Beaudesert Park, near Rugely; on Abbots Castle hill, on the Shropshire border, between Wolverhampton and Bridgnorth; and at Barr Beacon, near Walsall. There are tumuli in various parts of the county, some of which are thought to be Roman.

On the conquest of South Britain by the Saxons, the county was included in the kingdom of Mercia, or of the Middle Angles.

When Oswio, of Northumbria, who had slain Penda and subdued Mercia (A.D. 655), granted part of that kingdom to Peada, son of Penda, the county was divided, Oswio retaining the part north of Trent, and resigning the rest to Peada. Under these princes the Christian religion was established in Mercia, and a bishop appointed. On the death of Peada (A.D. 656), Oswio resumed the whole; but when the Mercians rebelled, and chose Wulfhere for their king, they seem to have recovered Staffordshire. Wulfhere restored paganism, but being subsequently converted to Christianity, the bishopric of Mercia was re-established, and fixed at Lichfield. The antient camp at Berty-bank, near Stone, is traditionally said to have been the residence of Wulfhere. In the year 716, Osred, king of the Northumbrians, was slain in battle, at Mere (Hen. Hunt., lib. iv.), which some suppose to be Maer, between Newcastle-under-Lyme and Drayton. Other accounts [NORTHUMBERLAND, vol. xvi., p. 318] lead to the supposition that he died in battle against the Picts.

There are the traces of an antient camp or fort, called the Burgh or Braff, near Maer. It is to be observed that although Staffordshire was wholly included in the Mercian kingdom, in the wide application of that term, the part north of the Trent was comprehended in what was sometimes termed Southumbria (Matt. Westmonast.): the southern part appears to have been included in the territory of the Middle Angles. The Mercian kings appear often to have resided at Tamworth.

In the division of the island between the Saxons and Danes, in the time of Alfred, Staffordshire was partly included in the Danelagh or Danish territory, Watling Street being the boundary; but the whole was recovered by Alfred's successors.

In the wars of Edward the Elder, son of Alfred, with the Danes (A.D. 910), a battle was fought at Tettenhall Regis, near Wolverhampton, in which the Danes were beaten; and in the following year they sustained another great defeat at Wednesfield: two years after (A.D. 913) Ethelfleda, 'Lady of Mercia,' sister of Edward, built forts at Tamworth and Stafford; and next year one at Eadesbyrig, which some suppose to be Wednesbury. Ethelfleda died at Tamworth (A.D. 920), at which town Edward assumed the direct government of Mercia. The Saxon chronicle, in recording this event, calls Tamworth a burgh or borough. In the divisions of the kingdom between Edmund I. and Anlaf (A.D. 940-943), the county was divided between the Saxons and Danes, the part north of Watling-Street being assigned to the latter. In the war of Ethelred II. with the Danes (A.D. 1016), his son Edmund marched through the county, ravaging it as he went. Under Edward the Confessor there was an earl of Staffordshire. At what time the county was formed is not known; possibly when this part of Mercia came under the power of the West-Saxon kings. There are several camps which are supposed to be of Saxon or Danish origin.

In the reign of Henry I. Staffordshire was ravaged by Robert de Belesme, who supported the claim of Robert of Normandie to the crown. In the troubles of the reigns of John and Henry III., there is no record of any remarkable event connected with it; but in those of Edward II. the earls of Lancaster and Hereford, then in insurrection, were defeated by the king at Burton-upon-Trent. In the insurrection of the Percys against Henry IV. a sharp encounter took place near Mavesyn Ridware, on the banks of the Trent (A.D. 1403), between two Staffordshire knights and their retainers, who had embraced opposite sides. Sir William Handsacre, the insurgent commander, was defeated and slain, and the victor fell shortly after in the fight at Shrewsbury.

In the War of the Roses, the Yorkist earl of Salisbury, marching from the north towards London (A.D. 1459) with 5000 men, was intercepted at Blore Heath, on the western side of the county, between Drayton (Salop) and Eccleshall, by 10,000 Lancastrians under Lord Audley. The good generalship of Salisbury secured the victory: Lord Audley was killed, with all his chief officers and a fourth part of his army. A stone pedestal, surmounted by an antient wooden cross, marks the field of battle. Richard III. was with his army at Tamworth just before the battle of Bosworth Field (A.D. 1485).

The principal monuments of the middle ages are ecclesiastical. Lichfield Cathedral is the most important. Croxden Abbey, between Cheadle and Uttoxeter, is a fine ruin in a narrow valley watered by a small rivulet. The west end of the church, the south wall and transept, part of the cloister, the walls of the chapter-house, and some parts of the offices, may be traced. The general character of the architecture is early English.

Mary, queen of Scots, was imprisoned for some time, under the care of the earl of Shrewsbury, at Tutbury Castle; also at Chartley, from whence she was removed by Abbots Bromley and Burton to Fotheringhay in Northamptonshire. Holbeach House, where most of the Powder-Plot conspirators were taken or killed, is in Staffordshire, between Wolverhampton and Stourbridge.

In the great civil war the county generally embraced the side of the parliament, though several families sided with the Royalist party. Some Royalists, under the earl of Chesterfield, garrisoned Lichfield Cathedral and Close; but it was taken by the Parliamentarians, though with the loss of their general, Lord Brook (March, 1643). This post was retaken about a month after by Prince Rupert, who also took Burton: in the interval the Parliamentarians under Sir William Brereton and Sir John Gell had a severe but indecisive battle with the Royalists, at Hopton Heath, near Stafford. The Parliamentarians occupied the towns of Stafford and Wolverhampton, and subsequently took Eccleshall Castle, and took and demolished Stafford Castle: they also besieged Tutbury Castle, but without success. Their horse had the advantage in a skirmish near Leek, which was one of their posts; and in the latter part of 1643 they gained the victory in two skirmishes with Colonel Hastings, the Royalist commander, in this county. In 1645 the king with his army marched through Staffordshire before the battle of Naseby, and was in it again after the battle. He appears to have had at this time two garrisons in the county, Lichfield Close, and Tutbury. Dudley castle, in the insulated portion of Worcestershire, was also held by his adherents; but in the course of this or the following year these all surrendered. After the battle of Worcester (A.D. 1651), Charles II. was at Boscobel House in this county. In the rebellion of 1745 the Pretender's army was at Leek, while that of the duke of Cumberland occupied Stone.

(Shaw's *History of Staffordshire*; Rickman's *Gothic Architecture*; *Parliamentary Papers*; *Ordnance Survey*; *&c.*)

STATISTICS.

*Population and Occupations.*—The population is chiefly employed in trade and manufactures, little more than one-fifth being engaged in agriculture. Staffordshire was the seventh in the list of manufacturing counties in 1831, and ranked the thirty-sixth among the agricultural counties. At that period there were 3781 males aged 20 and upwards, occupiers of land, employing labourers; 3649 occupiers of land not employing labourers; 16,812 labourers employed in agriculture; 26,755 persons employed in manufactures; 24,766 employed in retail trades and handicrafts; 3569 capitalists, bankers, and members of the professions; 22,690 non-agricultural labourers; 1959 other males twenty years of age; 1959 male domestic servants; 12,739 female servants. The places in which manufacturing employment is chiefly carried on are given in the following extract from the 'Census of 1831:'—The southern part of the county of Stafford is eminent for its manufacturing industry in producing iron and hardware (of which iron is the material); the north-west part of the county produces earthenware from the potteries in such quantity and excellence, as to have acquired the distinctive appellation of Staffordshire

Ware. Both these manufactures are, comparatively speaking, of modern date; and in crossing the southern part of the county from Birmingham through Wolverhampton, the activity displayed in the coal-field between Wednesbury and Bilston, in the conversion of iron-ore, is concentrated beyond example. Eastward of this, at West Bromwich above 1000 men are employed in the further preparation of iron for the forge and the workshop; 2200 men are employed at Tipton, 1200 at Walsall and the foreign of Walsall, 740 at Willenhall, 157 at Wednesfield, 444 at Wednesbury, and 200 at Rowley-Regis, in making guns and other fire-arms, gas-tubes, chains, spades and shovels, locks and keys, hinges, bridle-bits, stirrup-irons, buckles, screws, files, edge-tools of all kinds, and in producing machinery; and at Smithwick and Handworth about 150 men are so employed. Wolverhampton, which besides its comprehensive business as the chief town of a manufacturing district, contains nearly 2000 men, who, in addition to the articles above mentioned, are employed in making domestic fire-arms, tinned and japanned iron-ware. Sedgley contains 500, and Kingswinford 200 manufacturers of the same kind; at Tettenhall more than 60, and at Brewood about 130 men are employed in the less refined manufacture of stock-locks. Darlaston contains nearly 500 men occupied in hardware workmanship; and in most of the places thus enumerated, as well as in many populous villages, the more domestic manufacture of iron nails furnishes employment to 2500 men and part of their families. The other important manufacture of Staffordshire, unrivalled in amount, but not surpassing in beauty and excellence the china-ware of Worcester, is spread over the vicinity of Newcastle-under-Line. Employed in this manufacture, Burslem contains 900 men and their families; Skelton a larger number; Longton and Lane-end nearly 1000; Parkhall 700; Hanley, 360; Fenton-Calvert, 300; Sneyd, 125: these places, including a few adjacent villages which partake of the earthenware manufacture, contain about 4400 men and their families so employed. In the town of Stafford 800 men are employed in shoe-making, and these, in so far as the article produced is not consumed in the town and neighbourhood, may properly be deemed manufacturers. Burton-upon-Trent and its suburb (Burton-Extra), Yoxall, and Tutbury, partake in a small degree of the cotton-spinning trade as well as that of hardware.

The population of Staffordshire, at the decennial periods when the census was taken, was as under;—

| | Males. | Females. | Total | Increase per cent. |
|---|---|---|---|---|
| 1801 | 118,698 | 120,455 | 239,153 | .. |
| 1811 | 148,073 | 147,080 | 295,153 | 23·4 |
| 1821 | 171,668 | 169,372 | 341,040 | 17·1 |
| 1831 | 206,921 | 203,591 | 410,512 | 18·6 |
| 1841 | 258,729 | 251,477 | 510,206 | 24·2 |

While the population of England has increased 79·9 per cent. during the above forty years, that of Staffordshire has increased 113·3 per cent. The details of the census of 1841 are not yet fully published; but the number of houses was:—97,676 inhabited; 5455 uninhabited; and 899 building.

The population, &c. of each hundred and borough, as taken in 1831, was as follows:—

| HUNDREDS, BOROUGHS, &c. | HOUSES. Inhabited. | Families. | Building. | Uninhabited. | OCCUPATIONS. Families chiefly employed in agriculture. | Families chiefly employed in trade, manufactures, and handicraft. | All other Families not comprised in the two preceding classes. | PERSONS. Males. | Females. | Total of persons. | Males twenty years of age. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cuttlestone, E. & W. . | 5,050 | 5,532 | 14 | 167 | 2,649 | 1,744 | 1,139 | 13,950 | 12,968 | 26,918 | 7,706 |
| Offlow, N. & S. . . . | 21,076 | 22,327 | 176 | 1,248 | 4,419 | 13,018 | 4,890 | 57,816 | 55,205 | 113,021 | 27,586 |
| Pirehill, N. & S. . . | 20,319 | 22,047 | 140 | 813 | 4,973 | 11,179 | 5,895 | 52,584 | 52,531 | 105,115 | 25,746 |
| Seisdon, N. & S. . . . | 18,565 | 19,910 | 149 | 1,265 | 1,925 | 10,648 | 7,337 | 49,106 | 48,185 | 97,291 | 23,747 |
| Totmonslow, N. & S. . | 8,959 | 9,289 | 58 | 495 | 3,853 | 3,840 | 1,596 | 23,091 | 23,429 | 46,520 | 11,276 |
| Lichfield, City . . . . | 1,286 | 1,505 | 5 | 28 | 257 | 707 | 541 | 2,984 | 3,515 | 6,499 | 1,630 |
| Newcastle-under-Lyne, Borough . . . . . | 1,578 | 1,676 | 12 | 21 | 1 | 1,587 | 88 | 3,831 | 4,361 | 8,192 | 2,051 |
| Stafford, Borough . . | 1,216 | 1,307 | 19 | 51 | 79 | 925 | 303 | 3,559 | 3,397 | 6,956 | 1,890 |
| Total . . . . . | 78,049 | 83,593 | 573 | 4,088 | 18,156 | 43,648 | 21,789 | 206,921 | 203,591 | 410,512 | 101,632 |

*County Expenses, Crime, &c.*—Sums expended for the relief of the poor:—1748-49-50 (annual average), 9812*l.*; 1776, 32,088*l.*; 1783-84-85 (average), 40,964*l.* The sums expended at the four dates of

| | £. | | s. | d. | |
|---|---|---|---|---|---|
| 1801 were | 83,411, | being | 6 | 11 | for each inhabitant. |
| 1811 . . | 124,765 | „ | 8 | 5 | „ |
| 1821 . . | 133,702 | „ | 7 | 10 | „ |
| 1831 . . | 132,887 | „ | 6 | 5 | „ |

And in each of the following years ending 25th March, the expenditure was as under:—

| 1835. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|
| £104,245 | £92,176 | £83,817 | £81,183 | £82,971 | £92,835 |

The expenditure in the last of the above years would average about 3*s.* 8½*d.* for each inhabitant, which is much lower than for the whole of England and Wales. The expenditure for the year ending 25th March, 1834, was 120,512*l.* The saving effected between that year and 1840 amounted to 42,934*l.*, or 29 per cent.; namely, under the head of relief and maintenance, 27,677*l.*, or 23 per cent.; in suits of law, &c., 5021*l.*, or 73 per cent.; and in miscellaneous expenses, 10,236*l.*, or 49 per cent. The number of poor-law unions is 16, comprising a population of 404,141, according to the census of 1831: there are 22 parishes with a population of 6371, which are not in any union. The number of paupers relieved during the quarter ending Lady-day, 1840, was 19,047 (3777 in-door, and 15,270 out-door), being 5 per cent. of the population, the proportion for England being 8·6 per cent. The illegitimate births in 1830 were 736, or 1 in 17; in England 1 in 20. Bastard children chargeable on the poors'-rate in 1835-6, 2255, or 1 in 182;—in England 1 to 215. Lunatics and idiots chargeable on the same fund in 1836, 261, or 1 in 1573;—in England 1 in 1033. Proportion per cent. of persons married under 21 years of age in 1840, 13·4;—in England and Wales, 9·6 for the two sexes.

The annual value of real property in the county assessed to the property-tax in 1815, was 1,150,284*l.* The sum raised for poor-rate, county-rate, and other local purposes, for the year ending 25th March, 1833, was 175,591*l.*, levied upon the under-mentioned descriptions of property:—

| | |
|---|---|
| On land . . . . | £100,439 |
| Dwelling-houses . . | 48,804 |
| Mills, factories, &c. . . | 11,739 |
| Manorial profits, navigation, &c. . | 14,607 |
| Total | £175,591 |

The amount expended was—

| | |
|---|---|
| For the relief of the poor . . . . | £124,870 |
| In suits of law, removal of paupers, &c. . | 8,400 |
| For other purposes . . . . . . | 44,313 |
| Total money expended | £177,583 |

The county expenditure in 1834, exclusive of that for the relief of the poor, was 15,938*l.* disbursed as follows:—

| | |
|---|---|
| Bridges, building, repairs, &c. . | £1,442 |
| Gaols, houses of correction, and maintaining prisoners . . . . | 4,459 |
| Shire-hall and courts of justice, building, repairs, &c. . . . . | 240 |
| Lunatic asylums . . . . . | 12 |

| | |
|---|---|
| Prosecutions | 4,237 |
| Clerk of the peace | 1,054 |
| Conveyance of prisoners before trial | 918 |
| Conveyance of transports | 550 |
| Vagrants, apprehending and conveying | 806 |
| Constables, high and special | 213 |
| Coroner | 571 |
| Miscellaneous | 1,423 |
| Total | £15,938 |

The county-rate levied at different periods during the last half-century, and the principal disbursements, so far as they can be made out, are shown in the following table:—

| | 1801. £ | 1811. £ | 1821. £ | 1831. £ | 1838. £ |
|---|---|---|---|---|---|
| Income | 13,218 | 19,568 | 28,004 | 24,062 | 18,367 |
| Expenditure:— | | | | | |
| Bridges | 4,297 | 7,471 | 1,989 | 8,765 | 638 |
| Gaols | 102 | 129 | 1,459 | 704 | 190 |
| Prisoners' maintenance | 2,534 | 2,372 | 4,638 | 7,230 | 1,005 |
| Prosecutions | 618 | 854 | 2,382 | 6,220 | 6,308 |
| Constables and vagrants | 474 | 526 | 1,368 | 2,344 | ... |

In 1839 the length of streets and highways in the county, and the expenditure thereon, were as under:—

| | | Miles. |
|---|---|---|
| Streets and roads repaired under local acts | | 30 |
| Turnpike roads | | 601 |
| All other highways | | 2,347 |
| | | 2,980 |
| Amount of rates levied | | £23,138 |
| Expended in repairs of highways | £22,127 | |
| Law and other expenses | 410 | |
| Total expenditure | | 22,537 |

The number of turnpike trusts in the county in 1839 was 47; income from tolls, 54,648*l.*; from parish compositions, in lieu of statute duty, 212*l.*; and the total income (including 278*l.* borrowed) was 58,128*l.*; the total expenditure for the same year being 59,752*l.* The assets, including arrears of income, amounted to 16,293*l.*; the debts to 217,264*l.* In 1836 the debt was equal to 4·43 years of the annual income;—the proportion for England being 4·56 years; the proportion of unpaid interest to the total debt was 20 per cent., the average for England being 12 per cent.

In 1839 the church rates levied amounted to 8,503*l.*; and with 4772*l.* derived from other sources, were applied to defray expenses connected with the established church: in 1832 the sum derived from 'other sources' included 475*l.* from estates and rent charges. The sum expended for the purposes of the establishment amounted to 12,614*l.* in 1839, out of which sum 6695*l.* were for repairs of churches.

*Crime.*—Number of persons charged with criminal offences in the four septennial periods ending 1819, 1826, 1833, and 1840:—

| | 1813-19. | 1820-26. | 1827-33. | 1834-40. |
|---|---|---|---|---|
| Total of each septennial period | 1,907 | 2,295 | 4,415 | 5,330 |
| Annual average | 272 | 327 | 630 | 790 |

The numbers committed, convicted, and acquitted in each year from 1834 to 1839 were as under:—

| | 1834. | 1835. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|---|---|
| Committed | 649 | 715 | 636 | 909 | 768 | 930 | 923 |
| Convicted | 412 | 452 | 395 | 601 | 539 | 589 | 666 |
| Acquitted | 237 | 263 | 241 | 308 | 229 | 341 | 257 |

In 1834 the proportion of persons committed, to the total population of the county, was 1 in 633; and in 1840, allowing for the increase of population, 1 in about 541.

Of 923 criminal offenders tried at the assizes and sessions in Staffordshire in 1840, there were 68 charged with offences against the person; 80 with offences against property committed with violence; 715 (including 572 cases of simple larceny) with offences against property committed without violence; 13 with malicious offences against property; 10 for forgery and uttering base coin; and 37 for various misdemeanors, including 29 for riot and breach of the peace. Above seventy per cent. of the offences were those against property committed without violence; and above sixty-one per cent. were cases of simple larceny. Sentence of death was recorded in 8 cases; in 2 execution took place, and in the other 6 the sentence was commuted. Of 666 offenders convicted, including the 8 above-mentioned cases, 20 were transported for life; 1 for above 15 years; 32 for periods varying from 10 to 15 years; 44 from 7 to 10 years; 70 for 7 years, making in all 167 offenders transported; 6 were imprisoned for above 2 years; 9 for a term exceeding twelve months; 61 for above 6 months; and 395 for 6 months and under; and 26 were whipped, fined, or discharged on sureties. The acquittals were 257 in number; in 10 cases there was no prosecution; in 71 no bill was found; and 176 persons were found not guilty on trial. Of the total number committed 783 were males and 140 females: 216 males and 55 females could neither read nor write; 443 males and 169 females could read, or read and write imperfectly; 98 males and 8 females could read and write well; 7 males and 1 female were persons who had received superior instruction; and the state of instruction of 19 males and 7 females was not ascertained. On an average of several years the proportion of uninstructed criminals in this county was 84·9 per cent.; of those instructed 15·1 per cent.;—the average of the former for England and Wales being 89·3 per cent.

*Savings' Banks.*—There are 18 of these institutions in the county; and the number of depositors and amount of deposits on the 20th of November in each of the following years, was as under:—

| | 1833. | 1836. | 1837. | 1838. | 1839. | 1840. |
|---|---|---|---|---|---|---|
| No. of depositors | 8,058 | 10,212 | 10,296 | 11,512 | 11,911 | 12,509 |
| Am. of deposits | £250,617 | £313,073 | £311,723 | £345,457 | £355,870 | £369,151 |

The various sums placed in the savings' banks in 1830, 1834, and 1839, were distributed as follows:—

| | 1830. | | 1834. | | 1839. | |
|---|---|---|---|---|---|---|
| | Depositors. | Deposits. | Depositors. | Deposits. | Depositors. | Deposits. |
| Not exceeding £20 | 3,762 | £27,106 | 4,376 | £32,391 | 6,450 | £47,084 |
| „ 50 | 2,183 | 65,532 | 2,504 | 79,699 | 3,313 | 101,225 |
| „ 100 | 926 | 66,013 | 1,005 | 68,696 | 1,371 | 95,121 |
| „ 150 | 320 | 38,301 | 360 | 43,718 | 479 | 57,825 |
| „ 200 | 129 | 21,980 | 190 | 31,555 | 245 | 41,287 |
| Above 200 | 67 | 15,881 | 46 | 11,778 | 53 | 13,328 |
| | 7,387 | 234,848 | 8,477 | £267,832 | 11,911 | 355,870 |

The deposits of 235 friendly societies, not reckoned above, amounted in 1840 to 48,498*l.*; and 10,200*l.* were invested by 176 charitable institutions.

The state of the election franchise in 1839-40 is shown in the following table:—

| | N. div. | S. div. | Total. |
|---|---|---|---|
| Freeholders of every class | 7,181 | 6,416 | 13,597 |
| Copyholders and customary tenants | 382 | 449 | 831 |
| Leaseholders for life or for a term | 122 | 197 | 319 |
| 50*l.* tenants at will | 2,227 | 1,171 | 3,398 |
| Trustees and mortgagees | 15 | 54 | 69 |
| Qualified by offices | 9 | 12 | 21 |
| Joint and duplicate qualifications | 84 | 170 | 254 |
| | 10,020 | 8,469 | 18,489 |

*Education.*—Summary of the Returns made to Parliament in 1833:—

| | Schools. | Scholars. | Total. |
|---|---|---|---|
| Infant schools | 65 | | |
| Number of children at such schools; ages from 2 to 7 years:— | | | |
| Males | | 744 | |
| Females | | 882 | |
| Sex not specified | | 746 | |
| | | | 2,372 |
| Daily schools | 847 | | |
| Number of children at such schools; ages from 4 to 14 years:— | | | |
| Males | | 15,820 | |
| Females | | 12,199 | |
| Sex not specified | | 5,319 | |
| | | | 33,338 |
| Schools | 912 | | |
| Total of children under daily instruction | | | 35,710 |
| Sunday schools | 388 | | |
| Number of children at such schools; ages from 4 to 15 years:— | | | |
| Males | | 23,601 | |
| Females | | 22,492 | |
| Sex not specified | | 7,064 | |
| | | | 53,157 |

The number of children in Staffordshire in 1833, between the ages of 2 and 15, may be taken at about 100,000. Seven Sunday-schools, attended by 301 children, are returned from places where there are no other schools; but in every other case the children have also the opportunity of attending daily schools, but to what extent they do so cannot be ascertained. Seventy-nine schools, attended by 7081 children, are both daily and Sunday schools, and duplicate returns are known to be thus far created. It is probable that less than one half of the children between the ages of 2 and 15 were under instruction in the county in 1833. Fifty boarding-schools are included in the number of daily schools given above.

The proportion of persons who attested their marriages by marks instead of writing their names, was, in 1839-40, 43 per cent. for men and 61 per cent. for women, the mean proportion being 52 per cent., while for England and Wales it is 42.

*Maintenance of Schools.*

| Description of Schools. | By endowment. | | By subscription. | | By payments from scholars. | | Subscrip. and payment from scholars. | |
|---|---|---|---|---|---|---|---|---|
| | Schls. | Scholars. | Schls. | Scholars. | Schls. | Scholars. | Schls. | Scholars. |
| Infant Schools | .. | .. | 1 | 80 | 48 | 925 | 16 | 367 |
| Daily Schools | 124 | 5487 | 47 | 3,191 | 615 | 17,955 | 61 | 6705 |
| Sunday Schools | 16 | 858 | 339 | 4,465 | .. | .. | 33 | 3834 |
| Total... | 140 | 7345 | 387 | 50,736 | 663 | 18,800 | 110 | 11,906 |

The Schools established by Dissenters, included in the above statement, are—

| | | | Scholars. |
|---|---|---|---|
| Infant-schools | 2, | containing | 180 |
| Daily-schools | 29, | | 1,899 |
| Sunday-schools | 142, | | 23,960 |

The schools established since 1818 are—

| | | | |
|---|---|---|---|
| Infant and other daily schools | 423, | containing | 20,145 |
| Sunday-schools | 238, | | 36,839 |

Lending libraries are attached to 59 schools.

STAG. [DEER.]

STAGE-CARRIAGE, is defined by the act of 2 and 3 Wm. IV., c. 120, as a carriage of any construction for conveying passengers for hire to or from any place in Great Britain, which shall travel at the rate of not less than three miles in the hour and be impelled by animal power, provided each passenger pay a distinct fare for his place therein. Railway carriages and vehicles moved by steam are excluded from, &c. In 1799 the act of Parliament was passed (19 Geo. III., c. 51) which first imposed a duty on hired carriages of any description. This duty has at times been variously regulated, and is now by the above act (amended by 3 and 4 Wm. IV., c. 48) settled. By these acts any person above 21 years of age can keep or employ a stage-carriage, on obtaining a licence so to do from two or more commissioners of stamps, to be renewed yearly, and the amount of duty payable on every such licence is computed upon the number of miles such carriage is authorized by the licence to travel in the day, week, or month, as the case may be. This duty may be compounded for. Every stage-carriage is to have a numbered plate affixed to it, a licence is necessary for every pair of plates, and the number of passengers each carriage is allowed to carry is stated in the licence. These regulations are applicable to all such carriages throughout the country, and include the more recently introduced conveyance termed an omnibus, a word in no way recognised by the legislature. The conduct of the stage-carriages which are employed in London and within ten miles of the General Post-Office, is further regulated by the 1 and 2 Vic., c. 79, in which they are directed to be called 'metropolitan stage-carriages,' and by which, besides the rules applicable by the other acts to these conveyances as stage-carriages, other enactments are made as to the stamp-office plates, &c. It also empowers the secretary of state to appoint a registrar of metropolitan stage carriages, whose office is to issue the licence which the commissioners of stamps are authorised to grant to drivers and conductors of these carriages, to whom this act more particularly relates. These licences the registrar may grant to any person above 16 years of age who can produce certificates of his ability to drive, and of good character. The licence is renewable yearly, and with it is given an abstract of the laws and penalties to which the receiver is amenable, and a numbered ticket, the latter of which it is his duty to keep about his person and not to transfer or lend. These particulars are entered in a book kept by the registrar for the purpose, and they are receivable as evidence at law.

The word omnibus as applied to a carriage is borrowed from the French. They were at first confined to London, and ran to and from the extreme points of the city and its suburbs, through the principal leading thoroughfares, charging for each passenger, whether he travelled the whole or any portion of the distance, the sum of one shilling, which was soon reduced to sixpence, at which price it now remains through the metropolis. The convenience of the size and form of these vehicles, heavy as they are in draught, and weighing 15 or 20 cwt., caused their early adoption in the provincial towns, and they are now common throughout the country, and come under the general denomination of stage-carriages. In the principal lines of the metropolitan carriages, as the road from Paddington or from Westminster to the Bank, and frequently farther, the average number of trips each vehicle takes per day is five; and the amount of fares received by each in the course of the day is considered to be about 2*l*. The driver and the conductor receive about one guinea a week each. The duty is calculated in the proportion of so much per mile according to the number of passengers the carriage may be licensed to carry, but as the great majority are capable of holding 14 or 16, on which number the duty is about 2½*d*. a mile, the daily duty payable to government is very considerable. The number of miles which they journey in London, as the frequency of their trips is only limited by the will of the proprietors, some of whom possess 50 or 60 carriages, is ascertained by persons stationed in various parts of the metropolis in the great thoroughfares, to check their running and mark the number of each carriage as it passes. (2 and 3 Wm. IV., c. 120; 3 and 4 Wm. IV., c. 48; 1 and 2 Vic., c. 79.)

STAGE-COACH. [COACH.]

STAGGERS. [HORSE.]

STA'GMARIA, a genus of the natural family of plants called Terebinthaceæ from many of them producing a turpentine-like exudation. It was named by Mr. W. Jack, assistant-surgeon in the East India Company's service, and author of 'Malayan Miscellanies,' from the Greek word *stagmus* (σταγμα), 'a dropping fluid.' The tree *S. verniciflua*, which is the Arbor vernicis of Rumphius, and the Kayo Rangas of the Malays, is full of acrid resinous juice, and is a native of the Eastern Islands, but not very abundant in Sumatra, though occasionally found in the neighbourhood of rivers.

The calyx is tubular, with the limb irregularly ruptured, deciduous. Petals 5, longer than the calyx, obtuse, spreading, subreflexed. Stamens 5, alternating with, but inserted above, the petals into the stipe-like torus. Filaments filiform, equal to the petals in length. Anthers oblong. Ovary stipitate, 3-lobed, lobes one-seeded, 1-2 of which are usually abortive. Styles 1-3, terminating the lobes of the ovary. Stigmas obtuse. Berry kidney-shaped, furrowed, one seeded, with a warty rind. Embryo exalbuminous, erect, cotyledons united; radicle incurved. The genus is nearly allied to Rhus, but besides the difference indicated in the above character, it has simple leaves, which are without stipules.

The wood of the tree is of a fine dark colour towards the centre. The bark exudes a resin which is extremely acrid, causing excoriation and blisters when applied to the skin; in this, as well as in becoming black when exposed to the air, it resembles the Melanorrhæa, Cashew-nut tree, poison oak, and many others of the Terebinthaceæ. According to Rumphius, this tree yields the celebrated Japan lacquer or varnish, and he considers it the same with that of Siam and Tonquin. Loureiro however represents the latter to be the produce of an Augeia. Mr. Jack says the varnish of Siam and Cochin-china is probably the best, but that of Celebes and of Java, which is the produce of this tree, is also employed for the same purposes, and cannot be much inferior, as it bears an equally high price. Rumphius says the exhalations of this tree are considered noxious, and the people of Macassar, and of other parts of Celebes in particular, entertain such dread of it, that they dare not remain long under it, much less repose under its shade. As however it furnishes the celebrated varnish, the Chinese and Tonkinese boldly repair to the tree, but employ caution in collecting the resin. This they do by inserting into the trunks two pieces of bamboo, sharpened at their points, in such a manner as to penetrate the bark in a somewhat oblique direction. These remain all night, and are extracted before sunrise the next morning the trees yielding no juice during the day. This fluid resin bears a high price, being sold in Tonkin and Camboja for 30, 50, or 60 dollars, the pecul of about 133 pounds, but in many of the provinces of China for 200 or 300 dollars.

The varnish is prepared for use by boiling it with an equal weight of the oil of Tang-yhu, which is a Chinese tree allied to the Mimusops Elengi, from whose fruit an oil is prepared. The proportions are varied according to the purposes for which the varnish is required. Sometimes dry pigments are added for the sake of red or other colours. The Japanese are the most skilful in preparing and ornamenting all kinds of work with this varnish, and their black lacquered works are conveyed to all parts of the world. (Jack's *Malayan Miscellany*, No. 3, reprinted by Sir W. Hooker.)

**STAHL, GEORGE ERNEST**, one of the most celebrated physicians of the last century, was born at Anspach in 1660. He studied medicine at Jena, took his degree of doctor there in 1683, and at once began to deliver lectures. In 1687 the duke of Weimar made him his physician; and in 1694, at the instance of Hoffman, he was appointed to a professorship of medicine, anatomy, and chemistry in the university of Halle, then recently established. He taught there for twenty-two years, and upon being appointed physician to the king of Prussia, went to Berlin, where he died in 1734.

The system of medicine which Stahl taught, and on which were founded the principles and practice of his numerous school, may be regarded as produced from a combination of the physiology of Van Helmont, which he learnt at Jena from G. W. Wedel, with the doctrines of Descartes respecting the agency of immaterial principles upon inert matter. In his life [HELMONT, VAN] it has been shown what Van Helmont taught on the nature and operations of an Archæus, as a principle resident in the living body and governing all its actions. Stahl supposed a like influence to be exercised by what he called the *anima*, an immaterial principle which (as far as can be ascertained in the obscurity in which his style of writing has involved his meaning) he seems to have regarded as identical with the soul, and as capable of acting both with consciousness, in the operations of the mind, and unconsciously, in the government of the processes in the living body. He held that this anima first forms for itself the body; and then, abhorring the destruction of that which it has formed, directs all the processes of the organization so as to evade death. For this purpose, it guides them to resist putrefaction, and to expel through the appropriate organs the effete particles and morbid substances accidentally introduced; it directs the repair of all injuries, and, in ordinary nutrition, maintains the due form and composition of the tissues. For this last process (as an example of its agency in all the rest) he supposes the anima to have knowledge (independently of the consciousness of the animal in which it works) of the necessary composition of every part of the body and of the materials to be given to each, and to have power to guide aright all the acts necessary to the required end. These acts, he considered, are effected by what he named tonic vital movements, that is, movements of alternate tension and relaxation, dependent on a property of *tone* resident in all the soft tissues of the body, and by which, under the influence of the anima, each part directs the movements of the fluid in its vessels or its parenchyma.

Disturbances of the government of the anima and of this property of tone constituted the chief elements in Stahl's pathology: and the signs of disease were regarded by him as indications of the efforts of the anima to remove the source of the malady and to preserve the body, either by means of extraordinary tonic movements, or sometimes by the most violent spasms and convulsions. He held that one of the commonest sources of disease was plethora, either local or general; and for this, the hemorrhages from different organs at different periods of life were regarded as the remedies employed by the anima. Especially, he applied these notions to the vena porta, in which, from the slowness of the circulation in it, plethora was thought peculiarly apt to occur; and to this condition he mainly attributed hypochondria, melancholy, gout, calculus, and hæmorrhoids; so that it came to be an aphorism of his school, 'Vena porta, porta malorum.' Fevers in general he considered to be the results of the anima endeavouring by the local tonic actions to expel some morbid matter; and their fatality, like that of most other diseases, he ascribed to the morbid matter being too abundant or the tonic powers too weak for its expulsion.

Stahl's therapeutics corresponded closely with his theory of disease. His principles of treatment were to aid the beneficial efforts of the anima and to remove the obstacles to its action. His remedies were few and simple, consisting chiefly of bleeding for the relief of plethora, and of mild evacuant medicines.

Medical science owes much of its progress to the energy and acuteness with which Stahl aided in overturning the notion which, before his time, was generally prevalent in the schools, that the simple laws of chemistry or of mechanics were all on which the phenomena of the living body depended, and in drawing attention to the body as an organism governed by peculiar laws, and having all its healthy processes adapted to one final purpose, namely, the preservation of the whole by the different actions of its parts. He rushed indeed into an extreme opposite to that of his immediate predecessors; for he treated with all the bitter sarcasm and morose contempt of his naturally stern temper every endeavour to apply any other science, even anatomy, in the study of medicine; and he mystified the principle which he supposed to rule the organism: but still he gave the turn towards truth, by following which his successors were gradually brought to a more just appreciation of the complexity of the forces which are in operation in the living body, and of the share which each of them has in each of its processes. His hypothesis of an *anima* has been ridiculed; yet, with another name, it is that which is adopted in nearly all the physiology of the present day: the *vital principle* and the *nature* of the majority of modern medical writers differ in little more than name from the *anima*, the *archæus*, and the φύσις of Hippocrates: the common hypothesis involved in all is that of an immaterial principle resident in the living body, and governing *with reason* all the processes in it for the final purpose of preserving life. Though the hypothesis be false, the medical sciences have made great progress through being pursued in the spirit which it suggests; and to this progress no man's labours have contributed more than those of Stahl.

Though Stahl despised chemistry in its attempted application to medicine, we owe to him an important step in the advancement of that science. Taking up the crude opinions of Becker, as he did those of Van Helmont, he became the inventor of the theory of Phlogiston, which for many years had such influence in chemistry, and in the working out of which, though it was based in error, so many important truths were ascertained. [BECKER; PHLOGISTON.]

Haller, in his 'Bibliotheca Medicinæ Practicæ,' tom. iii., p. 577, gives a list, collated by J. C. Gœtz, of 250 medical works written or superintended and edited by Stahl. That in which his medical doctrines are most completely taught is entitled 'Theoria Medica vera Physiologiam et Pathologiam tanquam Doctrinæ Medicæ partes contemplativas e Naturæ et Artis veris Fundamentis intaminata Ratione et inconcussa Experientia sistens.' It was published by him in 1707 and 1708. All the peculiarities of his system however are discernible in his inaugural thesis 'De Sanguificatione,' Jenæ, 1684. His chemical works were comparatively few: he first proposed the phlogistic theory in 1697, in his 'Zymotechnia Fundamentalis.' The best brief account of his doctrines is in Haller, and in Sprengel, *Histoire de la Medicine*, tom. v.

STAINES. [MIDDLESEX.]

STAIR, LORD. [DALRYMPLE.]

STAIRCASE. This is an indispensable part of the interior of buildings which consist of more than a ground-floor, and stairs of some sort must have always been employed wherever there were upper rooms, or even to obtain access to the terraced roofs which are used in the East. But we are altogether ignorant of the character of antient staircases. Vitruvius—who touches upon so many matters that are very remotely connected with his subject—gives no information about staircases; neither has much light been thrown upon the subject by the discoveries at Pompeii. Scarcely any indications even of upper floors to the houses have there been found, and what few traces of staircases, or rather of stairs, remain, show them to have been exceedingly incommodious, fitted only for obtaining access to an upper loft, or to the roof, and not at all adapted for constant communication between dwelling apartments on different floors. It may therefore very safely be taken for granted—at least until some direct evidence to the contrary shall be found—that the houses of the antients were in this, as well as in many other respects, greatly inferior to our own, and had nothing whatever corresponding to the modern staircase. Nearly the same may be said with respect to the antient domestic architecture of our own country, where, even in residences of the highest class, the staircases were generally very confined—placed within turrets, and exceedingly steep and narrow—narrow not only as regards the actual width of passage up and down, but the diameter or space occupied by the whole, there being no *well*, or central opening, but the steps winding around a solid newel so that in ascending or descending a person is continually revolving,—without any 'foot paces' for resting upon, and cannot see whether he will encounter any one else. *Turnpike* was a term formerly applied to staircases of this kind; also *Vise*, from their spiral or screw-like shape, whence the more modern appellation of *Corkscrew* stairs, corresponding with the Italian *Scala alla Lumaca*, or *Scala alla Chiocciola*, with the French *Escalier à Limaçon*, and the German *Wendeltreppe*.

It was not till about the time of Elizabeth that staircases began to be planned more commodiously in this country, and made a decorative feature in the interior of a mansion. But though they were greatly improved, the flights being made wider, and the steps parallel to each other, with intermediate landings or resting-places between the several flights, and although considerable decoration was bestowed upon them, the walls being pannelled, and the parapet of the stairs formed either by richly carved balusters, or open fret-work, frequently with heraldic figures of animals on the pedestals at the angles of the different flights—the staircase itself was usually enclosed within a comparatively small area, so as to admit of no general view of the whole of it, there being very little open space, or *well*, as it is termed; sometimes none at all. The staircases at Aldermaston, Berks, Crewe Hall, Cheshire, and Knowle, Kent, may be taken as examples of the kind. At a later period, staircases in mansions of a superior class were made disproportionably spacious, being upon a scale as to size with which the apartments themselves were not at all in keeping.

The planning of a staircase is generally considered one of the most difficult matters in internal architecture, and it is certainly one that requires great consideration. Yet there is no particular difficulty, except where, as is generally the case in moderate-sized houses, the architect is cramped for room; more especially if, while restricted in that respect, the ascent from one floor to another is greater than usual. The number of stairs and the space required for the convenient arrangement of them, are easily estimated when the height of the ascent from one floor to another is given, and the dimensions are determined for the risers and treads. Stairs are technically described as consisting of *Risers* and *Treads*, the former being the fronts or heights of the steps, and the other their flat surfaces or breadths. Stairs are further distinguished as being *Flyers*, those which ascend straightforward; and *Winders*, which having their treads triangular, coming quite to a point at their ends next balusters, afford no footing there, and ought consequently to be avoided whenever it is at all practicable to do so. A *Flight* is a consecutive series of stairs in the same direction, or between one *Quarter-space* or *Half-space* (*Palier de repos*) and another, which last are short intermediate landings, serving to lessen the fatigue of a continuous ascent, by subdividing it into shorter flights. For the area containing, or rather constituting, the staircase itself, we have no distinct term in addition to the general one, similar to the French *Cage*, the Italian *Gabbia*, and the German *Treppenhaus*.

We proceed to notice the most convenient proportions of the stairs themselves as to height and breadth for their length. As to the breadth of the flights, that is comparatively arbitrary: it should never be much less than four feet, so as to allow two persons to pass, except in back-staircases; but it may be as much more as the space will permit, or the effect aimed at in the design may require. The best general and what may be considered standard proportions, are 6 inches for the risers and 12 inches for the treads; though from 6½ to 7 inches may be allowed for the former, and only 10 for the latter, in secondary staircases. In those of a very superior kind, on the contrary, the risers do not exceed 5 or even 4 inches (less height than which last would be more fatiguing than convenient), and their treads are then made from 14 to 16 inches. The height therefore to the landing of the floor to be reached being given, it is easy to calculate either how many risers of a certain number of inches will be required; or what must be the dimensions of the risers and treads, in order to ascend within the space allowed. Supposing the first-mentioned height to be 14 feet, and the risers six inches, two risers will be equivalent to one foot of ascent, and consequently twenty-eight risers will be required, or twenty-seven treads, the upper landing being the tread to the last riser. In such case, hardly less than an area of 20 by 8 feet, on the level of the upper floor, would be sufficient for the staircase, unless there were winders instead of quarter-spaces, or of a single half-space between the two flights. The number of risers required is ascertained by reducing the given altitude of ascent to inches, and dividing it by the height of the risers: thus, taking the altitude as before (14 feet), and the risers at 5 inches, there must either be 33 risers a trifle more than 5 inches each, or 34 a trifle less.

Palladio, and others following him, have laid it down that the staircase ought to be seen immediately on entering a building; but it is impossible to establish any positive rule for what must depend upon particular circumstances, and this is by no means the best as a general rule. In a public building or place where strangers go in and out without inquiry, it may be desirable that the staircase should present itself at once; but certainly this is not the case in private mansions. On the contrary, it is in every respect better that the staircase should be kept out of view until the first vestibule has been passed through, and that it should be placed as remote from the entrance into the house as the plan will admit, both in order that the approach to it may be lengthened, and that, in case it has any architectural pretensions at all, it may strike the more by not coming into view at once. At all events, only the lower part of the staircase—no more than is sufficient to indicate its situation—should be visible from the entrance, otherwise it will be inconveniently exposed; and if there are doors to several rooms on the upper landing, persons passing from one to the other would be seen from the hall. It is therefore a great error to place the staircase, as is sometimes done, in the first or entrance hall of a mansion, because, in addition to the inconvenience just pointed out, such hall must be made the height of two floors, and consequently, if otherwise suitably proportioned to such height, it will be the most spacious and loftiest room, and so far be attended by a degree of effect which, instead of being afterwards increased or kept up, is greatly diminished. Such arrangement also cuts off the communication above between the rooms on one side of the hall and those on the other, except there is a gallery or continuation of the landing carried over the entrance.

Even when kept apart from the entrance-hall or other vestibule, a staircase will always be sufficiently striking in proportion to the rest of a house, because it will produce greater architectural effect, and be loftier than the rooms themselves. We are now speaking only of what is usually termed a 'grand staircase,' leading up no higher than the principal floor, so that the whole of the space from the level of the landing is perfectly clear, and there are no flights leading up higher, for if there were, the space over head would appear encumbered and confused. There is in fact no part of an interior which accommodates itself more readily to architectural character and display, or which admits of greater variety of design both as to plan, section, and decoration, than a staircase of the kind just referred to. If the house itself be not upon a very large scale, there is danger of doing here rather too much than too little. In regard to altitude, there will here always be greater magnitude than elsewhere; if therefore corresponding magnitude of area be given to it, the staircase will overpower everything else, cause the rooms to appear small by comparison, and appear in itself too large for the house. It is therefore desirable to make the area, at least the visible area of the staircase, rather less than more than that of any of the principal rooms. It is also rather a solecism to affect magnitude of space in other respects corresponding to that of height. While it serves as a contrast to the apartments, loftiness or excess of height, as compared with length and breadth, is as much an appropriate characteristic of a staircase as it is of a tower. Its altitude therefore from the bottom of the first flight to the ceiling, may very properly be made between two or three times the breadth. Accordingly it will be found expedient to enclose the landing, if continued quite round the staircase, not merely by a screen of columns, but in such manner as to shut it out from view, with only partial openings at intervals, in order to avoid too much spaciousness on that level, and to keep the *cage* of the same size from bottom to top. Of such staircase upon a large scale there is an example at Taymouth Castle, the seat of the marquis of Breadalbane, which is about 40 feet square by 100 feet in height, with an upper corridor surrounding it, with open arches.

One of the most simple and effective yet least common arrangements of a staircase, is that which may be described by the term *Avenue staircase*, the stairs being continued in a straight line, though broken by *spaces* into a succession of flights, within what would else be a level corridor or gallery; and occupying its entire width. There is something particularly noble and majestic in a staircase of this kind, for although it may be narrow, considered as a gallery, it looks unusually spacious as a staircase, the *flight* itself being wider than those of staircases placed within a much larger area. Besides which, the whole is more regularly disposed, and forms a more striking piece of perspective. Still simple as such plan is in itself, it is by no means adapted to general application, because, although it requires only moderate width, it requires considerable length, short flights, and ample spaces between them, and stairs with low risers and broad treads; otherwise the descent as viewed from above, being in a straight line, looks precipitous, or at least has no dignity of appearance. Another circumstance which limits a staircase of this kind to particular cases, is, that in order for it to produce proper effect, the height to be ascended should be very moderate, hardly more than seven or eight feet; for else, the space at the foot of the stairs looks confined, and the upper flights scarcely show themselves from that station. Hence, though it may be referred to as an instance of an avenue staircase, the one leading to the keep or round tower at Windsor Castle is more remarkable than beautiful or grand, leaving decoration out of the question; the altitude ascended being so very great. Sir John Soane has given some ideas of the kind in his designs for a 'Scala Regia'—a favourite subject with him; and he executed such a staircase, though upon a more limited scale, for the royal entrance to the House of Lords. The width of that staircase is only 10 feet, by 49 in extreme length, and the ascent 9 feet. Though not free from little conceits, the whole has considerable effect, as may be judged from the perspective view of it in vol. i. of the 'Public Buildings of London,' by W. H. Leeds, which also contains a longitudinal section of it. The staircase of the Chamber of Peers at Paris, designed by Percier and Fontaine, is another example of the kind upon a larger scale, but not the very best, for the ascent is so great, that the columns on its sides, on the same level as the landing, look quite insignificant. That at Covent-Garden Theatre also belongs to the same class, although it differs from the preceding in being extended in the upper part by the landing being continued along its sides as a gallery divided from it by columns; the ascent is about 10 feet, in two flights. The National Gallery, again, affords instances of a different modification of the same arrangement, half the ascent being by an external flight in the vestibule, the remainder by another within the corridor leading from it; and though not exactly suited for such a building, the idea is pleasing in itself and would produce a striking effect in one of less pretension.

In public edifices or large mansions, whatever be the plan of the principal staircase, it is generally *branched*, that is, there is first a wide central flight, and then two other narrower ones branching off from it one on each side, either at right angles to it or as return flights parallel to it; and it is hardly necessary to observe that in all such staircases the *foot-spaces* are large, and that there are no winders. The staircase at Goldsmiths' Hall, which is parted off from the vestibule by a glazed screen, is an example of more than ordinary splendour, being lighted by a dome. The branching flights at right angles to the first, lead to a landing on each side, which has a double screen of Corinthian columns, so that the view across from side to side, in the upper part, is unusually rich. At Buckingham Palace, there is first a very wide flight, entered from between columns, branching off right and left in curved flights, the cage, which is about 36 by 26 feet, being curved elliptically on those sides or ends. In this example, the stairs rest upon a graduated podium or wall enclosing the space immediately beneath, which serves as a private passage behind; a mode frequently adopted in similar cases, being one which contributes to solidity and nobleness of appearance, and prevents that mass of shadow beneath the stairs which gives a gloom to the lower part of the staircase.

Instead of there being a central flight below, the ascent frequently begins on each side, and is carried up in one or more flights to the common landing where both branches terminate; from which point the stairs are sometimes continued, returning in an upper central flight which is carried across an arch thrown from that landing or half-space, to a higher landing. Staircases of this kind, which may be termed *bridge* staircases, occur in the Custom-house and the Auction Mart. Their effect, however is not good, because the upper suspended flight or *bridge* darkens the lower part of the staircase, and has a strangely awkward cumbersome appearance when viewed from that station. At the best therefore they are suitable only for places of evening resort, where they can be lit up below as well as above.

The staircase of the Fitzwilliam Museum, Cambridge, claims notice, not only on account of the richness of the general design, but of some peculiarities in its arrangement. Strictly speaking however, this example can hardly be given as that of a staircase, according to the usual meaning of the term, the stairs being mere flights of steps in the entrance hall. That in the centre is a broad descending one, leading down to the libraries, which are on a lower level than the hall; and on each side of it is a rather narrower ascending flight to the spacious landing carried around three sides of the hall, and serving as a statue gallery. Though the lower area is only 32 by 26 feet, consequently that of the floor very much less, owing to the space occupied by the flights of steps, that of the upper part on the level of the landing is 68 by 44 feet, the landing itself being about 17 feet wide. In some degree similar in plan, although very different in design, is the hall at Holkham, the seat of the Earl of Leicester, which has a noble flight of steps within a recess or tribune enclosed by columns which are continued along the sides of the hall.

The grand-staircase of the Reform Club-house, London, is an example, somewhat unusual in this country, though common enough in Italy, of what may be called an *enclosed* staircase; the flights are shut up between walls, and consequently there is no open *well*, nor can the whole be seen at one view. A plan of this kind therefore differs from the avenue staircase, merely in not being carried straightforward, but either returning in a parallel flight from the half-space or first landing, or having the second flight at right angles with the first. The last is the case at the Reform Club-house, where the staircase consists of three enclosed flights, the last being a return one to the first, and landing upon the gallery around the upper part of the inner hall or saloon. That at Burleigh too is similarly planned. The same mode may be adopted for circular or semicircular as well as rectangular plans; and one advantage attending it is, that while the ascent itself is as spacious and commodious as if the whole were entirely open, there may be a secondary staircase for servants, shut up within the larger one.

Though Milizia objects to them as inconvenient, circular and semicircular staircases, and such also as are partly rectangular and partly semicircular, being curved in the latter form at one or both ends, are very beautiful, at least capable of being rendered so; neither is the inconvenience alleged against them one of any moment, because though all the stairs are winders, the diameter of the staircase itself may be such, that the treads may be 10 inches wide at their ends next the balusters or open part of the staircase, and the whole ascent be completed in half a revolution or semicircle; whereas in a narrow newel staircase of the kind two or more revolutions will be required.

The architectural effect of a staircase will greatly depend upon the mode of lighting it. Where it is carried up only one floor, the best mode is to light it entirely from above, either through a dome or lantern in the ceiling, or by making the upper part of the walls just beneath the ceiling a continued lantern. If there are windows on the landings of the several flights, the effect will be improved by their being filled with stained glass, especially if towards a back court; or, if a conservatory can be carried out on the level of the first landing, so as to show itself through glazed folding-doors, a very pleasing and cheerful effect is obtained, even though the conservatory itself should be hardly more than a glazed viranda. As to material, stone is greatly preferable to wood for stairs, if only on account of greater security in case of fire; in lieu of stone, cast-iron may be employed. Marble is very rarely used for stairs in this country, and whenever it is, it should be left unpolished on the treads, or it would be dangerous to descend them. The same remark applies to stairs of wainscot, unless they are carpeted nearly their entire width.

STALACTITE and STALAGMITE. Stalactitic carbonate of lime occurs chiefly in long masses suspended from the roofs of caverns in limestone rocks. Stalactites appear to be continually forming; water containing carbonate of lime held in solution by carbonic acid, trickling through crevices in the roofs of the caverns, gradually during its exposure to the air loses its carbonic acid, and consequently deposits its carbonate of lime; the water passing over the portion first deposited gradually adds to it, and eventually gives the carbonate of lime its great length and stalactitic character. The flatter deposits, called stalagmites, are formed on the floor of the cavern by the water there depositing that portion of its carbonate of lime which is not separated during the formation of the stalactite. Stalactitic carbonate of lime is met with in the veins of lead-ore in Durham and Northumberland. Caverns are sometimes nearly filled with these deposits, which in some cases are of very large dimensions; the most remarkable instances of their occurrence in Britain are in the cavern at Castleton in Derbyshire, and Macallaster Cave in the Isle of Skye: the grotto of Antiparos in the Archipelago, the Woodman's Cave in the Harz in Germany, and that of Auxelle in France, are striking instances of their formation in other countries.

Besides the occurrence of this variety of carbonate of lime in the stalactitic form, it is sometimes met with reniform and tabular, and in other imitative shapes. The fracture is sometimes perfectly lamellar, occasionally fibrous, the fibres diverging from a centre, with a pearly or silky lustre, and sometimes resinous or waxy. The colour varies from white to greyish, brown, red, and yellowish white. Opaque, but frequently translucent.

The *Oriental alabaster*, much employed by the antients in statuary and the formation of vases, appears to be of stalactitic origin.

STALAGMITES (from σταλαγμός, a dropping), the name of a genus of plants belonging to the natural order Clusiaceæ or Guttiferæ. It has polygamous or bisexual flowers; 4-5 sepals, which are persistent and bractless; 5 petals alternating with the sepals; 4-5 united stamens, the bundles flat, elongated, and divided at the apex into several short antheriferous portions opposite to the petals, and alternating with 5 large truncated glands; the anthers are 2-celled, bursting longitudinally; the ovary is 3-5-celled, with 1 ovule in each cell; stigma 3-5-lobed; and fruit a berry. The species are trees natives of the East Indies and Ceylon, and belong to the family which produces the gamboge of commerce. Dr. Wight states that one of the species, the *S. ovifolia*, which is a native of Ceylon, yields a true gamboge, which is employed in commerce. It is known by its oval shining leaves, its lateral fascicled flowers, male and hermaphrodite mixed. Its anthers are arranged in 6 or 8 bundles, and it possesses a 3-celled 1-3 seeded ovary.

STALBRIDGE. [DORSETSHIRE.]

STALL-FEEDING. The feeding of cattle in stalls for the purpose of fatting them more readily than by simple grazing, and at a time when they cannot get fat on pastures, as a regular part of the process of husbandry, is comparatively modern. In former times cattle were slaughtered in October and November, which latter, in most languages derived from the Teutonic, is called *Slaughter-month*, there being no possibility of buying fresh meat of any degree of fatness during winter, and salt meat was the food of all classes in that season. But now the process of fatting cattle goes on without interruption during the whole year, and fat beasts come as regularly to market in winter as in summer. Stall-feeding is now the principal means by which oxen and cows are rendered fit for the market.

It has been observed, in the article SOILING, that one object of that system was to save the waste of food which is occasioned by the treading of cattle in pastures, and by their choosing the sweetest grasses to the neglect of the coarser. The principal object however is to save the manure, which in the pastures goes to waste, but in the yards or stall is all preserved. In stall-feeding another object is looked to, that of increasing the substance of the animal, especially the fat; and to do this judiciously and with profit requires much experience and attention. It has been proved that animals require a certain portion of meat and drink to keep them alive, and that this quantity, in the same species, is in general in proportion to the weight of the animal. If an animal has his exact ration of food, he will continue in health, but he will not increase in weight: in this case therefore it only produces a certain portion of manure, which is not equivalent to the food consumed. If a larger quantity be given, the animal, if in health, will increase in weight, and the more food he has, within a certain limit, the faster will be this increase: but there is a point where increase stops; and if by any means the animal is induced to take more, his stomach will be deranged, and he will become diseased, and occasion loss by over-feeding. It is consequently of great importance to the stall-feeder to ascertain what is the exact quantity of food which it will be most profitable to give to a stall-fed animal. Experience alone can teach this; but some rules may be given which will enable any one who wishes to stall-feed cattle not greatly to err in his mode of feeding, and soon to find out what is the most profitable course to pursue. For this purpose it is essential that after having ascertained by experiment the quantity of food which will give the greatest increase of flesh per week on a certain weight of beasts when put up to fatten, all the food given to the cattle be carefully weighed, and no more be given in any day than is needful. The quality of the food should also be attended to; for a truss of fine well-made clover, lucern, or sainfoin hay, may contain double the nourishment of another truss of coarse marsh hay. The best kind of food should always be reserved for fatting cattle. Roots are excellent helps; but roots alone are too watery, and must be corrected by dry food, such as straw cut into chaff, or good hay, and especially farinaceous food, whether it be corn ground or bruised, or oil-cake after the oil has been expressed. By a judicious mixture of food a much greater increase of flesh may be produced than by an irregular mode of feeding, however good the quality or abundant the quantity given may be. To overfeed is as unprofitable as to starve a beast, and produces similar effects. It is of great importance that the cattle should be fed with great punctuality, at certain hours during the day, and that the troughs should be cleared of all the remains of food which they do not eat at each time of feeding. Rest and sleep are great aids to digestion, and a little gentle exercise after sleep prepares the stomach for a fresh supply of food. Air also is highly conducive to health; and hence those beasts which are allowed to move about in a loose stall, or a small yard protected from the rain and wind, thrive better in general than those which are tied up. It is the practice of many good feeders to put oxen in pairs in small stalls, partly open, so that they may be in the air, or under shelter, as they prefer; and the finest oxen, if not the fattest, are prepared for the market in this way. Experience shows that all domestic animals like company, and that they are more contented and quiet when they have a companion than when they are alone. This is the reason why they are put up in pairs. Whatever promotes the health and comfort of the animal will be most profitable to the feeder. When a beast has acquired a certain degree of fatness, it is a nice point to decide whether it would be best to send him to market or continue to feed him. This is often decided by mere caprice or fancy; but if the food has been weighed, and the weekly increase of the beast is noted, which is best done by weighing, but may nearly be guessed by measuring, it becomes a mere question in arithmetic to determine whether his increase pays for his food and attendance; if it does not, there is a loss in keeping him; and if a lean animal put in his stead would increase faster on the same food, every day he is kept there is a loss of the difference between the increase of the two. The pride of producing a wonderful animal at a fair or show may be dearly paid for, and must be put down to the account of luxuries, such as keeping hunters or racehorses.

The most profitable food for fattening cattle is, in general, the produce of the farm: the expense of all purchased food is increased by the profit of the dealer and the carriage of it. And the only compensation for this additional cost may be in increasing the manure, where the straw and roots of the farm are deficient: in that case oil-cake, or even corn, may be purchased with advantage, since by means of the manure crops may be raised which without it must fail. The stalling of cattle, as well as the fatting of pigs, is in many situations the best means of carrying the produce of the farm to market. An ox can be driven many miles, whilst the food he has consumed would not repay the carriage, and all the manure would be lost, and must be purchased at a great expense, if it can be had at all. If a farmer can feed cattle, so as to pay him a fair market-price for the food consumed, and something for the risk of accidental loss, he may be well contented to have the manure for his trouble: few stall-feeders get more than this in the long run.

STAMENS, in Botany, the organs which constitute the last whorl but one of the series which form the flower in plants, the pistil with its parts forming the last or innermost whorl. These organs were called by the older botanists *Apices*, and by English writers Chives. They constitute the male organs of the flower, and are formed principally of cellular tissue. They are composed in most cases of three parts: 1, the filament, a long slender organ, on the summit of which is placed—2, the anther, which is a little case, mostly double, containing—3, the pollen, which is composed of little grains constituting the fructifying influence of the plant. [ANTHER; POLLEN.]

The stamen in theoretical botany is considered, as well as the other parts of the flower, a modification of the leaf. Although its form, structure, and functions differ so much from the leaf, it is not difficult to point out the series of modifications by which the one is converted into the other. In many plants the leaves cannot be distinguished near the flowers from the bracts, and these again cannot be distinguished from the sepals forming the calyx; whilst the calyx often insensibly passes into the corolla, and parts of flowers are often seen possessing both the characters of sepals and petals. In the case of the white water-lily, a good example is offered of the passage of petals into stamens, thus completing the series of changes from leaves to stamens. In this plant, a gradual contraction of the inner petals is seen to take place at their upper parts, the cellular tissue becomes coloured, and partakes of the character of pollen-grains, and these changes become more and more decided till the whorl of stamens is fully established in the centre of the plant. Many other plants might be cited as affording examples of the same changes, as *Calycanthus*, *Illicium*, &c. These changes occur naturally in the above plants, but a more decided exemplification of the conversion of these organs will be found in what are called monstrous or double flowers, which are the result of cultivation. If for instance a garden-rose is taken, it will be found that the natural position of the stamens in this flower is occupied by petals, and in many the character of half-stamen and half-petal may be clearly seen. In other double flowers the same backward change may be observed of petals into sepals, and so on.

In the change that has thus taken place of the leaf into the stamen, the filament of the latter represents the midrib of the former, whilst the anther and its pollen are modifications of the lamina and cellular tissue of the leaf. It is well known that the cellular tissue of the upper and under surface of the leaf differ very considerably, and it is to these parts that the anterior and posterior cells of the anther are analogous. On this point Schleiden has proposed the question as to whether there is any corresponding difference in the character of the pollen in the anterior and posterior cells; whether they both possess the power of fructifying; and whether in diœcious plants it might not be ascertained that the one produced pollen grains that would engender male embryos, and the other grains that would produce female embryos.

In their normal position in the flower the first row of stamens are always alternate with the petals; and as these organs are alternate with the sepals, the stamens are opposite the latter. If there is a second row of stamens, they will be alternate with the first, and thus of course opposite the petals. It however frequently happens, as in the primrose, that there is only one row of stamens, and yet opposite the petals. In such cases the anomaly is accounted for by supposing that the first row has not been developed, and consequently the second stand in their original position, that is, alternate with the aborted row. When there are only five petals and ten stamens, as in Silene, the latter are supposed to form a double row.

The stamens are said to arise from various parts of the flower, and according to the part of the flower from which they arise terms have been applied to express this origin, which are of great importance in systematic botany. When the stamens arise from (or, as it is often expressed, are inserted into) the calyx or corolla, they are said to be *perigynous*; when they arise from under the pistil or ovary, *hypogynous*; when from the pistil itself, *epigynous*. The classes and subclasses of the natural system of Jussieu are subdivided according to the existence of these distinctions in the families of plants. The above terms however must not be supposed to express the fact that the stamens do really originate in the parts from which they are said to arise or are inserted into.' The fact is, the stamens always arise from a point in the axis of the flower between the petals and ovary; and when attached to these or other parts, it must only be looked upon as an adhesion of one organ to another. Thus when it is said that the stamens are inserted into the calyx of the flower of the apple, it is meant that they adhere to the calyx up to a certain point, from whence they appear to arise. The same must be said of their connection with other parts.

The *filament* of the stamen is the representative of the petiole or midrib of the leaf, and in structure and function resembles that organ, and is not any more essential to the existence of the stamen than the petiole is to the leaf. It is composed of very delicate cellular and woody tissue, with which are intermixed a few bundles of spiral vessels. It is mostly filiform and cylindrical in shape, and in most instances without colour. In some plants, as the Canna, and in the whole of Zingiberaceæ, the filaments are hardly distinguishable from petals except in the possession of anthers at their apex.

The filaments are often combined into a single mass, the anthers being separate; when this is the case, they are said to form a brotherhood, and the term *adelphia* is applied to them. When there is only one such combination, the stamens are said to be *monadelphous*, as in geranium; when there are two such unions, or even if only one stamen is separated from the rest, they are called *diadelphous*, as in Fumaria, Vicia, Lathyrus, &c.; when there are more than two, as in Hypericum and Melaleuca, they are *polyadelphous*. The filaments are sometimes of different lengths; when two are tall and two are short, as is seen in the whole of the natural family Lamiaceæ, they are called *didynamous*; if four are long and two are short, as is seen in the family of Cruciferæ, they are *tetradynamous*.

The number of stamens in flowers is expressed by a Greek numeral being prefixed to the word *androus*: thus flowers with one stamen are *monandrous*; with two stamens, *diandrous*; with three stamens, *triandrous*, and so on.

It was on the number of stamens, and their arrangement and relations, that Linnæus founded the classes of his celebrated sexual or artificial system of the arrangement of plants. [SYSTEM, SEXUAL.]

For the function of the stamens, see ANTHER; POLLEN; IMPREGNATION; STIGMA.

STAMFORD, or STANFORD, a parliamentary borough in the wapentake of Ness, in the county of Lincoln, 80 miles from the General Post-Office, London, in a direct line north by west, or 90 miles by the road through Hatfield, Baldock, Biggleswade, and Norman Cross.

Stamford is said to have been a British town before the Roman invasion; and it is an antient fable that the British king Bladud established a university here which lasted till the time of Austin, the apostle of the Anglo-Saxons. Authentic history is however silent about the place till the troubled period succeeding the Roman dominion, when the Picts and Scots were defeated here by the Britons and their Saxon allies, A.D. 449. (Hen. Hunt., lib. ii.) It is again mentioned in a grant made (A.D. 656) by Wulfhere, king of Mercia, to the Abbey of Medeshamsted, or Medhamsted (now Peterborough), recorded in the Saxon Chronicle. The genuineness of this deed is however questioned by Peck. In the reign of Edward the Elder (A.D. 922) the part of Stamford south of the Welland was fortified by the Saxons, and the Danes, who occupied the northern part of the town, submitted. The town was one of the five Danish burghs which connected their Northumbrian and East Anglian possessions. It was again reduced by the Danes, or ceded to them; and recovered by Edmund I., A.D. 942. Stamford is noticed in a charter of Edgar to Medeshamsted (*Sax. Chron.*, A.D. 963) as a market-town. It submitted to Sweyn, king of Denmark, in his invasion, A.D. 1013, but was recovered soon after by Ethelred II. In Domesday Book, Stamford, there called Stanford, is styled a king's borough, and is described as having six wards, five in Lincolnshire and one in Hantune or Northamptonshire.

In the reign of Stephen, the king had a meeting at Stamford, A.D. 1140, with Ranulph or Ralph, earl of Chester, with a view to conclude a peace. In 1190 the Jews of Stamford, who appear to have been tolerably numerous and wealthy, were plundered, and many of them slain by those who had enlisted for the crusade. Their synagogue at Stamford, 'with its noble library,' was profaned and sold at the time of their expulsion by Edward I., A.D. 1290.* In the commencement of the civil war of John, A.D. 1215, the barons assembled here to oppose the king, and John was himself at Stamford a little before his death. In the early part of the reign of Henry III., Richard, earl of Cornwall, the king's brother, assembled a considerable body at Stamford of discontented barons and their retainers, who required the king to restore the two charters (Magna Charta and the Charta de Foresta): but the confederacy was dissolved by the moderation of the king and his promise to govern according to the laws of the realm. One of the crosses which marked the resting-places of Queen Eleanor's body, was erected at Stamford: it was utterly demolished in the civil troubles of Charles I. Several parliaments and councils were held at Stamford in the middle ages. The town was at this time fortified with walls and towers in which were seven principal and two postern gates: there was also a castle, demolished in the time of Richard III. There were sixteen parish churches in the town and suburbs, and religious houses were numerous: there were priories for Carmelite, Franciscan, Dominican, and Austin friars (two in or near the town), and Benedictine monks (at St. Leonard's, just out of the town to the east); also several 'halls' or monastic schools. On occasion of some discontent at Oxford, a number of the students retired here (A.D. 1333), and were not induced to return without great difficulty.

The town was taken by the Lancastrian army raised in the North by Queen Margaret (A.D. 1461); and as the townsmen were generally Yorkists, was given up to devastation. Six churches appear to have been destroyed at this time; four others were subsequently removed, and six still remain; five in the old borough, and one in Stamford Baron, on the south side of the Welland. The battle of Lose-Coat-field [LINCOLNSHIRE, vol. xiv., p. 15] was fought not far from Stamford, A.D. 1462. There were some troubles raised here by the Royalists A.D. 1648; and a riot was raised by the high-church party in 1714, in which the Presbyterian meeting-house was destroyed.

The town stands partly on the north side of the Welland, in the county of Lincoln, and partly on the south side, in the parish of St. Martin, Stamford Baron, in the liberty of Peterborough, in the county of Northampton. The old borough of Stamford, which did not include the latter part, has an area of 1860 acres, with a population in 1831 of 5837; the parish of St. Martin, Stamford-Baron, from which the late additions to the borough are taken, has an area of 2170 acres, with a population of 1274; together 4030 acres, and 7111 inhabitants. The two parts are united by an antient stone bridge of five arches. The streets are irregularly laid out, and paved and lighted with gas: the town is well supplied with water. The houses are chiefly built of freestone from the quarries of Ketton and Barnoak, and slated. All Saints church consists of a nave with two aisles, and a chancel with one aisle, at the end of the south aisle of the nave. Most of the interior, and the lower part of the exterior of this church, are of early English architecture; the tower, spire, and two porches are of perpendicular character: there is a fine perpendicular pannelled font. St. George's is a large plain building, retaining, amidst many alterations, some old portions, principally perpendicular; it consists of a nave, with side aisles, chancel, and western tower: there are some portions of antient stained glass. St. John the Baptist's is chiefly of perpendicular character, with a fine wooden roof and wooden screen-work; it has a nave and chancel, each with side aisles; a neat embattled tower and pinnacles; and a handsome south porch. St. Mary's is one of the finest churches in the town; it consists of a nave with two aisles, and a chancel with one; and a western tower and spire. The tower and spire, with some other parts, are of early English architecture; but a large portion of the church is of perpendicular character: it has some rich chapels and an antient canopied altar tomb. St. Michael's church has been much altered and modernized. St. Martin's church, Stamford Baron, south of the Welland, is a fine specimen of late perpendicular architecture: the piers and arches are very light and lofty, and there is a good south porch. It contains the monument of the great Lord Burghley. Part of the nave of the conventual church of the Benedictine priory of St. Leonard's (sometimes called St. Leonard's Hospital) is still standing, and is used as a barn: the architecture is mixed, being Norman in its form and early English in its details. The west gate of the Carmelite or White Friary is still entire, just outside the town on the north-east side; it is a good decorated English composition, of about the time of Edward III. Near it are part of a wall and a postern or back gateway of the Grey or Franciscan Friary. The grammar-school is part of the old church of St. Paul: it is partly of Norman, partly of early English architecture, with some later windows inserted: near it is a Norman gateway, antiently belonging to Brazen-Nose College, one of the monastic schools, and now forming an entrance into a garden. There are a small Norman doorway near the bridge, and a doorway in an old wall near the river, probably belonging to the castle. Brown's hospital has some portions of good late perpendicular character: Burghley hospital, in St. Martin's, Stamford Baron, is of the Elizabethan period. Of more recent date are the town-hall, the gaol, the theatre, a market for butcher's meat, butter, and fish; and the Catholic, Wesleyan, and Independent chapels. The infirmary for Stamford and the county of Rutland is a neat modern building in the Gothic style.

The trade of the place is considerable, and consists chiefly in the supply of the surrounding agricultural district: silk-throwing was carried on a few years since, but is now given up; considerable business in malting is done: the markets are on Monday and Friday, the latter is a considerable corn-market: there are seven yearly fairs. The Welland, or rather a lateral cut to the natural bed of the river, is navigable up to the town for boats and small barges.

The institutions for benevolent and literary purposes, and for amusement, are tolerably numerous. Besides the infirmary and Brown and Burghley's hospitals, there are several ranges of alms-houses, or, as they are locally termed, 'Callises;' a Bible society, a savings' bank, a library and reading-room, a theatre, and cold baths. Races are held: and a barbarous custom of bull-hunting, or, as it is locally termed, 'bull-running,' has been (unless quite lately put down) kept up yearly for several centuries. A similar custom prevailed at Tutbury [STAFFORDSHIRE], but is now suppressed. One newspaper, the 'Stamford Mercury,' is published in the town: it has been established considerably more than a century.

Stamford was a borough before the Conquest. By the Boundary Act a part of the parish of St. Martin, Stamford Baron, was added for parliamentary, and subsequently, by the Municipal Corporations' Reform Act, for municipal purposes. It is divided into two wards, and has six aldermen and eighteen councillors. Quarter-sessions are held, and there is a court of record. The borough returned members as early as 23 Edward I.: it sends two now: the number of voters in 1835-6 was 755; in 1839-40, 679.

The living of All Saints is a vicarage, united with the rectory of St. Peter's, of the clear yearly value of 431*l*., with a glebe-house; the living of St. George's (united with St. Paul's) is a rectory, of the clear yearly value of 124*l*., with a glebe-house; the living of St. John the Baptist's (united with St. Clement's) is a rectory, of the clear yearly value of 167*l*., with a glebe-house; the living of St. Mary's is a rectory, of the clear yearly value of 87*l*.; the living of St. Michael's (united with St. Andrew's and St. Stephen's) is a rectory, of the clear yearly value of 136*l*.; and the living of St. Martin's, Stamford Baron, is a vicarage, of the clear yearly value of 98*l*., with a glebe-house. The last is in the archdeaconry of Northampton and diocese of Peterborough: the rest are in the archdeaconry and diocese of Lincoln.

There were, in 1833, in the old borough, and in the parish of St. Martin, a grammar-school, well endowed, with 53 boys; an endowed day-school called 'the Blue-coat school,' with 80 boys; two day and Sunday schools, endowed by what is called Wells's Charity, with 56 boys and 46 girls; a national school, with 118 girls; an infant-school, with

* This incident deserves notice as connected with the cultivation of Hebrew literature in England. Many of the books belonging to the libraries of the Synagogues of Stamford and Huntingdon were purchased by Gregory of Huntingdon, a monk of Ramsey abbey, and a diligent student of the antient languages. The books thus purchased formed a valuable part of the library at Ramsey.

about 90 or 100 children, boys and girls; two other day-schools with small endowments, with from 44 to 54 boys and 16 girls; 22 other day or boarding schools, with 82 boys, 203 girls, and 314 to 334 children of sex not stated; and 3 Sunday-schools, with 156 boys and 126 girls.

(Peck's *Antiquarian Annals of Stamford;* Harrod's *Antiquities and present State of Stamford;* Drakard's *History of Stamford;* Allen's *History of the County of Lincoln; Parliamentary Papers.*)

STAMMER. The terms stammer and stutter are synonymously adopted to denote that involuntary interruption of utterance arising from difficulty and often total inability to pronounce certain syllables, the speech apparatus being frequently affected with spasm in the effort to speak.

In some stammerers the spasm consists of involuntary movements similar to *chorea* (St. Vitus's dance), which occasionally affects other than the speech muscles. Stammer with this spasm distorts the utterance by an involuntary repetition of some part of the syllable, as ge-ge-ge-good de-de-de-day. The repetitions may or may not be vocal. In other stammerers the spasm consists of involuntary immobility, similar to *tetanus* (lock-jaw), commonly of the form termed *trismus,* in which the mouth is closed, and the jaw cannot move to open it; and sometimes of the form termed *anti-trismus,* in which the mouth is open, and the jaw is equally incapable of moving to shut it. Stammer with this spasm distorts the utterance by an involuntary extension of some part of the syllable, as l——augh, where the *l* is much prolonged.

In the looseness of language resulting from inexact knowledge, all kinds of difficult and defective utterance are misnamed stammer, as the difficult utterance of the intoxicated, the faltering utterance of the paralytic, the imperfect utterance of deep emotion, as of fear, the defective utterance of malformed organs of speech, and the hesitation in discourse when the suitable word fails to present itself to a speaker's mind. Such affections of the utterance however are distinct from stammer, for

1. The stammerer's inability to pronounce words remains during health, soberness, calmness of mind, and also when the appropriate words occur to him.
2. The stammerer feels his difficulty of utterance essentially to consist in a refusal of some part of the speech apparatus to obey his will.
3. The stammerer's utmost efforts to force out any difficult word commonly excite spasm, and increase it if it previously existed.
4. The stammerer's inability to speak is intermittent: the same syllable is not always equally difficult to utter, and is sometimes uttered with ease.

Those circumstances will distinguish stammer from the misnamed stammer of paralysis, intoxication, &c.

Now to understand the nature of stammering, it is necessary to know the audibility and mechanism of utterance, which may be thus briefly described:—

The voice is produced in the larynx [LARYNX], whence it issues into the pharynx. [PHARYNX.] The pharynx opens into the nose and into the mouth; and by means of a curtain valve, named the *velum pendulum palati,* we can direct the issue of breath through the mouth or the nose, or through both mouth and nose at once. The voice is produced in the larynx, an audible sound, which may possess the distinctions of song-notes (musical sounds), as those of pitch, loudness, and quality [ACOUSTICS; MUSIC], or it may possess the peculiar conditions of those distinctions which constitute speech-notes. [ELOCUTION.] In the pharynx and mouth the volume of voice is magnified, and its quality is modified.

The elementary sounds of which speech is composed are further modifications of the voice, apart from and added to its pitch, loudness, and quality; and are produced in the mouth, pharynx, and nose. The popular classification of these sounds into vowels and consonants is adopted from its convenience. The vowel sounds of the English language are represented by the vowel letters in the following words: *a*ll, *ar*m, *a*n, *a*le, *e*nd, *ee*l, h*er*, *i*sle, *i*n, *o*ld, *oo*ze, *o*n, *u*s, *cu*be, p*u*ll, *ou*r, and *oi*l. The vowels are of two kinds, viz.:

1. Those which present a uniform sound, and thence are named monophthongs, as *oo* of the word *ooze,* in which it will be observed on verification that the cavity and aperture of the mouth remain the same during the whole time of uttering the vowel. The monophthongs are contained in the following examples: *e*nd, *ee*l, h*er*, *i*n, and *oo*ze.

2. Those which present a complex sound, in which the sound is ever varying from the initial to the final point, as in the *a* of the word *a*le, in which it will be observed on verification that the cavity and aperture of the mouth gradually change their forms from the initial to the final sound of the vowel. The *a* of *a*le ends in *ee* of *ee*l. From the circumstance of the initial and final parts of the vowel presenting different sounds, it is termed a diphthong. The diphthongs of the English languarge may be conveniently classified by the similarity of their final sounds:

| | |
|---|---|
| 1st class of diphthongs end in a well defined *ee* of *ee*l. | *a*le, the final sound is *ee* of *ee*l.<br>*i*sle, . . . . .<br>*oi*l, . . . . . |
| 2nd class of diphthongs end in a well defined *oo* of *oo*ze. | *o*ld, the final sound is *oo* of *oo*ze<br>*cu*be, . . . . .<br>*ou*r, . . . . . |
| 3rd class of diphthongs end in an obscure and faint *e* of h*e*r. | *a*ll, the final sound is *e* of h*e*r.<br>*ar*m, . . . . .<br>*a*n, . . . . .<br>*o*n, . . . . .<br>*u*s, . . . . .<br>p*u*ll, . . . . . |

The above table may be thus verified. Slowly drawl the vowel, making the final part as loud as the initial; preserve the mouth's position which moulded the final part of the diphthong *after* the cessation of voice, and then a new issue of voice through that adjustment of the mouth will produce the diphthong's final sound as a distinct monophthong.

The consonants are conveniently classed into those with and those without voice. The voice consonant sounds of the language are represented by the consonant letters in the following words: e*bb*, a*dd*, e*gg*, a*ll*, a*m*, a*n*, *r*ed, *v*ow, *w*e, *y*ou, *z*one, si*ng*, a*z*ure, *th*en, *j*ew. It will be observed on verification that these consonants have each voice throughout their duration, and that each as a separate sound can be prolonged to the utmost limit of the breath, except *b, d, g,* and *j,* which only admit of slight extension.

The voiceless consonants are represented by the consonant letters in the following words: u*p*, a*t*, ar*k*, i*f*, *h*ope, *q*uit, *s*oon, *ch*ip, *sh*in, *th*in, *wh*en. It will be observed on verification that these consonants have no voice throughout their duration; that they each have breath-sound, similar to a whisper, except *p, t, k,* which are perfectly mute; and that the remainder, except *ch, q,* and *wh,* can be indefinitely prolonged.

It is necessary however for our purpose to examine the whole of the consonants from another point of view. The consonants, like the vowels, are monophthongal and diphthongal. It will be observed on verification that one adjustment of the mouth, and one sound throughout, are characteristics in the mechanism and audibility of the following consonants:—e*bb*, a*dd*, e*gg*, a*ll*, a*m*, a*n*, si*ng*, *v*ow, *z*one, a*z*ure, *th*en; and of u*p*, a*t*, ar*k*, i*f*, *h*ope, *s*oon, a*sh*, *th*in, which are therefore named monophthongal consonants. It will be observed on verification that a complex sound and a change in the mouth's adjustment are characteristics of the following: *r*ed, *w*e, *y*ou, *j*ew; and of *q*ueen, *ch*in, *wh*en, which are thence named diphthongal consonants.

These elementary sounds of speech are the materials of the language. The utterance of these sounds is technically termed enunciation; their junction together to form syllables is termed articulation, of which there are three kinds, viz.:—

1. A vowel preceding a consonant, as *eat* = *ee* t.
2. A consonant ,, vowel ,, fee = f-ee.
3. ,, ,, consonant ,, bl = b-l.

In articulating those sounds it will be observed, 1st, that the mouth changes its adjustment for the second sound while voice is flowing through it; 2nd, that in the first example the mouth gradually closes, in order to produce the consonant; and, 3rd, that in the second example the mouth gradually opens to produce the vowel.

Observation and experiment concur to prove that the production of voice is an acoustic phenomenon depending on mechanical principles similar to those which regulate the production of sound from an inanimate instrument; for it is now agreed that the upward current of air passing through the larynx produces an effect on the vocal ligaments precisely similar to what it would if the larynx were *cæteris paribus* an inanimate mechanism. The voluntary power over the larynx adjusts it *to be acted on* by the current of air, and thus the voice is to be regarded partly as a mechanical and partly as a physiological result.

Observation and experiment concur to prove that the modification of voice into speech is also an acoustic phenomenon depending on principles similar to those which regulate the modification of sound by an inanimate instrument; for it is now agreed that the modification of voice into speech in passing through the variable cavity of the pharynx, mouth, and nose, produces an effect precisely similar to what would be produced if the variable cavity were *cæteris paribus* an inanimate mechanism.

Thus both in voice and speech the production and modification of vocal sound depend on the laws of acoustics, while the adjustments of the various parts of the apparatus which produce and modify the voice depend on voluntary muscular movement. The one is mechanical, the other physiological.*

It is familiarly known that the movement of every organ is effected by muscular contraction; that both voluntary and involuntary contraction of the muscles depend on the nerves; that all voluntary contraction is regulated by the brain; and also that the voluntary contraction of one muscle is accompanied by an adjusted voluntary relaxation of its antagonist muscle.

The speech-apparatus may be considered as consisting of the lungs or bellows, which can send a current of air through the trachea or windpipe to the larynx, which is situated on its summit.

In the larynx this current of air can be vocalized into song, or into speech-sounds, at will, which, on passing through the variable cavity, consisting of the mouth, pharynx, and nose, can be further modified into speech. Thus the speech-apparatus, as a whole machine, consists of the respiratory, the vocal, and the enunciative organs.

Variable cavity.

Larynx.

Trachea or Windpipe.

Lungs or Bellows.

The respiratory apparatus consists of the chest, the lungs, and the air-passages. The respiratory movements are involuntary and periodic; the inspiration of breath alternates with its expiration; and in both acts the breath flows in a continuous stream. There is a periodic action of the inspiratory muscles, but whether their action alternates with an action of the expiratory muscles, or simply with the spontaneous return of the parts by their elasticity and gravity, is yet undetermined. The muscular actions during the tranquil respiration of repose appear to be limited to periodic inspiratory movements.

The movements of respiration include the motions of the diaphragm, the abdominal and thoracic muscles, and those of the larynx, which dilate and contract the aperture of the glottis. The nerves engaged in these movements are the phrenic, the spinal accessory, the vagus, many of the spinal nerves, and the portio dura of the seventh. The will can influence and somewhat modify the movements of respiration; thus we can prolong or shorten the duration of an inspiration, and we can delay or hasten to begin one. We have similar control over the expiration of the breath; and we have power also to limit, or nearly so, the movements of respiration to sub-groups of muscles: thus we can breathe by the diaphragm alone, or by the ribs alone.

Sir Charles Bell, in the 'Philosophical Transactions,' 1832, has shown how the respiratory muscles can be changed at will into voluntary muscles by means of the thyroarytenoid muscles, as when a sailor leaning his breast over a yard-arm can raise himself and perform various acts by aid of the inspiratory muscles, which for a time he causes to act under the will. It is however during speech and song that the respiratory apparatus is most completely placed under control. Indeed in the act of vocalizing, whether for speech or song, the involuntary is almost superseded by the voluntary act of respiration. The will gives a different play to the chest. We breathe less by the diaphragm and more by the ribs; we shorten the duration of the inspiration and completely change the character of the expiration. A person about to speak is observed to take a voluntary inspiration, which elevates the chest, draws the abdomen flatter, and frequently also raises the shoulders.

* It is a curious fact that mechanicians constructed speaking machines to imitate the human voice and speech long before philosophers had determined how far speech is a mechanical result. It is more curious that the mechanician Kempeler excludes acoustics in his definition of a vowel, which he entirely deduces from the organs of the human mouth, thus forgetful alike of the circumstance that parrots can utter words, and that his own mechanism uttered certain vowels.

There are two modes of involuntary respiration: in the one, the breath issues in one continuous unbroken stream, as in the ordinary breathing of unruffled tranquillity, which by some emotions is hurried and involuntarily vocalized, producing sighs, groans, &c.; in the other mode the stream of breath is interrupted so that it issues in detached portions, which during some emotions is also involuntarily vocalized, producing laughter, crying, &c.

The will has power to produce voluntary expirations in both modes. The unbroken stream is termed the exhausting breath, which is often required for a long-drawn note in song. The broken stream is termed the holding breath, which is constantly required in lengths suitably adjusted to the demands of the syllables as they occur in speech. The beauties of utterance and the economy of muscular exertion which result from a dexterous use of the holding breath in public reading and speaking would require much space to describe.

The machinery of respiration, of vocalization, and of enunciation, together constitute the speech-apparatus. The various muscles subservient to those separate acts associate their functions to adjust and give play to the speech apparatus as a united whole—as a machine for the production of speech. Thus to pronounce an elementary sound, as the *ee* of the word eel, the muscles of speech (consisting of the respiratory, the vocal, and the enunciative) act in simultaneous association to produce the proper adjustment of the speech-apparatus. There are near fifty distinct elementary sounds in the English language, and hence as many different adjustments of the speech-apparatus are required for their utterance. And to pronounce a word consisting of several elementary sounds articulated together, as the word *steam* (which consists of the elements *s*, *t*, *ea*=*ee* of eel, and *m*), the simultaneous group of associated muscular movements required for each element must succeed each other in one syllabic impulse. Now it will be observed that in adjusting the speech-apparatus from a previous state of rest to pronounce any given element, the muscles have a certain movement to perform, but the movement is somewhat different when they have to readjust the speech-apparatus from a previous adjustment. This fact may be verified in pronouncing the *ee* of *eel* by itself as a distinct syllable, and afterwards the word *steam*, where the same vowel follows a *t*, from which adjustment that for the *ee* has to be made. The general conditions of respiration, vocalization, enunciation, and articulation, under which stammer occurs, are subjoined.

I. Respiration. 1. Most stammerers manage their respiration badly, although nearly all can speak freely in a whisper. 2. They feel that they have insufficient breath to speak. This sensation however arises less from an insufficiency than from attempting to speak on an involuntary inspiration. The breath is expired to be vocalized by the voluntary action of the ribs, which mechanically contract the chest's cavity. The ribs however cannot accomplish this when they are in the position in which an involuntary inspiration leaves them; they must be raised to that position to which a voluntary inspiration carries them, before they can act with mechanical effect on the chest to expire a holding breath for the purpose of conversation. 3. With the sensation of insufficiency of breath, some feel also a pain at the pit of the stomach. This pain is connected with attempting to speak on an involuntary inspiration, and its severity is commonly increased by struggling to speak.

II. Vocalization.—1. *Song-voice.* The song condition of voice seldom presents any difficulty to stammerers. The writer of this article has seen only three cases of stammer in the song-voice; and it is familiarly known that stammerers, when struggling with a difficult word, are sometimes advised *to sing it.*

2. *Speech-voice.* — The distinguishing features of this voice are described in the article Elocution. Stammer occurs in all parts of the speech-note, more frequently however in the middle than towards the end, but most commonly at the initial.

3. *Pitch of Voice.*—Changes of pitch, whether concrete or discrete (slide or skip), through narrow intervals of the scale, present difficulties which wider changes of pitch do not. Stammerers can mostly declaim, if they cannot converse or quietly read; and it is well known that wider intervals of pitch occur in declamation than in ordinary conversation.

4. *Loudness of Voice.*—When the loudness of the speech

note is of the form of the musical *diminuendo*, which begins abruptly and gradually diminishes in loudness, as thus figured >, a difficulty is presented to the stammerer which does not occur if the form be the musical *crescendo*, where the note begins feebly, and gradually increases in loudness, as thus figured <.

5. *Quality of Voice.*—The conversation tone presents a greater difficulty than the falsetto, or than the full enriched voice of epic declamation.

6. *Quantity or Duration of Syllables.*—Short and inextensible syllables present a greater difficulty than the long and extensible.

7. *Accent.*—The unaccented syllables of discourse seldom offer any difficulty to stammerers. The element, or combination of elements, which is difficult to utter with accent, is easy to utter without accent. The accent given by stress is infinitely more difficult than that given by extended duration.

8, *Rhythmus.*—The measured movement of verse is easier for the stammerer than the unmeasured movement of prose and conversation.

III. Enunciation.—Syllables are of two kinds, viz.:—

1. Those composed of one elementary sound.
2. Those composed of more than one elementary sound.

1. *Vowels.*—A vowel alone may constitute an accented syllable, and even a whole word, of which the pronoun *I* and the article *a* are familiar examples. Stammer often occurs on such syllables. The diphthongal vowels present less difficulty than the monophthongal; and the long much less than the short vowels.

2. *Consonants.*—A consonant alone never constitutes a syllable; and when two or more are combined together without a vowel to form one, such occur only as unaccented final syllables of words. The stammerer's difficulty is less to utter the elementary sounds singly than to articulate them so as to form syllables.

IV. Articulation.—As before stated, the elementary sounds are articulated in three orders of succession:—

1. The vowel followed by a consonant.
2. The consonant followed by a vowel.
3. The consonant followed by a consonant.

Stammer occurs in each of these modes of articulation. There is seldom any difficulty to articulate two consonants together; some however is felt in postfixing a consonant to a vowel, and the greatest is felt in adding a vowel to a consonant. Of this latter class there is most stammer when the consonant is *p*, *t*, *k*, or their voice correlatives *b*, *d*, *g*, especially if they precede a short vowel, as in the examples pit, top, king, bud, dot, get.

To these general conditions of voice and speech under which stammer occurs, may be added other conditions, as

Sex.—The great majority of stammerers are of the male sex.

Age.—Few stammer from their early infancy; children commonly speak freely until about five years of age. An occasional difficulty is first observed, which becomes more frequent up to the tenth year, when it is commonly at its maximum; although the spasm frequently increases in severity up to manhood. In the decline of life sometimes the stammer spontaneously diminishes, and it has been known to entirely disappear. The voices of childhood and old age differ in several respects from that of the intermediate period of life. A comparison of these voices with the above-described vocal conditions of stammer will account for the occasional spontaneous disappearance of stammer in old age.

*Voice of Childhood.*—The speech melody of infancy is set in a high pitch, which often runs into the falsetto, and is much intersected with wide intervals both concrete and discrete. The loudness is chiefly of the *crescendo* form on long whining quantities.

*Voice of Old Age.*—The speech melody often falls into the tremulous scale, the rate of utterance is slow, steady, and uniform. The loudness not often of the *diminuendo* form, and is on extended quantities. The accent is given to syllables by quantity rather than by stress, deliberate pauses are made, and the whole style is marked by the self-possession of experienced age conversing with a consciousness of superiority, if in nought else, in a longer reach of memory.

Temperature.—Sudden changes, especially from a high to a low temperature, commonly increase a stammer. The cold of travelling outside a coach in winter also increases it. It is well known that cold produces involuntary movements in chattering of the teeth and shivering of the whole body; hence the effect of cold on the stammerer's speech is what we are prepared to expect; it lessens his voluntary power over his speech-apparatus, and thus increases his stammer.

Stammerers have a greater difficulty in conveying new information than in uttering what they are aware is known to the hearer.

We now proceed to describe the varieties of stammer.

Voice stammer is of two kinds.

i. Difficulty to produce voice.

ii. Difficulty to produce voice in quantities adjusted to the syllable's demands.

i. Difficulty to produce voice.

1 *Variety.*—That difficulty which arises from ill regulated respiration, in which the effort to vocalize is accompanied with a feeling of insufficiency of breath. The stammer arises from an attempt to speak on an involuntary inspiration, when from mechanical considerations alone we know that the ribs cannot much control the chest to regulate the issue of breath to the larynx. A holding breath cannot be maintained on an involuntary inspiration, and therefore voluntary respiration for speech must always begin with an inspiration of breath.

The physiology of this stammer indicates a discipline for its removal. The organs of respiration must be drilled to rightly change the involuntary act of respiration to the voluntary, which, with a course of rhythmus, will effect a permanent cure.

2 *Variety.*—That difficulty to produce voice which is occasioned by an involuntary closure of the glottis. In this variety of stammer, instead of the larynx receiving the adjustment for vocalization in ready obedience to the will, the glottis suddenly closes, either by an involuntary associate movement, or by a tetanic spasm, probably in most cases by the latter. Some years since, Dr. Arnott pointed out the nature and means to cure it. His remedy consists in keeping open the glottis, by issuing a drone sound, such as the *e* of the word berry, before beginning to speak, and in joining this prefixed drone to the words. See his 'Elements of Physics,' vol. i., p. 603, et seq. Dr. Arnott's remedy however has fallen in repute, probably from the subjoined circumstances:

1. It has been indiscriminately applied to remedy all varities of stammer.

2. Where applicable, the principle has not been fully carried out as a discipline to the glottis. And

3. From neglect to accompany the special training of the glottis with a general rhythmical training of the whole speech-apparatus.

3 *Variety.*—That difficulty to produce voice which is occasioned by an involuntary twitching of the glottis similar to chorea. The larynx obediently receives the vocalizing adjustment, but so soon as the current of breath presses against the vocal cords, they involuntarily start from the adjustment with a sudden twitching, as if the glottal muscles were seized with St. Vitus's dance, which occasions several short sounds to be jerked out similar to those of loud laughter. This spasm is sometimes so soon excited as to preclude vocalization, when only short iterations of breath are audible. The glottis must be disciplined on sounds of the *crescendo* form of loudness in a low pitch, and proceed gradually from the song-voice to that of speech. Respiration and speech-voice training will follow, accompanied with general rythmic discipline to the whole speech-apparatus for reading and speaking both verse and prose.

ii. Difficulty to produce voice in quantities adjusted to the syllables' demands.

In this stammer the difficulty is not to produce voice, but to control its quantities. Vocalization freely takes place, but the event of two or three short or accented syllables following near together throws the glottal muscles into choreal spasm. And in most cases there is an occasional want of harmony between the actions of the expiratory muscles of the chest and those of the larynx, so that the holding breath is not fully under control. There appear to be two causes in operation to produce this stammer, viz. a tendency to spasm in the larynx, and a defect in the power to associate the movements of the chest muscles with those of the larynx. The principles of discipline for the spasm will be similar to the preceding variety of stammer; while a distinct discipline must be projected to acquire a higher degree of associating power, the nature of this special discipline will depend on the nature of the defect, which should however be accompanied with a general training to associate all the muscles in action

Speech stammer is of two kinds.

i. Enunciative, or difficulty to produce the elementary sounds.

ii. Articulative, or difficulty to join them together.

i. ENUNCIATIVE STAMMER.

1. *On the Vowels.*—The difficulty of uttering a monophthongal vowel is a voice stammer, it being an absence of voluntary control over the vocalization of the breath. The difficulty of uttering a diphthongal vowel may be either a voice or a speech stammer, and is often a combination of both. When the difficulty is to produce voice to begin the vowel, the stammer is vocal; and when the difficulty is to change the adjustment from that for the initial, to that for the final sound of the diphthong, it is a speech stammer. Three diphthongs end in *ee* of eel, viz. *a*le, *i*sle, *oi*l. Now to produce this final sound, the mouth's cavity and aperture are contracted by raising the lower jaw, and bringing the lips parallel to each other; which adjustment is effected by the masseter, the labial, and their groups of muscles, including their antagonists. These are disobedient to the will, so that the stammerer finds himself unable to control the jaw and the lips. Three diphthongs end in *oo* of *oo*ze, viz. *o*ld, cub*e*, *ou*r. Now to produce this final sound, the aperture of the mouth is contracted by pursing together the lips, while the lower jaw is sufficiently depressed to allow free egress to the voice; which adjustment is effected by the orbicular muscle of the lips with its group, including their antagonists, while the masseter and its antagonists hold the jaw in its required place. The stammerer finds himself unable to control the lips while he holds the jaw. The remaining diphthongs are less marked, and as diphthongs never present a difficulty to the stammerer.

2. *On the Consonants.*—The difficulty to utter a monophthongal consonant is a voice stammer, it being an absence of voluntary control over the vocalization of the breath. The difficulty to utter a diphthongal consonant may be either a voice or a speech stammer, and is often a combination of both. When the difficulty is to produce voice to begin the consonant, the stammer is vocal; and when the difficulty is to change the adjustment from that for the initial to that for the final sound of the consonant, it is a speech stammer. The diphthongal consonants are, r, w, y, j, q, ch, wh. In producing these sounds the stammerer's difficulty consists, in the r, to vibrate the tongue; in the w, to move the lips while depressing the jaw; in the y, to control the lips; in the j, to move the tongue while depressing the jaw; in the q, to separate the soft palate and root of the tongue along with the lips' movement; the ch and wh respectively present similar difficulties to the j and w.

Stammer on the single elementary sounds of speech can be permanently remedied only by a systematic training of the disobedient organ which occasions it. The organ must be disciplined to perform the necessary movements under all conditions of voice, which, accompanied with a general training of the whole apparatus of speech, conducted on rhythmical principles, will effectually remove the stammer.

ii. ARTICULATIVE STAMMER.

Stammer occurs in all three modes of articulation, viz.:

1. A consonant followed by a vowel, as *bee*.
2. A vowel followed by a consonant, as *ebb*.
3. A consonant followed by another consonant, as *bl* of the word *bled*.

i. *A Consonant followed by a Vowel.*—This class of difficulties in articulation, is occasioned by an inability to change the consonant adjustment of the mouth to that for the vowel. There are three varieties of difficulty of this class.

1 *Variety.*—The adjustment of the mouth for the consonant is found, on attempting to change it for the vowel, to be immovably fixed as if by tetanic spasm. This occasions an undue extension of the consonant: thus the word *laugh* is distorted into *l—augh*, from inability to move the tongue at will. It is remarkable, that until the attempt to move the tongue is made, there is no consciousness of its being involuntarily fixed.

2 *Variety.*—The attempt to change the adjustment produces a twitching similar to chorea. Thus, to illustrate the effect on the same word *laugh*, the tongue's tip involuntarily slaps against the palate, producing a repetition of the consonant, which occasions the word to be distorted into *l-l-l-l-laugh*.

An involuntary repetition of this consonant may however occur without spasmodic twitching of the tongue. An instance lately occurred, in the practice of the writer, which, without retraction of the tongue's tip from the palate the *l* was iterated. On examination it was found to be occasioned by a voice stammer, the third variety of the first kind of voice stammer.

Such cases indicate the necessity of correctly ascertaining what part of the speech-apparatus produces the stammer in order to adapt a special discipline to train it to perform its necessary movements readily.

The initial consonant is often voluntarily repeated, in a new attempt to utter a syllable, which may be mistaken for this variety of stammer.

3 *Variety.*—The attempt to change the adjustment produces an involuntary associate movement of some portion of the speech-apparatus, occasioning a syllabic sound to be uttered, in place of the required vowel. Thus, in attempting to pronounce the word *laugh*, the *l* is freely produced, but suddenly the syllable *fit* is involuntarily jerked out, perhaps more than once, when the whole word *laugh* is at last pronounced.

The involuntary associate movements are commonly similar in the same person, and consequently the involuntary syllabic sound is similar, but different persons present varieties of movement, and thence of involuntary syllables: thus one iterates the syllable *fil*, another *gub*, a third *ber*, a fourth *bed*, or *bet*, &c.

ii. *A Vowel followed by a Consonant.*—This class of difficulties in articulation is occasioned by an inability to change the vowel adjustment of the mouth to that which is required for the consonant. Nearly all stammerers can freely join a consonant to an initial vowel, but many find a difficulty in postfixing a consonant to a vowel which is already articulated to an initial consonant, as in the word *better*, where the stammer occurs in articulating the *t* to the *e* of the first syllable, which it distorts into *be-t*.

This stammer most frequently occurs when the consonant to be articulated to the vowel requires a movement of the tongue's tip for its formation, as the s, t, l, d, r, n, zh, sh, j, *ch*, and th, in such words as master, latter, willing, reader, which are respectively distorted to ma-ster, la-tter, wi-lling, rea-der. In some cases the tongue appears fixed as by lock-jaw, and resists attempts to move it; while in others the impulse of the will appears not to reach it. This stammer occurs most in dissyllabic words; the consonant, and with it the succeeding syllable, is often produced by a kind of hiccup after an involuntary prolongation of the vowel.

iii. *A Consonant followed by another Consonant.*—This class of difficulties in articulation is occasioned by an inability to change one consonant adjustment to that for another. It occurs amongst the initial consonants of a syllable, frequently prolonging both; thus distorting the word slay into s-l-ay. Sometimes the difficulty is to control the tongue's movements, as in the syllables *pray, bleed, clot*, and frequently the difficulty is to control the movement of the lips, as in the words *small, speak*, &c.

Stammer on articulating the elementary sounds of speech to form syllables, can be permanently remedied only by a systematic training of the disobedient organs to perform their required movements for the several adjustments of the mouth which are necessary to articulation. The training must be general and special. The general is a rhythmic training of the whole speech-apparatus; and the special is a training of the disobedient organ to perform its various movements in articulation, under, 1st, all conditions of voice; 2nd, in all sequences of elementary combinations; and 3rd, under varied conditions of mind and external circumstances. The mode and order of application of these principles of training will depend on the vocal and general conditions under which the stammerer can freely speak.

This brief analytic statement of the different kinds of stammer illustrates the position that stammer is a consequence of inability to make the muscular movements which are necessary to utterance.

Writers have misled themselves by assuming that all stammering depends on one cause. There are advocates for mental, for organic, and for mechanical causes. Those who believe in a mental cause however differ in opinion: thus, one refers the defect to indecision; another to absence of mind; and another to confusion of ideas, or to loss of presence of mind. The advocates for an organic cause differ also: thus, one refers it to weakness of the muscles engaged in utterance; another to confusion of the speech-apparatus by the too rapid irradiation of will to it; while others adopt the term *nervous*, as if it indicated a special cause. Those who advocate a mechanical cause are no less at variance: as one refers it to irregular teeth; another to too large a tongue; and another to the obstruction which enlarged tonsils and uvula occasion.

These, and similar conjectures, will be cleared away, and the inquiry will be narrowed, by stating what does not produce stammering, that is to say, does not cause the inability to produce, control, and associate the muscular movements of utterance. The familiar circumstances: 1, Of stammerers speaking freely under certain states of mind, and in certain conditions of voice; 2, Of the stammer sometimes entirely disappearing for a few hours or even days; for stammer is popularly known to be intermittent, though not periodically so; 3, Of its being increased by certain states of mind and conditions of voice; and 4, Of its being diminished also by certain other states of mind and conditions of voice. All these circumstances concur to prove, first, that stammering is not caused by any fixed ill constitution of mind, or weakness of will; and, secondly, that it is not caused by any structural defect in the brain, the nerves, or the muscles; for a structural defect would *always* produce an imperfect action.*

These circumstances, together with the fact of the numerous cures effected by the late Mr. Thelwall, and by the author of this article, with no other means than training the speech-apparatus, firmly establish the truth that the cause of stammering is entirely functional.

Our analytic description of stammering reveals three functional causes of inability to control the muscular movements which are required for utterance, viz.:—

I. Spasm, both of the tetanus and chorea forms. All muscles are liable to spasm. Spasm of the larynx, the tongue, the lips, and the masseter muscle, are each sources of stammering.

II. Defect in the associating power, which combines the voluntary movements of different organs in one simultaneous act, or in an allied succession of acts. Defective association of vocalization with respiration will occasion stammer; for perfect association of the voluntary movements of the larynx with those of the chest are required in utterance. The movements of the larynx and chest are effected by means of the laryngeal, the recurrent, and the expiratory nerves.

Some stammerers can associate these movements with facility, but stammer from inability to associate with them the movements of the jaw and lips, whose movements are effected by means of the third trunk of the fifth pair of nerves. And other stammerers who can associate these movements, are unable to associate with them the movements of the tongue, which are effected by the eighth and ninth pairs of nerves, and they stammer in consequence.

III. Involuntary associate movements; as after mimicing a stammerer it has been found that those muscular movements, which in the mimicry were *voluntarily* associated with the proper movements of utterance, have suddenly become linked to them so firmly in allied motion, that he is unable to dissociate them, and an actual stammer results. Thus those movements which were voluntary in the mimicry are now (in accordance with an ill understood law of nervous action) excited independently of or even contrary to the will, by the voluntary impulse which is directed to effect the proper movements of utterance.

Some movements spontaneously ally themselves with others, as those of the corresponding parts of the two sides of the body. Many persons without conscious imitation are prone to establish involuntary associate movements. And apart from all imitation, involuntary movements associate themselves in allied series with the voluntary movements; whence the origin of awkward habits. This peculiarity of disposition is often the precursor of stammering. Persons thus sensitive may acquire the habit of stammering after a conversation with a stammerer. It is stammering which originates in this cause only which can be accurately termed a habit.

The great distinction between functional derangement and vicious structures (whether arising from original formation or from organic disease) is both broad and clear. Thus the three causes of stammer above stated are functional.

The adoption of appropriate remedies for stammering then will depend on the following conditions, viz.:—1, On the part of the speech-apparatus which is affected; 2, On the cause producing the stammer; and 3, On the vocal and other conditions under which the utterance is least affected.

The principles dependent on the first condition were incidentally stated in the description of the varieties of stammer. The principles dependent on the second condition are subjoined; and the details in carrying out these combined principles depend on the third condition.

I. *Spasm.*—The great object to be effected is to enable vocalization and utterance to take place without (the impulse of the will) throwing the part into spasm. The value of voluntary periodic movements in allaying spasm of the speech-apparatus is immense, as is seen in its enabling spasmodic stammerers to sing and to read smooth verse with facility. The suggestion offered by this fact should be well followed out. Let the respiration of utterance be strictly periodic, it will then be a voluntary act, and let the voluntary act always begin with an inspiration of the breath. Mark time with the hand and foot, march in time, count time both verbally and mentally, in short periodicize every moment of body and mind, in harmony with all the varieties of English versification. The rhythmus of blank verse, of prose, and of conversation will follow. The speech-apparatus should be disciplined by going through a course of rhythmical training for the voice, such as is laid down in Cull's 'Discourse on Public Reading.'

II. *Defect in the associating power.*—The great object to be effected is to obtain control over two or more voluntary movements so as to combine them, both simultaneously and in those allied successions which are required in utterance. The stammerer must be trained to accomplish the several movements of utterance, on principles similar to those adopted to train a musical pupil. At first the piano-forte student exerts a distinct impulse of the will for each separate movement of each finger. He in time becomes a musician, and is now scarcely conscious of exercising the will to effect the movements in playing the piano. He now learns to sing; and rightly conceiving the note for the voice, he would sing it, but is unable to connect the piano accompaniment with it. His mind is absorbed in the song-note, and the instrument halts; he therefore gives more attention to the piano, and now his voice halts. His difficulty is to control two distinct sets of voluntary movements (that of the hands and that of the voice) in one combined act of accompanying his own voice. As each note of the music is read, it becomes an incitement to move this or that finger; each note of the song line becomes an incitement to adjust the larynx to intonate it; and each word of the song becomes an incitement to adjust the speech-apparatus for its utterance. The pupil is trained in various combinations of these movements, from the simplest to the most complex, so that they immediately follow his perception of the music, in allied and simultaneous groups. And when these perceptions are firmly fixed in the mind, so as to be recalled at will (remembered), the act of memory will incite the movements in similar groups.

He who has failed spontaneously to acquire the perfect association of the voluntary movements which are required in utterance, and who in consequence stammers, must be systematically taught to acquire it. When he is able to associate the voluntary movements in all the necessary groups by means of perceptions, that is to say, by *reading* what he utters, he may be unable to reproduce the movements by the mere incitement of memory, but able again to do so by recurring to his book. When however he can accomplish this, he may be unable to take part in a conversation;

* Medical men have lately drawn public attention to stammering in announcing its cure by surgical operation. The remedy proposed by one surgeon is the removal of part of the tongue; that of another is the division of of the frænum and hyo-glossi muscles; and that of a third is to excise the uvula and tonsils. Now enlarged tonsils and uvulæ exist; large tongues also, and tongues bound down by the frænum and the hyo-glossi muscles, without the co-existence of stammer, and the writer of this article states both advisedly and emphatically that very few stammerers have any deviation from the ordinary structure and condition of mouth. He has witnessed these operations, and his observations coincide with the statements of the medical journals on their utter want of success; and also on the danger of at least one of them.

The medico-chirurgical reviewer of Dieffenbach's memoir on excising part of the tongue, condemned it, and thought it necessary to caution his readers 'not to allow their minds to be too much influenced by the reports of *immediate* success after the operations.' and adds a note on the 'foolish practice of reporting cases of surgical operations almost immediately after their performance, and often before their ultimate results can be known,' and which he reprehends as 'only worthy of an advertising quack.' (*Med. Chir. Rev.*, July, 1841.)

for if he thinks on a subject, and endeavours to express his ideas in suitable language, while he yet requires concentrated attention to control the movements of utterance, he will falter somewhere; either in the language, if his attention be given to the utterance; or in the utterance, if the attention be given to the language. Training and practice will be required to cultivate the power of associating together the movements of utterance, while the mind is occupied in giving language to its ideas. It is common, even after the patient can converse with facility, for the stammer to recur from any confusion of mind, as a sudden noise, or an unexpected visitor. This will require a special training, while the patient is cautiously brought within the influence of the disturbing force.

III. *Involuntary associate movement.*—The great object to be effected is to break the association, and thus insulate the proper movements of speech from all associate movements. In making one voluntary movement an awkward person makes several others which are involuntary: thus many persons move the head and loll out the tongue while writing, many musicians have ungainly habits associated with their performance, and the ill habits of orators is a common theme of censure. By discipline these ill habits can be dissociated from the necessary movements.

Some movements have a great tendency to accompany others, as one finger that of another. Instrumental musicians offer excellent examples of the power of insulating the movements of each finger from that of the rest. By training they acquire rapidity, exactness, and decision in the movements of each finger, along with the ability to associate those movements in every possible permutation, without the intrusion of an involuntary movement. A training of the speech-apparatus on similar principles is followed by similar results. The elementary sounds of the language, in the several conditions of voice, must be systematically persevered in, under the guiding voice and the watchful ear of an experienced tutor.

The great principle which governs the construction of details, in carrying out the foregoing views, is to advance from the simple to the complex, basing the whole on that vocal condition which is most free from stammer.

The attentive reader will see that it is impossible to state more than general principles of the discipline to which the speech-apparatus must be subjected, to remedy the various kinds of stammer. He will also remark that active and accurate observation, combined with continuous exercise of mind, in adapting the instruction and training to the peculiarities of the case, is required in the tutor; and that much depends on the stammerer. On him alone depends a persevering exercise of his speech-apparatus in the projected discipline; and on him alone depends that concentration of his own mind, in watching for the occasions to apply the knowledge and power which he daily acquires; and for these acts of his own mind nothing whatever can be substituted.

It is difficult to obtain accurate statistics of stammering. Dr. Colombat estimates the proportion in France to be 1 to every 5397 inhabitants. The author of this article estimates a higher proportion in Great Britain, viz. 1 to every 3500. Of stammerers the writer's practice has shown only 13 per cent. to be females.

The writer's object has been to give an accurate statement of the facts of stammering, and the principles which he has found successful in its treatment. The reader may consult with advantage Thelwall's *Letter to Clive on Stammering*; Dr. Arnott's *Physics*; Cull's *Observations on Impediments of Speech*; and Cull's *Stammering Considered.*

STAMPS, STAMP ACTS. Stamps are impressions made upon paper or parchment by the government or its officers for the purposes of revenue. They always denote the price of the particular stamp, or in other words, the tax levied upon a particular instrument stamped, and sometimes they denote the nature of the instrument itself. If the instrument is written upon paper, the stamp is impressed in relief upon the paper itself; but to a parchment instrument the stamp is attached by paste and a small piece of lead which itself forms part of the impression. These stamps are easily forged, and at various times forgeries of them upon a large scale have been discovered. The punishment for the forgery of stamps was made a capital offence by the Act of William and Mary, and continued so until the year 1830 (11 Geo. IV. & 1 Wm. IV., c. 66), when it was punished by transportation.

In France stamps are used both for the authentication of instruments and as a source of revenue: thus they constitute a large part of the income of the municipality of Paris.

The stamp tax was first introduced into this country in the reign of William and Mary (5 W. & M., c. 21), such an impost having previously existed in Holland. The Act 5 W. & M., c. 21, imposes stamps upon grants from the crown, diplomas, contracts, probates of wills and letters of administration, and upon all writs, proceedings, and records in courts of law and equity; it does not however seem to impose stamps upon deeds, unless these are enrolled in the courts at Westminster or other courts of record. Two years afterwards however, conveyances, deeds, and leases were subjected to the stamp duty, and by a series of Acts in the succeeding reigns every instrument recording a transaction between two individuals was subjected to a stamp duty before it could be used in a court of justice. By the 38 Geo. III., chap. 78, a stamp duty is imposed on newspapers, and by a subsequent Act inventories and appraisements are required to be stamped. Legacies too are largely taxed by means of stamped receipts. Stamps are also used as a convenient method of imposing a tax upon a particular class of persons. thus, articles of apprenticeship are subject to duty, and articles of clerkship to a solicitor to no less a tax than 120*l*. Solicitors and conveyancers are required to take out annually a certificate, stamped either with 12*l*., 8*l*., or 6*l*., according to circumstances. Before a person commences practice as a physician, an advocate, a barrister at law, or an attorney, he must pay a tax varying from 50*l*. to 10*l*., under the form of a stamp upon an admission. Notaries public, bankers, pawnbrokers, and others must obtain a yearly licence in order to exercise their callings.

It is only possible thus generally to point out the nature of the things subject to stamps, as the schedule to the act 55 Geo. III., c. 124, which consolidates all the previous acts, occupies nearly 100 octavo pages. Since the year 1815 the stamp duties have been mitigated. The 5 Geo. IV., c. 41, exempts law proceedings from stamps; and the stamps upon newspapers were reduced from fourpence to a penny by 6 & 7 Wm. IV., c. 76 (1836), that duty exempting the paper from postage.

In order to protect the revenue, the stamp acts usually impose a penalty upon any fradulent evasion of their provisions; and the 44 Geo. III., c. 98, enacts that the proceedings shall be in the name of the attorney-general in England, or king's advocate in Scotland, and that the penalty shall go entirely to the crown.

But besides these penalties, the acts render an unstamped instrument invalid, and in order to increase the revenue they multiply the number of instruments to authenticate any transaction. Hence the Stamp Acts have given rise to many questions in courts of law as to the amount of stamps required by particular instruments, the nature of those stamps, the effect which the insufficiency or erroneous nature of the stamp may produce upon the instrument, and the use which may be made in a court of justice of a paper not stamped, but nevertheless unquestionably recording a particular fact.

The courts of law have usually interpreted the Stamp Acts with the same strictness with which penal statutes are interpreted, giving to exemptions as large an extension as the words will admit. On the other hand, feeling it a duty to enforce the payment of this branch of the revenue, judges oppose the admission of an instrument so constructed as to evade the payment of the stamp duty.

The main rule in the levying of these duties is that each distinct transaction between separate parties, recorded by a written instrument, shall have a separate stamp attached to it. Thus, when separate houses are let to separate tenants with distinct rents, each demise will require a separate stamp, although all are engrossed on the same parchment; but if two demises of the same estate, or even of separate estates, are made, although to separate persons, if the one demise is dependent upon the other, and the two form only one transaction, the instrument making the demises will be subject to only a single stamp. An indorsement of new terms upon an agreement already stamped, requires a fresh stamp, or cannot be admitted as evidence; and a document which has been already used, but which is wanted for a fresh purpose, must be restamped: thus, before the repeal of the duties on law proceedings, an affidavit used in one stage of a cause, before a judge in chambers, was required to be resworn and re-stamped for the hearing in court. A series of letters forming together the evidence of an agreement require only a single stamp.

An agreement not under seal may be stamped within twenty-one days after it has been signed; but in all other cases the instrument must be written upon paper previously stamped; nor will the attaching a blank piece of paper properly stamped to the instrument already executed render the latter admissible as evidence in a court of law. We shall presently mention the penalties by payment of which the severity of these provisions may be mitigated. The value of spoilt stamps, if claimed within twelve months, may be recovered, provided the absence of all fraud is established on oath.

If the court has sufficient evidence that an instrument has been properly stamped, but has been lost, or is withheld by the opposite party, it will receive an unstamped copy as evidence. Again; if a debt which has been contracted under a written agreement can be established by parole evidence, so that the existence of the agreement shall not come under the notice of the court, the plaintiff may recover without production of the agreement; but if the existence of the written agreement appears from the testimony of the plaintiff's witnesses, or from some condition coming into question which necessarily implies the existence of a written instrument, then the agreement must be produced as the best evidence; and the plaintiff cannot recover unless it is duly stamped. Nevertheless an unstamped instrument, such as a receipt or a signed account, may be used by a witness to refresh his memory as to the amounts paid in his presence or acknowledged in his presence to have been received; the case resting in such instances not on the document, but on the testimony of the witness.

An unstamped instrument, though an insufficient foundation for proceedings at law, may be used as evidence to defeat fraud, and with certain limitations to establish a criminal charge. Thus where an unstamped agreement contained matter not requiring a stamp, it was used as evidence of that matter, although invalid as evidence of the terms of the agreement. An indictment for forgery likewise may be maintained although the instrument forged may be invalid for want of a proper stamp; but such an invalid instrument is not sufficient to support an indictment for larceny.

Originally a stamp was invalid if the denomination was erroneous, although the amount paid was correct; but by the 55 Geo. III., wrong stamps, if of sufficient value, are rendered valid, unless upon the face of them they are appropriated to a different instrument from that to which they are attached. In this case the stamp is forfeited, but the instrument may be re-stamped upon payment of the penalty; by a previous act (37 Geo. III., c. 127, s. 2) any instrument, excepting bills and promissory notes, is allowed to be stamped upon payment of the duty, and a penalty of 10*l.* (or if it is a deed, 10*l.* for each skin); if it is brought to be stamped within a twelvemonth after its execution, the commissioners are allowed to remit the penalty (44 Geo. III., c. 19). Thus even during a trial an instrument may be stamped so as to render it admissible; but as this is rarely possible, it has been suggested that an officer of the court ought to be enabled to affix the proper stamp and levy the penalty; so that justice may not be defeated, or at least deferred from the want of this formal circumstance.

The general principle which regulates the courts in the interpretation of the Stamp Acts is, that on the one hand fraudulent evasion of the stamp duties shall be punished by forfeiture of all benefit from the document which ought to have been stamped; and, on the other hand, that a just claim shall not be evaded or a fraud be effected because the just claimant has unintentionally violated the stamp laws.

The stamp duties and the custody of the dies are placed under the superintendence of commissioners appointed under the great seal; to whom has also been recently entrusted the general management of the taxes. They transact their business in Somerset House, London. It may not be out of place to remark that the endeavour to impose stamp duties upon our American colonies in 1765, was one of the proximate causes of the American revolution.

The law respecting stamps, and a reference to the principal cases cited, will be found in Chitty's *Practical Treatise on the Stamp Laws.* That work has been mainly used for this article.

STANDARD MEASURE, WEIGHT, &c. In this article we separate from the general subject of WEIGHTS AND MEASURES those preliminary considerations which refer to the manner in which weights and measures are verified and preserved, so far as they can be entered upon in a work partly of reference, partly of general information. We do not pretend to complete a scientific account, but shall be satisfied with preparing the unpracticed reader to look with some degree of interest on the sources of more elaborate information to which we shall refer.

We should direct the mathematical reader to the first part of the article RATIO for the reason of the necessity of such an article as the present one; but it is sufficiently obvious, without deep consideration, that magnitudes in general cannot be described in words without reference to some other magnitudes supposed to be known. To this there is one case of exception well adapted to strengthen the rule, that of angular magnitude. An angle is a magnitude: it may grow visibly greater or less. One side of an angle remaining fixed, an alteration of the magnitude of the angle alters the direction of the other side. But direction cannot be varied without end; for if the moveable side of the angle should set out from the fixed side, and revolve, so as to make a continually increasing angle, a certain amount of change (a whole revolution) would bring the direction of the moving line again into coincidence with that of the fixed line. A whole revolution then is a permanent angular unit which cannot be misunderstood by any one who can think clearly about the magnitude in question; and a given fraction of a revolution, described in simple numbers, means the same thing everywhere, and is everywhere understood in the same sense. Give two workmen, in different countries, directions to place two bars at an angle of ·1672 of a revolution, and their angles would be sure to coincide; or if not, the error would be a consequence of want of skill, of power to do what was required, not of a complete conception of the thing required. But send to all the countries in Europe a description of a length or a weight, without reference to any other length or weight, more than can be contained in verbal description, and require the production of an equal length or weight:—No possible description could be given: there is no length or weight which has limits so perceptible (like those of a whole revolution in angular measure) that full description can be given by drawing upon ideas which we are sure the persons addressed will already possess: there is no natural unit of length or weight; and consequently it is beyond the power of any two persons, whatever their qualifications may be, to talk to each other about the magnitude of lengths or weights until some one length and some one weight have been agreed upon between them as standard references.

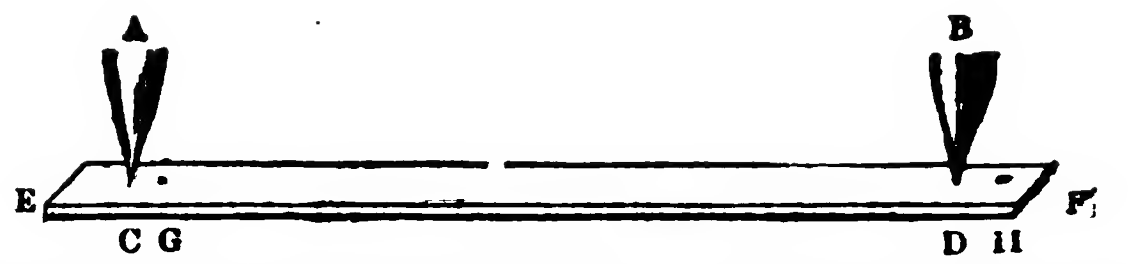
The common purposes of life require a continual reference to lengths and weights which it is intended shall be always the same, but as to which it is sufficient that they should be very nearly the same. Nature continually presents resemblances between the lengths and weights of similar things. As to lengths, for instance, the corresponding parts of different human bodies are so nearly of the same length, that, throughout the same country at least, there could never be wanting a sufficient mode of laying down a length from description, as long as a well proportioned man, neither very tall nor very short, was to be found. The foot, the cubit, the palm, the digit, the fathom, &c., differ so little in different persons, that the occurrence of these words as measures of length is no ways surprising; and when we come to that state of society in which an attempt is made to establish a uniform measure, independent of the slight variations which exist between one person and another, we might expect to see, as we do see, these names preserved to denote conventional lengths, originally derived from the human body, but fixed, or attempted to be fixed, by law.

Measures are wanted for two distinct objects, the commercial and the scientific. The wants of natural philosophy have grown up within the last two centuries; while so early as Magna Charta it was one of the concessions to the grievances of the subject that there should be one weight and one measure throughout the land. But though a few acts of parliament were sufficient, in process of time, substantially to establish the political rights which that charter was intended to grant, hundreds of them, down to the present time, have been ineffectual in producing the use of one weight and one measure. Some of these we shall afterwards refer to [WEIGHTS, &c.]: in the meanwhile we have here only to state that, as may be supposed, this unity was for commercial, not scientific, purposes; and that the resemblance of natural objects was supposed to be a sufficient reliance for obtaining it. Some of the old statutes expressly make the inch to be the length of three barleycorns, placed end to end, round and dry, from the middle of the ear. Standards were made, no doubt, from this definition; or at least it was supposed that if the existing standard should be lost, the barleycorns would enable its restoration to be effected. Our readers may smile at what they think so rude a contrivance; but the same principle, carried a little further, might be made very efficient in preserving a measure. Suppose, for example, that the government were now to think it desirable to recover the three-barleycorn inch, or at least to invent one which should be capable of being recovered. They would put together not three barleycorns, but three thousand, or thirty thousand; or many different collections of three thousand or more. The average inch deduced from these would be capable of being recovered at any time from the same grain grown in the same soil. A commercial standard might be easily recovered from many different modes of proceeding: for example, the *average* height of the barometer at a given place throughout any period of five years is so nearly the same from one five years to another, that a commercial standard might be sufficiently well obtained from it. It would be of little consequence if the yard were wrongly recovered by one-hundredth or even one-tenth of an inch, in any matter of buying and selling.

It is the *scientific* standard at which the government has been aiming during the last century. The object here is, first, to measure the old standards to the utmost accuracy of which our senses, assisted by microscopes, are capable; secondly, to discover the means of reconstructing a lost standard. In the more delicate operations of natural philosophy and astronomy, our knowledge cannot go down to posterity, unless they know within the thousandth of an inch what it is that we call a yard. The public at large has never understood the reason why so much trouble has been taken; and perhaps the members of different administrations, while trusting such investigations to men of science, and relying on them for the whole conduct of the matter, may have wondered at the great difficulty which there seemed to be in the way of furnishing the shopkeepers of all generations with yard measures and pound weights of the same values. It is our principal object in this article to endeavour to point out the nature of these difficulties, and the extent to which they have been overcome: it being remembered however that the object is scientific, not commercial, and that the standard of length is chosen as the most important illustration.

To elucidate the *principle* merely of the manner in which scales are compared, we must first show how it is that very small lengths can be measured. A screw can be very accurately constructed, say with threads one-twentieth of an inch apart: if this screw be the axis of a circular plate, which turns with it, and the edge of the plate be divided into 100 parts, each of these parts will be very perceptible, if the plate be three-quarters of an inch or more in diameter, and it will not be difficult to estimate the half or quarter of one of the divisions. Let there be an index attached to the frame, which does not move with the screw, by which it may be seen, when the plate (and with it the screw) is turned, how many divisions it is turned through. Now since a whole turn of the screw moves the end of it forward through one-twentieth of an inch, a motion of the plate which passes one of the divisions over the index, or the hundredth part of a turn, sends the end of the screw forward through only one two-thousandth of an inch, and a quarter of a division answers to one eight-thousandth of an inch. Suppose a couple of such screws, each of which is attached to a pointer, as in the following diagram, in which the pointers only are inserted, and one of the scales which are to be compared; the screws which move the pointers, and all the frame-work, being omitted. Observe also that this is not the apparatus employed, but only a convenient illustration of it.

It is supposed that A and B can be moved, by the screw motion, in such manner that a motion so small as the eight-thousandth of an inch may be given to either. The scale at present used is E F, on which are two points, C and D,




which are, or are supposed to be, exactly a yard asunder. Let the screws be moved until the ends of the pointers, which all but touch the scale, are exactly over C and D; then if the scale be removed, the length CD is retained in the distance between the points of the pointers. Now let another scale be introduced, and let its points be brought as near as may be, conveniently, to the pointers: it is supposed that the distances CD and GH are very nearly equal, for workmen used to the construction of mathematical instruments never fail in making two yard measures agree within a fiftieth of an inch. Perhaps the reader will say the point G might be brought *exactly* under the pointer A, and then the pointer B alone would show whether the present scale is shorter or longer than its predecessor: but as the pointer is much less cumbrous than the scale, it is easier and safer to put the scale in a convenient position than to attempt to place it in one exactly given. This being done, move the pointer A from C to G, and observe how many turns, or how much of a turn, of the screw, is required to do it: say it makes $87\frac{1}{2}$ divisions of the plate pass the index. Also move the pointer B from D to H, which makes, say, $97\frac{3}{4}$ divisions of the plate pass the index. Now we obviously have

$$GH = CD + DH - CG;$$

and since DH is longer than CG, it appears that GH exceeds CD by the excess of DH over CG, answering to $97\frac{3}{4} - 87\frac{1}{2}$, or $10\frac{1}{4}$ divisions of the plate, being $10\frac{1}{4}$ times the two-thousandth of an inch, or ·005125 of an inch. This experiment may be repeated any number of times, and, as may be expected, the results will not agree, since it is not to be supposed that any two persons, or the same person at two different times, will agree in their estimation of exact coincidence between the pointers and the ends of the scales. As in other cases, the averaging of the discordant results will bring out the truth very nearly.

The difference between the apparatus which was actually used in the latest experiments and that above described was as follows. The pointers were MICROMETER* microscopes, in which the intersection of two fine spider-threads, placed at the focus, was the point which was made, by a slow screw motion, to coincide with the centre of the (magnified) dot (or line) which formed the extremity of the scale. The micrometer head (the circular plate of the preceding illustration) was divided into 100 parts, each of which was found to be equivalent to one 20,000th of an inch; or a whole turn of the screw altered the position of the intersection of the spider's webs by one 200th of an inch. The magnifying power used was about 27 times in linear dimension. It was attempted, in each experiment, to estimate tenths of the divisions of the micrometer-head, or to attain† the 200,000th part of an inch. The apparatus is described in Mr. Baily's 'Report to the Royal Astronomical Society on their Standard Scale' (published in the ninth volume of their Memoirs), from which much of the present article is taken.

The first attempts to be scientific in matters of measurement made in this country date from the beginning of the seventeenth century. Previously to this time men of information probably believed that the Roman and English foot were the same, and that the pound troy was deducible from the Roman Libra. Bishop Tonstal, in his Arithmetic (1522), where he only treats what is necessary for common life, 'ad vitam communem transigendam necessaria,' cites Columella on measures of length, and deduces the system of coinage from Budæus on the Roman As. The other writers of the same century pass over the mode of obtaining measures, as if it were perfectly fixed, and generally refer to the three-barleycorn inch as a standard. In the early part of the seventeenth century we find Oughtred ('Circles of Proportion,' pp. 55-57) referring to actual measures of the content of the gallon made by the celebrated Briggs, and

* The principle is the same as that of the beam compasses, and the apparatus might be called microscopic beam-compasses, or beam-microscopes.

† Every attempt at measurement strives to be ready for more than there is any reasonable hope of attaining. It is certainly not likely, at present, that even the mean of a large number of measures would settle the question within so small a quantity; but if ever the day shall arrive when the 200,000th of an inch is attainable, the previous attempts to obtain it will point out the cause of their own failure, and probably be a source of information.

also by one William Twine, but taking the Roman foot as 'very little less if not exactly the same' as the English foot. Later in the century Dr. Wybard ('Tactometria,' p. 268, published in 1650) gives an account of experiments at which he was present, for the determination of the same gallon; and later still, in 1688, we have the experiment with the same object [GALLON], at which Flamsteed and Halley were present, which is referred to in the Report of the Committee of the House of Commons in 1758. As far as measurements are concerned, had it not been for Greaves [GREAVES, JOHN], we might have summed up the efforts of the seventeenth century by saying they were mostly directed to finding, within one, how many cubic inches there were in the several gallons. Greaves first directed attention to the difference between the Roman foot and the English, by tolerably accurate determinations of the former [WEIGHTS AND MEASURES]: he also attempted the investigation of the Roman weights, and must be considered as the earliest of the scientific metrologists. He was followed by Dr. Bernard [BERNARD, EDWARD], whose treatise on antient weights and measures (1685 and 1688) must have given a great impetus to the spirit of comparison. A work of this kind soon shows its consequences; Jeake's 'Arithmetic' (folio, 1696) contains a hundred pages on the subject. Towards the end of the century the measures of Auzout and Picard awakened attention to the comparison of standards in France. Both countries were thus prepared to desire some information from each other on the subject of their measures; and a communication took place in 1742 between the Royal Society and the Academy of Sciences for an interchange of standards. Then, for the first time, as far as we can learn, a yard was taken off on a brass rod from a standard kept in the Tower of London (which we believe is not now in existence). But the legal standard, usually so considered, was one which was kept at the Exchequer; there was another at the Guildhall, and another in the possession of the Clockmakers' company. When these came to be compared with one another and with the Exchequer standard by Graham (who also laid down an Exchequer yard on the same brass rod), it appeared that the shortest and the longest differed by seven-hundredths of an inch, a little more than the height of an *o* or an *a* in this work. But had the difference been greater, it would not have mattered much, considering the way in which standards were to be used. In our own day, after nearly a century of communication between statesmen and philosophers on the subject of a uniform measure, Mr. Baily visited the Exchequer standard (from which the copies we shall presently mention were made, and his account (Report above cited, p. 146) is as follows: 'Since the preceding sheets were printed I have had an opportunity of seeing this curious instrument, of which it is impossible at the present day to speak too much in derision or contempt. A common kitchen poker, filed at the ends in the rudest manner by the most bungling workman, would make as good a standard. It has been broken asunder, and the two pieces have been dovetailed together; but so badly that the joint is nearly as loose as that of a pair of tongs. The date of this fracture I could not ascertain, it having occurred beyond the memory or knowledge of any of the officers at the Exchequer. And yet, till within the last ten years, to the disgrace of this country, copies of this measure have been circulated all over Europe and America, with a parchment document accompanying them (charged with a stamp that costs 3*l.* 10*s.*, exclusive of official fees), certifying that they are true copies of the English *standard*.'

In 1758 a committee of the House of Commons began to investigate this subject, and was followed by another in 1759: both committees made full Reports. Both committees caused to be made, by Bird, a copy of the Royal Society's (or Graham's) copy of the Exchequer standard, and these copies, which remained in the official possession of the Speaker of the House of Commons, were called Bird's parliamentary standards of 1758 and 1760: it should be stated however that the latter was only a copy of the former. The Reports were agreed to by the House; a bill was brought in, according to their recommendation, namely, that Bird's standard of 1758 should be the national standard; but it was not carried through. A committee, appointed in 1790, did nothing; and the matter was thus abandoned. Private individuals and scientific societies began to provide themselves with standards; Sir G. Shuckburgh (*Phil. Trans.*, 1798 had one made by Troughton, which he compared with the parliamentary standards and others. Troughton made one for himself, and first introduced the micrometer microscopes into the comparisons; this last was made from one which Bird had made for the then assay-master of the Mint. Another was made for General Roy, and was used by him in the great survey; another, Bird's own private property, was in existence. Thus matters went on until the year 1814, when the House of Commons again appointed a committee to consider the subject.

In the meanwhile however experimental philosophy had made great advances, and investigators began to look more at the successes of the past than at the new difficulties which those very successes had opened into view. As soon as the measurements of the earth began to be attended with some success, the French proposed a standard measure which should be the ten-millionth part of a quarter of the meridian; which last they hoped, by their great survey, to ascertain so exactly that no future measurement should make even a microscopic alteration of their new *metre*. In England the pendulum began to be considered a perfect instrument; and the second being determined invariably by the motion of the earth, it was thought that the length of the seconds' pendulum in a given latitude would be an invariable quantity which could always be recovered. The committee of 1814, on the evidence of Playfair and Wollaston, recommended that Bird's standard of 1758 should be the one adopted, and gave it as their opinion that the length of a second's pendulum in the latitude of London is 39·13047 inches, of which the above-named standard yard contains 36. Playfair and Wollaston hinted at the necessity of verifying this number, but the committee take it for granted, and assert that any expert watchmaker can make a seconds' pendulum, without stating how that pendulum is afterwards to be measured, nor at what temperature, pressure, &c. it is to be swung. They also state that a cubic foot of pure water at 56½° Fahrenheit weighs exactly 1000 ounces avoirdupois, as the connecting link between measures of weight and capacity. No bill was brought in in consequence of this Report.

In 1819 the Prince Regent appointed a commission composed of Sir J. Banks, Sir G. Clerk, Davies Gilbert, Wollaston, Young, and Kater. This commission made three Reports, dated June 24, 1819, July 13, 1820, and March 31, 1821. In the first (we confine ourselves to matters affecting the standards) the standard yard recommended is that on the scale used by General Roy in the measurement of his Hounslow Heath base, and it was the opinion of the reporters that the mean solar seconds' pendulum in London, at the level of the sea, in a vacuum, and at 62° of Fahrenheit, was 39·1372 inches of this scale. They also take 19 cubic inches of distilled water at 50° to be exactly 10 ounces troy. In the second Report, they announce that an error has been discovered in their standard, and they propose that Bird's parliamentary scale of 1760 shall be the standard, the seconds' pendulum being 39·13929 inches. In the third Report, they announce, by new experiments, that a cubic inch of distilled water at 62° is 252·72 grains of the standard pound of 1758, when weighed in a vacuum. The House of Commons again appointed a committee in 1821, to which these Reports were submitted: this committee agreed with the commissioners, and a bill was introduced in 1823. A petition from the Chamber of Commerce at Glasgow to the House of Lords occasioned an investigation in that House also; Dr. Kelly, one of the witnesses before the committee, called attention to the known effects of variety of attraction on the pendulum, as shown by Captain Kater's own observations, and to the insufficient manner in which the level of the sea was known: and his opinion was that of few others at the time, though now nearly universally received, namely, that 'nature seems to refuse invariable standards; for, as science advances, difficulties are found to multiply, or at least they become more perceptible, and some appear insuperable.' The House of Lords adjourned the question over till 1824; when the act 5 Geo. IV., c. 74, was passed, from which extracts will presently be made. This act was to take effect May 1, 1825, but in the March of that year 6 Geo. IV., c. 12, was passed, deferring the operation of the preceding act till January 1, 1826. This last act took effect, and nothing has since been done as to the standards; there was an inquiry before the House of Commons in 1834, which ended in the statute of 4 and 5 Wm. IV., c. 49, and another inquiry before the same House in 1835, which ended in 5 and 6 Wm. IV., c. 63, repealing the former act and substituting new provisions.

These last acts however contain nothing with reference to the standards, except the following excellent wind-up of the chequered and ill understood legislation upon weights and measures. The Houses of parliament were burnt in 1834, and with them Bird's standards of 1758 and 1760 (the last *the* standard). Nevertheless 5 and 6 Wm. IV., c. 63, passed after the fire, takes no notice of the destruction of the standard, but refers to it as still in existence. Seven years have since elapsed, but we are not aware of the legislature having yet swung the pendulum to recover the lost measure.

As to the standards, the act prescribes as follows:—

1. The straight line or distance between the centres of the two points in the gold studs in the straight brass rod now in the custody of the clerk of the House of Commons, whereon the words and figures 'Standard yard, 1760' are engraved, shall be the original and genuine standard of that measure of length or lineal extension called a yard . . . the brass being at the temperature of sixty-two degrees of Fahrenheit's thermometer. . . . . The act goes on in many words to say that the pendulum vibrating seconds of mean time in the latitude of London* in a vacuum at the level of the sea is 39·1393 inches of the said standard.

2. The standard brass weight of one pound troy weight, made in the year 1758, now in the custody of the clerk of the House of Commons, shall be the original and genuine standard measure of weight. . . . The act goes on to say that the cubic inch of distilled water, weighed in air by brass weights, at 62° of Fahrenheit, the barometer being at 30 inches, is equal to 252·458 grains.

It happened fortunately for the scientific standard, that about the year 1832 the council of the Royal Astronomical Society caused a scale to be constructed for themselves, and obtained permission of the Speaker of the House of Commons to compare it with Bird's two standards, which was done in the beginning of 1834, by a much more extensive set of experiments than had ever been made before for a like purpose, conducted chiefly by Mr. Baily and the late Lieutenant Murphy. This is now, in fact, the standard scale of the country; or, at least, the only measure from which the standard scale can be deduced. The manner of conducting the comparisons has already been slightly described; we shall now proceed (from the Report already quoted) to give some account of the difficulties which were found in the way of measurement, and of the results.

This scale is a cylindrical tube of brass 63 inches long, 1·12 inches and ·74 inches in exterior and interior diameter. Three thermometers are immoveably inserted into its length, and the ends are stopped by brass plugs. Two parallel lines (·09 of an inch apart) are drawn in the upper surface; and, commencing 1¼ inches from one end, at the distance of every foot, a palladium pin is inserted in the tube, between those lines; on each of which pins, at proper distances, a fine line is cut to designate the length of a foot. The first foot is similarly divided into inches and tenths; and the middle foot (there being five in all) is bisected. The three middle feet constituted the yard which was used in the comparisons. It was found that any constraint, however slight, affected the expansion and contraction of the bar; even the friction arising from its first supports, which were lined with baize: it was therefore found necessary to support it, when under the microscopes, on friction-rollers: and care was taken that these should always be placed under the same points of the tube. To give an idea of the power of the mode of comparison, it was found, by fourteen experiments agreeing very well with each other, that the middle yard was shortened ·48 of one of the divisions of the micrometer-head (described at the beginning of the article), or ·000024 of an inch, by nothing but removing the plugs from the end of the tube.

Nothing can be known of such a bar as a scientific standard until the rate at which it expands by the action of heat is determined. By a mean of six experiments, taken with the tube at the freezing and boiling temperatures, it was found that every addition of 1° of Fahrenheit to the temperature lengthened the centre yard by ·000377 of an inch, or 7·6 divisions of the micrometer-head.

The instrument being placed ready for observation, and two scales being put down for comparison, one observer may bring both the micrometers to the ends of one scale, or one observer may be placed at one end, and another at the other. In the latter case, a new cause of error enters, of which it is impossible to give any account, though a remedy may be provided. It is not true that two persons, though using exactly the same instrument, and noting the same phenomenon under the same circumstances, will note it exactly in the same way. When one observer made (as he thought) the coincidence of the intersection of the micrometer-wires with the dot or line at the end of a scale, another, looking into the microscope, would seldom or never agree with the former that the coincidence was exactly made, but would turn the micrometer-head three or four divisions, one way or the other, before he (the second) could be satisfied that the coincidence was perfect. This difference of the manner of observing, arising from the peculiar habits of vision and judgment of the observers themselves, has received the name of the *personal equation*, and its amount, as between any pair of observers, can be ascertained by experiment. If one observer made the coincidences at both ends, it would matter nothing what his manner of observing was, since, however much he might differ from absolute correctness (be that what it may), he would differ by the same amount at both ends, and the length of the scale would not be affected. If, when two observers are employed, they make a given number of comparisons, and then change places and make the same number, the mean of all their observations will be unaffected by their mode of observing, since, if the scale be made too long in the first set, it will be made as much too short in the other, and vice versâ. Some of the personal equation might arise from the curious figures which the dots of the old scales (into which beam-compasses had been inserted) presented when viewed under the microscope. Bird's standard of 1758, for instance, had pear-shaped holes at its extremities, the centres of which no two persons could agree upon.

The following results will give a notion of the degree of accuracy obtained in the workmanship of scales. The Astronomical Society's scale was compared with the Imperial standard (Bird's of 1760); the Royal Society's scale of 1742, having two scales in it marked E and Exch.; a scale called Aubert's, the prototype of one which was used in the Indian survey by Lambton; one which had been used by Sir G. Shuckburgh; one belonging to the town of Aberdeen; one belonging to Mr. T. Jones; and four new ones made after the model of the Society's scale, one for the Danish government, one for the Russian government, one retained for himself by Mr. Simms the constructor, and one for Mr. Baily. Calling the middle yard of the Astronomical Society's scale 36 inches, the different scales are as follows, each from the mean of many observations:—

| Scale. | Standard portion. | Mean inches of Ast. Soc. scale. |
|---|---|---|
| Astron. Soc. . . | centre yard. | 36·000000 |
| Danish . . . | do. | 35·999758 |
| Russian . . . | do. | 36·000050 |
| Simms's . . . | do. | 35·999903 |
| Baily's . . . | do. | 35·999949 |
| Aberdeen . . . | do. | 35·998615 |
| Jones's . . . | do. | 35·999802 |
| Aubert's . . . | 0 in.—36 in. | 35·998447 |
| Shuckburgh . . | 0 in.—36 in. | 36·000185 |
| Do. . . | 10 in.—46 in. | 35·999921 |
| Royal Society . | line E. | 36·001473 |
| Do. . . | line Exch. | 35·993684 |
| Imperial standard of Bird's of 1760 | . . . . . | 35·999624 |

Temperature is not here alluded to, it being presumed of course that the effect of temperature upon the *difference* of two scales is inappreciable; thus the Astronomical Society's standard being ·000376 longer than the Imperial standard, and the standard temperature being 62°, the length of the former standard, observed at 62°, and diminished by ·000376 of an inch, will give the true standard of the law.

It is believed, after all, that the Imperial standard is about one 140th of an inch longer than the old standard of the country, but this matters nothing to the scientific part of the question; for all the scales which have been used in trigonometrical surveys have now been diligently compared with the Astronomical Society's scale, and are therefore known, independently of the national standard, as long as the latter scale exists. The only thing to be feared is the loss of this last-mentioned standard; the government might keep it, but cannot be trusted to use it; the Society, which knows how to use it, has no place of perfect security in which to keep it. That the government knows and cares

* The latitude of London was rather a vague phrase for legislation which could not let 'length' pass without the explanation 'lineal extension.'

nothing about the standards is obvious from the legislation which has taken place since the legal standard was destroyed; and it would not do to let the nation possess a scientific record of the first importance to be broken by Exchequer officers, or altered in length by a blow given for the purpose of impressing a government stamp.

We shall not here enter into the various modes used by Sir G. Shuckburgh, and subsequently by Captain Kater, for the determination of the standard of weight. An old standard pound exists in the Exchequer, from which in 1758 a copy was made for the committee of the House of Commons. This last, as we have seen, has been declared the standard; and was never recovered from the ruins of the late House of Commons. The original standard of weight, as prescribed in a statute of 51 Hen. III., called *Assiza Panis et Cervisiæ*, was that an English penny called the sterling, round without clipping, should weight 32 grains of wheat, well dried and gathered out of the middle of the ear; and that 20 pence should make an ounce, and 12 ounces a pound.

It is understood that a commission of men of science was appointed by the late administration to consider further on any alterations which might appear advisable, and that this commission will soon make its report. We sincerely hope that no important change will ever again be attempted until the public is ripe for the introduction of a purely decimal system. Nothing would be so easy a preliminary to the attainment of this great object as the decimalization of the coinage, which, it is the opinion of many, both men of science and men of business, might be brought about with great ease and little temporary confusion. The French decimal system was for a long time a failure, owing to the universality and suddenness of the attempted change; but if a commencement were made with the coinage (and our coinage is nearly decimal already, though few people know it), there would in a few years be an outcry for the assimilation of weights and measures to the money, arising from the advantage which would be felt in the simplification of all the money rules of arithmetic.

Since writing this article, we have seen the Report above alluded to, being 'Report of the Commissioners appointed to consider the steps to be taken for the Restoration of the Standards of Weight and Measure, 1841.' The commission was appointed in May, 1838; and its members were MM. Baily, Bethune, Davies Gilbert (who died during the inquiry), Lefevre, Lubbock, Peacock, Sheepshanks, and (after his return to England) Herschel. The Report, which is long, is accompanied by extracts from various kinds of evidence oral and written. After reciting that the standard yard was rendered absolutely useless by the fire at the House of Commons, and that the standard troy pound was altogether missing, the commissioners begin by recommending the total disuse of all attempts to procure a natural standard, and the return to the old plan of standards manufactured in metal; that four copies of the best existing representations of the old standards should be made, and carefully compared; that one of these copies should be hermetically sealed, and imbedded in the masonry of some public building, marked by an inscription, and only to be opened by Act of Parliament; that the standard of capacity be defined by that of weight, not by that of length; that various precautions, minutely named, be taken for the preservation and safe custody of the others; that the averdupois pound, and not the troy, be the standard; that the government purchase all the known copies of the old standards which have been noted in scientific operations; that no circumstance would contribute so much to the introduction of a decimal scale in weights and measures as the *establishment of a decimal coinage*, which is strongly recommended; that the old Gunter's chain be preserved in the measurement of land; that a measure of 1000 or 2000 yards receive a name, and be used coordinately with the mile, with a view to the gradual disuse of the latter; &c.

STANDARDS are those trees or shrubs which stand singly without being attached to any wall or support. In gardening and planting they are distinguished into three kinds, the full standard, the half standard, and the dwarf standard. The full standards are trees whose stems are suffered to grow seven or eight feet or more without allowing side branches to be developed, but at this point are allowed to spread in all directions. In this way most fruit-trees, with the exception of the vine, may be grown, though many of those of the almond tribe, as the peach, apricot, &c., are best grown against a wall. The various kinds of apple, pear, and plum trees are grown as full standards. In fruit-trees the primary branch or stem is often cut off at a certain height for the purpose of favouring the lateral growth; but in forest-trees grown for the sake of timber or for ornament, this treatment is never resorted to.

Half standards are those plants which are allowed to run up three or four feet and then permitted to branch out. The height at which it is desired a tree should branch out may be frequently secured by cutting off the lower branches up to that point, or by cutting down the primary branch and allowing the highest lateral branches to develope themselves. Many shrubs grow naturally in this manner, and when fruit-trees are grown in this way, it is done as a matter of convenience for gathering the fruit, or ensuring their growth under particular circumstances.

Dwarf standards are those plants whose stems are only allowed to reach a height of one or two feet before they are permitted to branch, and this object is effected in the same manner as in the last. All kinds of fruit-trees, as apple, pear, plum, and cherry trees, may be grown as dwarf standards, but these trees do not bear so good fruit under such treatment as when allowed to grow as half or full standards. Gooseberry and currant trees are best treated in this way, and when care is taken to thin them well, they produce by far the finest fruit when grown as dwarf standards of about a foot high. It is in this way that the fruit of the goose berry has been brought to so great perfection in the county of Lancashire. Many shrubs may be trained as dwarf standards, although in most instances they are more ornamental when allowed to grow as bushes with several stems direct from the ground.

STANHOPE, GEORGE, D.D., born 1660, died 1728, a dignitary of the English church, who in his life-time was regarded as an honour and ornament to the church by his rational piety and eminent charity, united with the manners of an accomplished gentleman; and whose writings, partly original and partly translated, continue to be prized as amongst the most valuable practical works which the divines of the church have provided for the edification of its members. He belonged to a family several branches of which have been enobled, and was the son and grandson of clergymen who had been harshly treated when Puritanism was in the ascendant. His father had the living of Hartshorne, in Derbyshire, where he was born. He had his earlier education in schools in the country, but was afterwards at Eton, from whence he passed to King's College, Cambridge. He had the living of Tewing, but resided for the greater part of his life on his vicarage of Lewisham, to which he was presented in 1689, by Lord Dartmouth, to whose son he had been tutor. He gave up Tewing in 1703, on being presented to the vicarage of Deptford St. Nicholas. He commenced D.D. in 1697. In 1701 he was appointed dean of Canterbury. This was the highest preferment he enjoyed, but it was understood that he would have been made bishop of Ely by the Tory Ministry of the latter years of Queen Anne, had the see fallen vacant only a few weeks sooner than happened to be the case. He was chaplain to King William and Queen Anne, and had a share in the education of the duke of Gloucester, the heir presumptive to the crown. He was a celebrated preacher, and a very influential person in all affairs relating to the church.

His principal work is his 'Paraphrase and Comment on the Epistles and Gospels as they are read in the Book of Common Prayer.' This was written originally for the special use of the duke of Gloucester. It is a large work, forming four octavo volumes, and has gone through at least nine editions. Of his other practical writings the chief characteristic is this, that they are, if not direct translations of antient authors chiefly Christian, adaptations of their sentiments to the use of members of the English reformed church. Thus we have his 'Morals of Epictetus;' the 'Christian Pattern, by Thomas à Kempis, with Prayers and Meditations for the Sick annexed;' the 'Meditations of Marcus Aurelius Antoninus;' the 'Christian Directory,' written originally by the Jesuit Parsons; 'Pious Breathings,' from the works of Saint Augustin, with select Contemplations from Saint Anselm and Saint Bernard. To these are to be added a translation of Charron's 'Three Books of Wisdom' and of the Maxims of Rochefoucault. He printed also various Sermons, including a set of Discourses at Boyle's Lectures. His translation of the 'Devotions' of Bishop Andrews, written originally in Greek, was not published till after his death. He was buried in the church at Lewisham.

STANHOPE, JAMES STANHOPE, EARL, was the eldest or only son of the Hon. Alexander Stanhope, second son of Philip Stanhope, first earl of Chesterfield. His mother was Katherine, daughter of Arnold Burghill, Esq., of Thingehill, in Herefordshire; and he was born in 1673. His father, who lived till 1707, was employed as envoy by King William to Spain in 1699, and to the Hague in 1700 (during the negotiation of the Partition Treaties), and again by Queen Anne to the Hague in 1702. Young Stanhope accompanied his father to Spain; and, after spending a year or two in that country, made the tour of France and Italy.

He first carried arms under the duke of Savoy (Victor Amadeus II.), and then under King William, in Flanders, in the war carried on against France by the Grand Alliance, which was terminated by the peace of Ryswick, in 1697. Young as he was, William was so much struck with his spirit and talent, that in 1694 he gave him a captain's commission in the foot-guards, with the rank of lieutenant-colonel. He was wounded at the siege of Namur in 1695.

He appears to have been first returned to parliament for the borough of Cockermouth, at the general election after the accession of Anne, in September, 1702; and he continued to be a member of the House of Commons from this time till his elevation to the peerage; having been returned again for Cockermouth in 1705, 1707, 1708, and 1710, for Wendover in 1714, for Cockermouth in 1715, and lastly for Newport in the Isle of Wight, in April, 1717, after having vacated his seat by taking office.*

For some years however he appears to have taken little or no part in the proceedings of the House; it is not till the year 1713 that his name occurs in the reports of the debates; and indeed he was all this time chiefly employed in quite another field. In 1702 he went as a volunteer on the expedition to Cadiz, so disgracefully misconducted under the command of Admiral Sir George Rooke; and in 1703 he proceeded to Portugal, and, having been made a brigadier-general in 1704, served under the duke of Schomberg in the still more unsuccessful operations carried on in that country, till he was forced to surrender with his regiment at discretion. But soon after, having probably been exchanged, we find him serving again under the earl of Peterborough, in whose brilliant Spanish campaign of the year 1705 he greatly distinguished himself. After the capture of Barcelona (at which he was present), in September of that year, he was sent home with despatches from Charles III.; and early in 1706 he was sent back by Queen Anne as envoy extraordinary to his Spanish majesty. In 1707 he was made major-general; and in 1708 he was appointed commander-in-chief of the British forces in Spain.† That same year he projected and accomplished the capture of Port Mahon and the reduction of the island of Minorca. In 1710 he gained the battles of Almanara (17th July) and Saragossa (9th August); but on the 27th of November following, he and the forces under his command, amounting to 2000 men, being surprised and attacked by the duke of Vendôme at Brihuega, were, after a gallant defence, forced to surrender themselves prisoners of war.

This terminated his military career. Tindal (iv. 213) says that he was detained in confinement throughout the winter of 1710-11, and 'till all the prisoners on both sides were released,' that is, till the end of the war; but it appears that he was one of the managers for the Commons on the trial of Sacheverell, in the beginning of the year 1710; and he is expressly stated to have distinguished himself in a very particular manner on that occasion before the lords in Westminster Hall. (See his speech in *State Trials*, xv. 126-134.) As soon as he got home, he had begun to take an active part in politics on the side of the Whig party, to which he had always adhered. One of the first objects against which his friends and he directed their attacks was the commercial treaty with France. Besides his exertions in the House, Tindal says that Stanhope was one of a number of gentlemen (Walpole among them) who attacked the proposed treaty through the press in several excellent pieces; and the editor of the collection of papers called the 'British Merchant,' the publication of which is believed to have chiefly prevented the ratification of the treaty, declares that the great patrons of that work were Stanhope and Charles Montagu (afterwards earl of Halifax). 'When our trade was just expiring in the late reign,' says this writer, in his preface to the republication of the papers, 'General Stanhope came into the House of Commons, as a vote was ready to pass for taking off the duties on French wines for two months, by which our treaty with Portugal would have been instantly broken, by which we should have lost above a million sterling per annum, and have reduced several hundred thousand families to the parish for subsistence. But he opposed the vote, began the debate, and brought them to consent that our merchants should first be heard before it passed.' This appears to have been on the 14th of May, 1713, when, according to the 'Parliamentary History,' the general made a long speech, the first made by him of which any note has been preserved. We find him afterwards, in the same session, moving an address to the queen (which was carried), to beseech her to use her influence with the duke of Lorraine and all other princes in amity with her, to prevent them from giving shelter to the Pretender.

On the accession of George I., Stanhope received the reward of his abilities and his party zeal, by being immediately taken into favour and office. On the 24th of September, 1714, he was appointed one of the principal secretaries of state, Viscount Townshend being the other. Stanhope and Walpole now became the ministerial leaders in the House of Commons; and in that capacity the former, in the next session, impeached two of the late Tory ministers, the duke of Ormond and the earl of Strafford (who had been plenipotentiary to the United Provinces at the negotiation of the treaty of Utrecht).

But it was not long before intrigue and disunion crept in among the knot of attached friends who had thus obtained possession of the government. Stanhope is said to have been indebted for his appointment as secretary of state mainly to Horace Walpole (Sir Robert's younger brother), who was brother-in-law and confidential secretary to Townshend, and who recommended him to that lord, to whom the king had left the selection of his colleague: 'Stanhope himself,' Coxe tells us, on the information of Lord Orford, 'had made no application for the office of secretary. His frequent residence in camps, and skill in the profession of arms, rendered him, in his own opinion, more fit for a military than a civil station; and when Walpole proposed it, he considered the offer as a matter of raillery, and applied his hand to his sword. It was not till after much persuasion, and the most solemn assurances that his compliance would materially contribute to the security of the new administration, that he was induced to accept the post.' (*Memoirs of Walpole*, i. 96.) Walpole, who had been long on terms of the most intimate friendship with Stanhope, in seconding his brother's recommendation of the latter to Townshend, had, to use Coxe's expression, 'answered for his integrity as for his own.' But from the first there had been a latent rivalry between Townshend and the ambitious earl of Sunderland, who had been very ill-pleased with the office of lord-lieutenant of Ireland, a sort of banishment, as he considered it, to which he had been appointed on the formation of the new government, and was not much better satisfied with that of lord privy seal, to which he had been since transferred—holding, in fact, as he did, that he ought to have been at the head of the administration. When the king went over to Hanover, in the summer of 1716, Stanhope was sent with him, specially charged by his colleagues to protect their royal master (and themselves) against the intrigues of Sunderland, who, under the pretext of ill health, had also sought the Continent. But the end was that Sunderland managed to gain over both his Majesty and Stanhope; and that, after much correspondence and negotiation, the details of which may be read in Coxe, Townshend was dismissed from his secretaryship, with an offer of the Irish lieutenancy, which he at first refused, and then accepted, to be turned out of it after only a few weeks' possession. Even Coxe however, who takes an unfavourable view of Stanhope's conduct in this affair, admits that 'he did not yield to the suggestions of Sunderland from venal or ambitious motives,' but rather from a conviction that Townshend and Walpole were really pursuing an ob-

* We collect the latter returns from Beatson's 'Chronological Register.' The list of the House of Commons in George I.'s first parliament, given in the 'Parliamentary History,' does not contain Stanhope's name.

† Tindal ('History,' iv. 58) asserts that in 1707-8 the parliament passed 'A Bill to discharge the Clans of Scotland from their Vassalage to their Heads who should take up arms against the Queen:' and he adds, 'This bill was chiefly owing to Major General Stanhope and Sir David Dalrymple: but, the enemy not landing in Scotland, the bill had no effect.' We cannot discover any act to this effect among the printed statutes.

jectionable course of policy. All the changes consequent upon this commotion were not completed till about the middle of April, 1717, when the cabinet was at last reconstructed by Sunderland being made secretary of state, with Addison for his colleague; and Stanhope taking the post of first lord of the treasury, along with that of chancellor of the exchequer. Even this however was only an interim arrangement: in July following Stanhope was removed to the House of Lords, by being created Baron Stanhope, of Elvaston, and Viscount Stanhope, of Mahon in the island of Minorca; and in March, 1718, he took the office of secretary, and Sunderland that of first lord of the treasury, Mr. Aislabie being appointed chancellor of the exchequer. A few weeks after Stanhope was made an earl by the title of Earl Stanhope: that same year he proceeded first to Paris and thence to Madrid, to endeavour to avert hostilities with Spain, an attempt in which he did not succeed; and he was afterwards more than once employed in similar negotiations abroad, being apparently the member of the cabinet who was considered to be best acquainted with foreign countries and foreign politics. His death was very sudden, and accordant in the circumstances of it with his constitutionally warm and sensitive temper, and with the impetuous bearing of the camp, which he had never altogether shaken off. In the course of the discussions on the South Sea Company affair, which so unhappily involved some of the leading members of the government, the duke of Wharton had, on the 4th of February, 1721, delivered some severe remarks in the House of Lords, comparing the conduct of ministers to that of Sejanus, who had made the reign of Tiberius hateful to the old Romans. Stanhope, in rising to reply, spoke with such vehemence in vindication of himself and his colleagues, that he burst a blood-vessel, and died the next day. 'May it be eternally remembered,' says the writer of the preface to the 'British Merchant,' 'to the immortal honour of Earl Stanhope, that he died poorer in the king's service than he came into it. Walsingham, the great Walsingham, died poor; but the great Stanhope lived in the time of South Sea temptations.'

This eminent person has the reputation, among his other accomplishments, of having been well acquainted with antient literature; and some evidence of his research into Roman history remains in a correspondence between his lordship and the Abbé Vertot on the constitution of the Roman senate, which was printed the same year in which he died: 'Memorial to the Abbé Vertot concerning the Constitution of the Roman Senate, with the Abbé's Answer,' London, 1721, 4to., commented upon by Hooke, in his 'Observations on the Roman Senate,' 8vo., 1758.

He married Lucy, daughter of Thomas Pitt, Esq., governor of Madras, the grandfather of the first Lord Chatham; and his titles have descended to his great grandson, the present Earl Stanhope. In addition to Coxe and the older writers, the 'History of England from the Peace of Utrecht,' by his descendant Lord Mahon, may be consulted for the latter part of his political course.

STANHOPE, CHARLES, EARL, a nobleman remarkable for the eccentricity of his character, and for his talents, was born in August, 1753. He was the eldest son of Philip, the second earl Stanhope, and his mother was lady Grisel Hamilton, granddaughter of the earl of Haddington. On the death of his father, in 1786, he succeeded to the peerage. He was twice married, and his first wife was lady Hester Pitt, the eldest daughter of the first earl of Chatham. By this lady he had three daughters, of whom the eldest, lady Hester Stanhope, quitting her family and connections in Europe, retired to Syria, in which country, after a residence of several years, she died. After the death of his first wife, he married, in 1781, Louisa, daughter of Mr. Henry Grenville, and a relative of the Marquis of Buckingham; and by this lady he had three sons, of whom the eldest is the present Earl.

It is to his mechanical inventions that Earl Stanhope principally owes his celebrity. He conferred on mankind an important benefit by the invention of the press which goes by his name. [PRINTING-PRESS.] He also made some improvements in the process of stereotype printing; in the construction of locks for canals; and among the lighter efforts of his mind may be ranked the invention of an ingenious machine for performing arithmetical operations.

During great part of his life he had studied the action of the electric fluid; and in 1779 he made public his theory of what is called the returning stroke. He imagined that when a large cloud is charged with electricity, it displaces a considerable portion of that fluid from the stratum of air in its neighbourhood; and he considered that, on the discharge of the cloud, the electric matter returns into the portion of the atmosphere from which it had been driven. By this theory he was able to explain in a satisfactory manner the cause of the death (in Berwickshire) of a man and two horses by lightning, at a time when the only thunder-cloud from which a discharge could have taken place was at the distance of several miles from the spot. (*Phil. Tr.*, 1787.)

Earl Stanhope was a decided opponent of the ministry of the day; and probably, if he were living in the present times, he would be considered as a radical Whig. Full of enthusiasm for the improvement of social institutions, he looked with complacency on the great French revolution, which he considered as an important step towards the attainment of that end; but he is said to have carried out his principles beyond the point to which men of his own party were prepared to follow him. He wrote a reply to Mr. Burke's 'Reflections on the Revolution in France;' a refutation of a 'Plan for a Sinking Fund,' which had been proposed by Dr. Price; and an 'Essay on Juries.' He died in 1816.

STANHOPE, P. D. [CHESTERFIELD, EARL OF.]

STANHOPE. [DURHAM.]

STANISLAUS LESZCZYNSKI (commonly written *Leczinski*), king of Poland, and duke of Lorraine, was the last branch of one of the most antient and distinguished families in Poland. As a proof of the consideration which that family enjoyed, not only in their own country, but even abroad, we may quote the words of a known Bohemian writer of the seventeenth century, the Jesuit Balbirnus, who says, in his 'Epitome Rerum Bohemicarum,' lib. ii., cap. 7, 'Qui Leszczynsciorum genus ignorat, Poloniam ignorat, triumphalis familia, ex qua tot duces, tot senatus decora, tot antistites et archiepiscopos numerare licet.'

The origin of that house may be said to be coeval with that of the Polish state, as its founder in Poland, a Bohemian of note, is supposed to have arrived in that country with the Bohemian princess Dombrowka, who was married in 965 to Mieczyslav, duke of Poland, who established the Christian religion in his dominions. From that time this family continued to occupy the high dignities of the church, and important offices in the state, but the name of Leszczynski seems to have been assumed by them early in the fourteenth century from the estate of Leszno.* Venceslav Leszczynski distinguished himself at the council of Constance, 1415, by his exertions in behalf of Huss, in which he was joined by all the Poles present at that council, who made on that occasion common cause with the Bohemians. It seems that the Leszczynskis had, like many other powerful families in Poland, embraced the opinions of Huss, and they were amongst the first of those who declared themselves in favour of the Reformation in Poland. A Leszczynski of the name of Raphael may be said to have given the signal of an open revolt against the Roman Catholic church, at the diet of 1552, by refusing to kneel and even to uncover himself at the celebration of high mass, in the presence of the king and the assembled states, before the opening of the diet. His conduct was tacitly approved of by the Chamber of Nuncios (House of Commons), which elected him marshal or president of the diet. The Leszczynskis also did much for the advance of learning in their country, which they particularly promoted by the establishment of a high school on their estate of Leszno or Lissa. [POLISH LITERATURE.] They passed to the Roman Catholic church in the second part of the seventeenth century, but they continued to protect against all oppression the Protestant inhabitants of their estates.

The subject of the present article, born in 1677, was son of Raphael Leszczynski, grand treasurer of Poland. He was highly gifted by nature, and received a very superior education. He was elevated to the dignity of a palatine of Posen at the early age of twenty-three. When Charles XII. of Sweden had expelled from the throne of Poland Augustus II., elector of Saxony, he wished to put one of the sons of John Sobieski in his place; but two of them, James

* The nobles of Poland began to assume their present names only about the fourteenth century, deriving them generally from some estate which they possessed, with the addition of the syllable *ski*, which answers to the English 's appended at the end of the word, instead of prefixing the *of*. Formerly they took the name of their escutcheons, which have their peculiar appellations in Poland, and generally several families have the same escutcheon, having a common origin.

and Constantine, were seized at a hunting-party, and confined in a Saxon fortress by the order of Augustus, and the younger of them, Alexander, refused the crown. Leszczynski was sent as a deputy from the diet to Charles, in order to consult about the election of a new king. A conversation which he had on that occasion with the Swedish king prepossessed the latter so much in favour of Leszczynski, that he recommended him to the assembled diet as a candidate for the throne, a recommendation which, under the existing circumstances, was equal to an order, and could not be disregarded. Leszczynski was therefore elected king, and crowned with his wife, born in Opalinski, in 1705. Between his election and coronation he had experienced a temporary reverse, and was nearly taken by the troops of Augustus, who surprised Warsaw at the time when Charles XII. was in the south of Poland. Stanislaus was obliged to fly with his family in great haste from the capital, and his daughter Maria, who became afterwards queen to Louis XV. of France, was nearly lost in the confusion of the flight, and was found in the stable of a village inn.

The arms of Charles XII. soon compelled Augustus to abandon his temporary advantages, and to sign an abdication of the crown, and Stanislaus appeared to be firmly seated on the throne of his country. But the reverse of Pultawa changed the state of affairs, and Augustus, having entered Poland with a Saxon army, resumed the throne without opposition. Stanislaus retired to the Swedish dominions, and afterwards went to Turkey, in order to induce Charles XII. to accede to a peace of which his own abdication was one of the principal conditions. He was arrested by the Turkish authorities, but treated with the honours due to his station. After some time he was permitted to depart, and he retired to the principality of Deuxponts, which was the family estate of Charles XII., and the revenues of which were assigned by him to Stanislaus. He remained there with his family for many years, and fixed his residence after the death of Charles XII. in Alsatia. His daughter Maria became queen of France in 1723, a circumstance which improved his position. In 1733, after the death of Augustus II., he was elected for the second time king of Poland; but the influence of Russia and Austria opposed to him Augustus III. of Saxony, who was elected by a small minority, but supported by a Saxon and Russian army. Stanislaus was obliged to leave Warsaw, and to retire to Danzig, where he was besieged by Russian and Saxon troops. A small French force, which came by sea to his assistance, was obliged to surrender to the besiegers, after having landed and made an unsuccessful attack on the Russian lines. Stanislaus left Danzig in disguise, and escaped from his enemies. An account of his escape, written by himself, is one of the most romantic incidents either in history or biography, and equals, if not surpasses, the interest of the adventures of prince Charles Edward Stuart after the battle of Culloden. By the treaty of Vienna (1736) between Austria and France, Stanislaus was invested for his life with the possessions of the duchies of Lorraine and Bar, retaining the title of king of Poland. He devoted himself entirely to the welfare of his new subjects and to literary pursuits. He patronized literature with great zeal, nor did he forget his native land, which he served most effectually by educating a great number of his countrymen at Luneville. He died in 1766, at the age of 89, in consequence of an accident, his clothes having taken fire when he was standing near a chimney. He was so much burnt that he died in a short time. He left some productions in Polish and French. Those in French appeared in 4 vols. at Paris, in 1765, under the title of 'Œuvres du Philosophe Bienfaisant.'

STANISLAUS PONIATOWSKI, the last king of Poland. The family of Poniatowski does not belong to the number of those houses which, having acquired by favourable circumstances great influence in that country, directed the affairs of Poland, and formed a powerful aristocracy. When Stanislaus was elevated to the throne, some of his flatterers endeavoured to deduce his pedigree from the Torellis of Italy, on account of the similarity of the escutcheons of the last-named family with that of the Poniatowskis, which represents a young bull. These genealogical pretensions have not found much credit, nor do they seem to have been countenanced by the king whose family they were intended to elevate. All that we know about the ancestors of the last king of Poland is, that his grandfather Francis Poniatowski was a gentleman of small fortune, who had served for some time in the army, and it is supposed that he died as the steward of an estate belonging to Prince Lubomirski. It was a common occurrence in Poland for the poorer nobles to serve the richer, and this was not considered derogatory to their rank. The rich nobles maintained their influence by means of their numerous noble dependents, who had equal rights with themselves, and whose votes at the elections supported their interests. The patrons rewarded the devotion of their clients by promoting their welfare in every way, and particularly by educating the children of the most favoured clients with their own. This custom was productive of excellent results, and by affording to many poor nobles the advantages of a good education, rendered them fit for the service of their country. It was in that manner that Stanislaus, son of the above-mentioned Francis Poniatowski, born in 1675, received an excellent education, which he completed at the university of Paris. [PONIATOWSKI.]

STANISLAUS AUGUSTUS, the last Polish king, was the third son of Count Stanislaus Poniatowski. He was born in 1732, at Wolczyn, an estate in Lithuania, and received a most careful education. He was of an exceedingly prepossessing exterior; and he was well informed and highly accomplished, having improved the advantages received from his education by his subsequent travels in the principal parts of Europe. Sir Hanbury Williams, who was English envoy in Poland, became very intimate with the princes Czartoryski, uncles of Poniatowski, and took a particular liking to this young nobleman. He persuaded Poniatowski to accompany him to St. Petersburg, where he was appointed British minister, and facilitated his *liaison* with the grand-duchess of Russia, afterwards Catherine II. This circumstance, and the influence of the Czartoryskis, prevented the appointment of Poniatowski as Polish ambassador at St. Petersburg, where he continued his intrigue with the grand-duchess.

The election of Poniatowski to the throne of *Poland*, the salutary reforms introduced at the same time into the constitution of the country by the Czartoryskis, and the abolition of those reforms by the influence of Russia, are described in the article on the history of Poland, as well as the subsequent events of this reign. The great progress which public education, learning, and literature made in Poland during the same reign, and owing to the patronage of Stanislaus, are likewise delineated in the article on the Polish literature [SLAVONIAN LITERATURE]; we have therefore only to mention some particulars of his life and family.

When the final dismemberment of Poland was effected, Stanislaus retired for some time to the town of Grodno in Lithuania, where he signed the abdication of his throne; a step which he is said to have been induced to adopt by the promise of the payment of his private debts. He was then transferred to St. Petersburg, and a large pension was assigned him by the emperor Paul, who treated him with great kindness in many respects, but subjected him to the humiliation of assisting at his coronation at Moscow. He died at St. Petersburg in 1798, and was buried in the Roman Catholic church of that capital.

Stanislaus Poniatowski had four brothers: 1, Casimir, born 1721, who was grand-chamberlain of Poland. 2, Francis, born 1723, who had entered the church, but died young. 3, Andrew, born 1734, died 1773, a lieutenant-general in the Austrian service. Michael George, born 1736, died 1794, archbishop of Gniesno and primate of Poland. There were also too sisters, Louisa, born 1728, married to Zamoyski, palatine of Podolia; and Isabella, born 1730, married to Branicki, castellan of Cracow, and the last scion of an illustrious house. This family was invested with the princely title at the coronation of Stanislaus.

The family Poniatowski rose to great distinction in a short time, but it soon passed away, and became extinct. The last of that family was Prince Stanislaus Poniatowski, son of Prince Casimir, the grand-chamberlain, and who died in 1833 at Florence, after having lived for many years in Italy. The last of the Poniatowskis who supported the honour of that name, and whose chivalrous death at the battle of Leipzig, 1813, gave a new eclat to this family, was Prince Joseph, son of Andrew and Countess Kinsky, born 1763. [PONIATOWSKI, PRINCE JOSEPH.]

STANLEY, THOMAS, was born in 1625, at Cumberlow in Hertfordshire. His father, Sir Thomas Stanley who was connected with the noble family of the earls of Derby, had his son Thomas, during the first fourteen years, educated in his own house in Cumberlow-green, under the tuition of Fairfax, the translator of Tasso. He applied himself with great zeal not only to the study of the antient languages, but also acquired great facility in reading French, Italian, and Spanish. In 1639 he was accompanied by his tutor to Cambridge, where he entered Pembroke Hall, and continuing his studies with the same ardour, soon distinguished himself among his fellow students. In 1641 he obtained at Cambridge the degree of MA., which, according to the register of the university of Oxford, he had obtained in the latter place a year earlier. But it is not known whether he ever studied at Oxford. Some of his biographers state that after the year 1641 he travelled for some time on the Continent, while others are not only silent upon this point, but expressly affirm that while his family during the civil commotions in England took refuge in France, Thomas alone remained behind, and took up his residence in London in the Middle Temple, where he formed an intimate friendship with Edward Sherburne, afterwards Sir Edward Sherburne. In his new place of residence Stanley devoted his time partly to his professional pursuits, but more especially to the study of the antients. The first time that he made his appearance as an author was in 1649, with a volume of Poems and Translations, which has subsequently been often reprinted.. The volume contains some English and Latin original poems, together with translations from Greek poets. About the same time he translated several French, Italian, and Spanish poems into English. It must have been as early as this time that his chief attention was directed to one of the two great works to which he owed his reputation,—we allude to his 'History of Philosophy,' the first edition of which appeared in three parts from 1655 to 1662, folio, and was dedicated to his uncle John Marsham, to whom the author attributes the merit of having designed the work. The title is, 'The History of Philosophy, containing the Lives, Opinions, Actions, and Discourses of the Philosophers of every Sect.' A second edition appeared in 1687, folio; a third in 1701, folio; and the fourth and last, London, 1743, 4to. The work was translated into Latin by Gothofredus Olearius, Lips., 1711, 4to., with numerous additions and corrections. The latter part of the original, containing the 'History of the Chaldaic Philosophy,' was translated into Latin by Leclerc in 1690, and is contained in vol. ii. of his 'Opera Philosophica.' Stanley's 'History of Philosophy' was certainly at the time a great production, which excelled all that had been done before him in this department; but it is nevertheless only a storehouse of facts and materials diligently collected, and as such it is still a useful book. In every other respect it has been superseded by later works on the same subject.

After the completion of his 'History of Philosophy,' Stanley devoted most of his time to the study of the Greek poets, more especially to Æschylus. In 1663 (some editions bear on the title-page the date 1664) he published the tragedies of Æschylus, with a Latin translation, an explanatory commentary, the Greek scholia, and the fragments, in one vol. folio. This edition, though one of the best that had then appeared, has no great critical value. It was afterwards reprinted, with some alterations, by De Pauw, Hague, 1745, 4to.; and with some improvements by S. Butler, Cambridge, 1809, &c. After the publication of his Æschylus, Stanley began an extensive commentary on Æschylus. This work, on which he spent the greater part of the last years of his life, has never been published. The manuscript, consisting of eight volumes folio, is preserved in the public library at Cambridge. There are also some other works, chiefly commentaries on antient authors, which are ascribed to him, and have never yet been printed.

Stanley appears to have continued the practice of the legal profession, but he can never have devoted much time to it. He is said to have been a man of great benevolence and integrity. He died in London on the 12th of April, 1678, and was buried in the church of St. Martin's-in-the-Fields.

See the memoir of Stanley by Sir Egerton Brydges, prefixed to his edition of Stanley's Poems (London, 1814 and 1815); and William Wotton's Latin Eulogium on Stanley, in his *Scævolæ Sammarthani Elogia Gallorum Sæculo XVI. Illustrium. præfationem præmisit Ch. A. Heumannus; subjunctum est, quod primum nunc editur Guillelmi Wottoni Elogium Thomae Stanleii*, p. 307, &c.

STANLEY, JOHN, bachelor in music, a composer and organist of no inconsiderable celebrity during the latter half of the last century, was born in 1713. Two years after his birth he became blind, owing to an accident, a circumstance which renders the progress and success of his professional life highly interesting, if not almost marvellous; though certainly there are a few other instances on record of as great attainments in persons suffering under a similar privation, among whom Blacklock the poet and Saunderson the mathematician are striking examples. At the age of seven he began to learn music, as an amusement, in which he was instructed by Reading (composer of 'Dulce Domum'), one of the disciples of Dr. Blow, and evinced such extraordinary aptitude for the art, that what his father intended as some alleviation of a grievous calamity, was soon converted into a profession, and the sightless boy became the pupil of one of our great church composers, Dr. Greene, under whom he made such rapid, such astonishing advances, that at the age of eleven he was appointed organist of All-Hallows, Bread Street, and at thirteen was elected to a similar situation in St. Andrews, Holborn, though he had many able competitors. In 1734 the benchers of the Middle Temple chose him as one of their organists, and the two latter places he held till his decease. On the death of Dr. Boyce, in 1779, Mr. Stanley succeeded him as Master of the King's Band, and regularly discharged the duties of the office by setting to music the two odes annually produced by the poet-laureate, which were performed at the drawing-rooms held at St. James's on New-Year's day and the king's birth-day. During many years Mr. Stanley carried on the Lent oratorios at Drury Lane theatre; first in conjunction with Mr. Smith, Handel's successor in those performances, and next with Mr. Linley. [LINLEY.] These he conducted in person, accompanying all the songs, choruses, &c. with an accuracy that the ablest musician, in full possession of the sense of vision, could not have exceeded. It is therefore almost superfluous to say that his memory was of the most extraordinary kind, many instances of which are still related, as well as of the additional strength which his other senses gained, apparently as a compensation for the loss of that important one which he had to deplore.

Mr. Stanley died in 1786. His compositions, all of which were published during his life, were numerous, and chiefly of the vocal kind; but he wrote many voluntaries for the organ, which long continued exceedingly popular. These, as well as his cantatas, songs, &c., were widely circulated, and not only spread his fame throughout the two kingdoms, but proved the source of much profit to the author: pleasing in melody, and easy to execute, they were generally admired, but are deficient in some of those qualities which are required in works of lasting reputation.

STANNARY, from the Latin *Stannum*, 'tin.' This term sometime denotes a tin-mine, sometimes the collective tin-mines of a district, sometimes the royal rights in respect of tin-mines within such district. But it is more commonly used as including, by one general designation, the tin-mines within a particular district, the tinners employed in working them, and the customs and privileges attached to the mines, and to those employed in digging and purifying tin.

The great stannaries of England are those of Devon and Cornwall, of which the stannary of Cornwall, particularly in modern times, is by far the more important.

The stannary of Cornwall, and also that of Devon, were granted by Edward III. to the Black Prince, upon the creation of the duchy of Cornwall, and are perpetually incorporated with that duchy. [WALES, PRINCE OF.] In general both stannaries are under one duchy-officer, called the lord warden of the stannaries, with a separate vice-warden for each county. The stannary of Cornwall is subdivided into the stannary of Blackmore, in the eastern parts of the county, and the stannaries of Tywarnhaile, Penwith, and Helston, in the west.

All tin in Cornwall and Devon, whoever might be the owner of the land, appears to have formerly belonged to the king, by a usage peculiar to these counties; the general prerogative of the crown extending only to mines of gold or silver, or other mines in which the value of the gold or silver exceeds that of the inferior or base metal with which it is combined. (12 Coke's *Rep.*, 9.)

King John, in 1201, granted a charter to his tinners in Cornwall and Devonshire, authorising them to dig tin and turves to melt the tin anywhere in the moors and in the fees of bishops, abbots, and earls, as they had been used and accustomed. (Madox, *Exch.*, 279 t, 283 l.) This charter was confirmed by Edward I., Richard II., and Henry IV.

The privilege of entering the lands of strangers for the purpose of mining, conferred, or rather recognized, by the charter of John, is not peculiar to this country. Thus, by an edict of Charles VI. of France, of 30th May, 1413, power is given to all miners and others to search for and open mines wherever they may expect to find them, giving security to the owner to make him satisfaction, according to a valuation to be made *au dit de deux prud'-hommes*. This satisfaction was afterwards declared to be merely the value of the land, &c. taken, without reference to the mines. (Mathieu, *Code des Mines*, &c., 11, 45, 107.)

In Cornwall the right of digging in other men's land is now regulated by a peculiar usage, called the custom of *bounding*. This custom attaches only to such land as now is or antiently was *wastrel*, that is, land open or uninclosed. The mode of acquiring a right to *tin-bounds* is this: an agent goes on the spot to be bounded, and digs up the turf or surface, making little pits at the four corners towards the east, west, north, and south, of a reasonable extent; and the area or space within the four corners will be the contents of the bounds. Having made these corners, the agent describes on paper the situation of the bounds, states the day when, and the person by whom, they were marked out or cut, and makes a declaration for whose use this was done, expressing therein that the spot was free of all lawful bounds. At the next stannary court he procures this description to be put on parchment, when a first proclamation is made of it in open court, the parchment or paper being stuck up in a conspicuous place in the court, and a minute of the transaction is made by the steward in the regular court paper. On the next court day, three weeks afterwards, a second proclamation is in like manner made, and so also at the third court; when, if there be no successful opposition, judgment is given, and a writ of possession issues to the bailiff of the stannary, who delivers possession accordingly. In this mode the bound-owner acquires a right to search for and take all the tin he can find, paying the lord of the soil one-fifteenth, or to permit others to do so; and to resist all who attempt to interrupt him. The bounds must be renewed annually, by a bounder employed on behalf of the bound-owner, or the lord may re-enter.

As part of the stannary rights, the duke of Cornwall, as grantee of the crown, has or had the pre-emption of tin throughout the county, a privilege supposed to have been reserved to the crown out of an original right of property in tin-mines, but which in modern times is never exercised.

Formerly for the redressing of grievances and the general regulation of the stannaries, representative assemblies of the tinners were summoned both in Devonshire [LYDFORD] and in Cornwall. These assemblies were called parliaments, or convocations, of tinners, and were summoned by the lord warden of the stannaries, under a writ, issued by the duke of Cornwall, or by the king, when there was no duke, authorizing and requiring him so to do. The last convocation was held in 1752. (*Appendix* to the case of Rowe *v.* Brenton; 3 Manning and Ryland's *Reports*.)

The duties payable to the duke of Cornwall on the stamping or coinage of tin were abolished by 1 & 2 Vict., c. 120.

The new modelling of the stannary courts under 6 & 7 Wm. IV., c. 106, has been already noticed under CORNWALL. Since that article was printed further regulations for these courts have been introduced by 2 & 3 Vict., c. 58.

STANSTEAD. [ESSEX.]

STANZA (*Stance*, in French) an Italian word which means room or dwelling-place, is used in poetry to designate certain parts or divisions of a poem, each forming a complete period within itself, and consisting of a number of lines regularly adjusted to each other, and containing every variation of measure or rhyme which is to be found in the whole poem. There is a great variety of stanzas in the poetry of modern languages, according to the rhythm and structure of the poem. There is the terzina of three lines, used chiefly by the Italians and Spaniards for satires, elegies, and descriptive poetry; the quartetto (quatrain, in French) of four lines, used in didactic poems; the sestina, 'sixain,' of six lines, used in lyric poetry; the ottava, consisting of eight lines, uses in epics, &c. Each of these is susceptible of various combinations of measure and rhyme. [LYRICS.]

STAPEL, JOHN BODÆUS A, a Dutch physician, and distinguished as a botanist. He was born at Amsterdam in the beginning of the seventeenth century, where his father Engelbert Stapel practised as a physician. He finished his education at the university of Leyden, where, under the tuition of Vorstius, he acquired a taste for botany, and, in conjunction with this science, he applied himself to the study of the Greek language for the purpose of publishing a complete edition of the botanical works of Theophrastus. In the midst however of his studies and preparations for his great work, he died at an early age in 1636. He left materials enough for his father to publish an edition of the ten books of Theophrastus, 'De Historia Plantarum.' This work was published at Amsterdam in 1644, and exhibits great industry, being perhaps one of the most laborious editions of Theophrastus ever published. Under the head of each plant he has given all that has been said upon it by Dioscorides, Pliny, and other writers. In addition to plants known to the antients, he has given descriptions of new ones from America and the Cape of Good Hope. Among the latter is a species belonging to the genus which Linnæus has consecrated to his name and called *Stapelia*. The original plant was called by Stapel *Fritillaria crassa*. He had made preparations for an edition of Theophrastus' 'Αἴτια Φυτικά,' or 'De Causis Plantarum;' but his papers were not sufficiently forward for publication. He was a botanist of great promise, and his early death was much lamented by his contemporaries. (*Biog. Univ.*)

STAPE'LIA, the name of an extensive and curious genus of African plants, given to it by Linnæus in honour of John Bodæus a Stapel. This genus belongs to the natural order Asclepiadaceæ, and possesses the following characters: corolla rotate, 5-cleft, fleshy, in the inside of which is a double nectary, consisting of two rows of leaves, the inner leaves, of which there are five, are subulate; the outer leaves are broader and undivided; the anthers are simple at top; the pollen masses are fixed by their base, having one of their edges cartilaginous and pellucid; follicles two, smooth; seeds numerous, comose. Most of the species of this genus are natives of the Cape of Good Hope. They are succulent plants without leaves, frequently covered over with dark tubercles, giving them a very grotesque appearance. From uncertain points of their succulent stems large flowers expand themselves, exhibiting a variety of colours, and marked in the most grotesque manner. In most instances the flowers give off very unpleasant odours, which have been compared to carrion, rotten cheese, putrid water, and other unpleasant smelling substances. These odours however have not prevented their being very generally cultivated on account of their singular and beautiful flowers. The genus is at present imperfectly understood, and many species that were originally referred to Stapelia are now placed under a variety of other genera, as *Podanthes*, *Tridentea*, *Orbea*, *Piaranthus*, *Huernia*, &c. The great diversity in the form, colour, size, and structure of the flowers of these plants, have afforded the means of distinguishing a large number of species, but the whole have a family likeness which is possessed by few genera. We shall therefore only give two or three examples.

*S. hirsuta*, hairy Stapelia, or Carrion-flower: corolla with the segments villously ciliated with white hairs, and the base villous from red hairs, the segments ovate, acute, and transversely corrugated; segments of outer whorl of nectary acute, lanceolate, of the inner spreading. The stem is angular and erect, the flowers appearing at its base. The corolla is very large, of a dark chocolate-crimson colour, streaked with yellow, the marginal fringe resembles a grey fur; the nectaries are red. The whole flower is the size of a French rose. The smell of this plant is so like that of carrion, that flesh-flies deposit their ova in the flower, and when the maggots are produced they are starved for the want of food. Sir John Hill wrote an essay to prove that the fly which attacked these plants was a peculiar species, whose larvæ lived on the flower, which seems to have been an error of observation, but for which Fabricius, the entomologist, spoke of him as '*damnandæ memoriæ Johannes Hill*.' This plant is a native of the Cape, and is one of the earliest species brought to Europe by the Dutch.

*S. pulvinata*, Cushion-flowered Stapelia, has a procumbent stem, with quadrangular erect branches, at the base of which the flowers appear; the segments of the corolla are roundish, wrinkled transversely, ciliated, bottom of corolla elevated, covered with hairs. This is the most elegant of the species, and, notwithstanding its unpleasant odour, the Dutch natives of the Cape call it the Arabian

Rose. The corolla is very large, and its segments are of a deep violet colour, variegated with whitish transverse wrinkles, and red at the bottom.

*S. Gordoni*, Gordon's Stapelia: stem with square branches and tubercles ending in a spine; corolla orbicular, slightly 5-cleft, segments broad, roundish, acuminated. It has erect long follicles which are solitary, and thus form an exception to the rest of the genus. The flowers are very large, almost 3 inches in diameter, of a brownish-yellow colour with a whitish centre; the segments of the nectary are black in the middle and white on the edges.

In the cultivation of this and the allied genera, the soil best suited for them is a mixture of loam, sand, lime, or brick rubbish. If placed in a better soil, they become luxuriant and are exposed to rotting, especially if they are supplied with too much water. They may be increased by cuttings, which should be allowed to dry for ten days or a fortnight after they are cut, before they are planted, which should be done in separate pots. Water should be very sparingly given to these plants, they require none in winter, and in summer a little increase should be given them during flowering.

STAPES. [EAR.]

STAPHISAIN, a substance discovered by Couerbe on the *Delphinium Staphisagria*. It is solid at common temperatures, of a light yellowish colour, melts at about 392° Fahr., and at a higher temperature is decomposed, yielding much charcoal and ammoniacal vapour. The taste of this substance is extremely acrid, and water, though it takes up only a very small portion of it, acquires an acrid taste. Dilute acids dissolve, but do not appear to form salts with staphisain, and therefore, although in its composition it greatly resembles the vegetable alkalis, it does not possess their power of forming salts.

By the action of nitric acid when heated, staphisain loses its peculiar properties, and is converted into a yellowish resin; chlorine, when heated to about 300° Fahr., deepens the colour, renders it very brittle, and deprives it of its acrid taste.

According to Couerbe, it consists of very nearly—

| | | | |
|---|---|---|---|
| Hydrogen | 8·67 | 23 | equivalents. |
| Carbon | 73·89 | 32 | „ |
| Oxygen | 12·09 | 4 | „ |
| Azote | 5·35 | 1 | „ |
| | 100· | | |

STAPHYLEA'CEÆ, a small natural order of plants belonging to the syncarpous group of polypetalous Exogens. They are shrubs with opposite pinnate leaves, having both common and partial petioles, and the flowers arranged in terminal stalked racemes. The calyx has five sepals, which are imbricated in æstivation; petals five; stamens five, alternate with the petals, perigynous; ovary 2- or 3-celled, seated on a disk; fruit membranous or fleshy, frequently deformed by the abortion of some of its parts; exalbuminous, roundish, ascending seeds, with a bony testa, large hilum, and thick cotyledons. There are only three genera and ten species belonging to this order, which are inhabitants of the warmer and temperate parts of the earth. Only one species, the Staphylea pinnata, is found in Europe. This order was separated by Lindley from the order Celastraceæ, with which it is most nearly allied, but from which it is distinguished by its opposite pinnated stipulate leaves. One of the genera, *Turpinia*, has unisexual flowers. The species do not possess active properties. The seeds of all contain a mild oil, which may be expressed.

**Turpinia paniculata.**

*a*, branch showing the opposite leaves (also the unisexual monœcious flowers of this genus); *b*, tricoccous fruit; *c*, female flower; *d*, transverse section of fruit; *e*, section of seed.

STAPHYLEA (from σταφυλή, a bunch of grapes), the name of a genus of plants, the type of the natural order Staphyleaceæ. It has a coloured 5-parted calyx, with an urceolate disk at the base; five upright petals; five stamens standing round the disk; an ovary with from two to three styles, with a small stigma; a membranaceous swelled capsule with two or three cells, and one or two seeds in each. This genus has six species, of which one is a native of Europe, one of North America, one of Japan, two of Jamaica, one of Peru, and one of the Himalaya.

*S. pinnata*, common bladder-nut, is known by its pinnated leaves, petioles without glands, two styles, and bladdered capsules. It is a native of woods and thickets in the middle and south of Europe. It is admitted into the 'British Flora,' on the ground of its occurring occasionally in hedges and thickets in Yorkshire. It is frequently planted in shrubberies as an ornamental shrub, for which it is well adapted. It has a firm white wood, which adapts it well for various kinds of turning. The seeds are eatable, and act as a mild aperient: this arises probably from the oil they contain. The flower-buds, when gathered young, are pickled and eaten as capers.

*S. trifolia*, three-leaved bladder-nut, is characterised by its ternate leaves, and its petals longer than the calyx. It is the species of North America, where it is found on dry hills in rocky situations from New York to North Carolina. It is also frequently cultivated as an ornamental shrub, and its wood and seeds may be used for the same purpose as the last.

In the cultivation of these plants they may be increased by seeds, suckers, and cuttings. The seeds should be sown in the autumn, about an inch in depth; and the following spring or autumn the larger plants may be placed out in nursery-rows, about two feet apart. Suckers may be cut off early in the spring or autumn, and placed out in rows at once. Cuttings should be made in autumn, and planted in a shady border: they may be planted out in rows the following autumn. The cuttings should be taken from the preceding year's shoots at the part nearest the stem.

*S. Emodi* is an Indian species: it was found by Dr. Royle in the Himalayas, at an elevation of 7000 feet. (Royle's *Ill. Him. Bot.*, p. 166.)

STAPHYLO'MA (from σταφυλή, a grape, to which some forms of the disease bear a very distant resemblance) is an affection in which some part of the eyeball is protruded beyond its natural position. It may exist in either the cornea or the sclerotica [EYE], and, according to its seat, is named S. corneæ or S. scleroticæ. It is most frequent in the former, and may arise from any cause by which the texture of the cornea is so weakened as not to be able to resist the ordinary force by which the fluids behind it are secreted, or (which is perhaps more common), from an ulceration of the cornea, which is first filled up by the adhesion of the iris and a newly-produced tissue, and is then distended. In either case the cornea is generally of a dull pearl-white hue and opaque, so that the loss of sight is complete and irremediable. Its treatment, of which the main object is to prevent the increase of the protrusion, and to relieve the pain to which the distension of the diseased parts gives rise, must vary with the circumstances of each case: the extreme measure is the removal of the protruded portion of the cornea.

Staphyloma may affect that part of the sclerotica which is near the cornea at the same time that it occurs in the latter. When it occurs in the sclerotica alone, it is usually the result of some morbid growth or of some fluid effusion within the eyeball behind the lens.

STAPLE, 'anciently written *estaple*, cometh,' says Lord Coke, 'of the French word *estape*, which signifies a mart or market. It appears to have been used to indicate those marts both in this country and at Bruges, Antwerp, Calais, &c. on the Continent, where the principal products of a country were sold. Probably in the first instance these were held at such places as possessed some conveniences of situation for the purpose. Afterwards they appear to have been confirmed, or others appointed for the purpose by the authorities of the country. In England this was done by the king (2 Edw. III., c. 9). All merchandize sold for the purpose of exportation was compelled either to be sold at the staple, or afterwards brought there before exportation. This was done with the double view of accommodating the foreign merchants, and also enabling the duties on exportation to be more conveniently and certainly collected. Afterwards the word staple was applied to the merchandize itself which was sold at the staple. The staple merchandize of England at these early times, when little manufacture was carried on here, is said by Lord Coke to have been wool, woolfells or sheepskins, leather, lead, and tin. Incident to the staple was a court called 'the court of the mayor of the staple.' This court was held for the convenience of the merchants, both native and foreign, attending the staple. It was of great antiquity; the date of its commencement does not appear to have been certainly known. Many early enactments exist regulating the proceedings at the staple and the court held there. Most of these were passed during the reigns of the two Edwards, the first and the third of that name. These kings appear to have been extremely anxious to facilitate and encourage foreign commerce in this kingdom; and by these statutes great immunities and privileges are given, especially to foreign, but also to native merchants attending the staple. The first enactment of importance is called the statute of merchants, or the statute of Acton-Burnel, and was passed in the 11th year of Edw. I., A.D. 1283. By virtue of it a merchant might cause his debtor to come before the mayor of the staple and make a recognizance acknowledging his debt, and the day when the payment of it was due. This was entered on a roll with the seal of the debtor and of the king attached; the roll was made double, one part was given to the debtor, the other was to be used for the purpose of enforcing payment to the creditor. If the debtor did not discharge the debt within a quarter of a year after the day mentioned by the sale of his lands and goods, all his lands and goods were to be delivered to the creditor, to be held by him until the debt was paid. By this process the creditor became possessed of an estate of freehold in the lands, defeasible by the payment of the debt. And if the land was held over that period by the creditor, the debtor was entitled to a scire facias [SCIRE FACIAS] to recover his land. But the statute more expressly directed to this subject was passed in the 27th year of Edw. III., cap. 8, and is entitled the statute of staple. One object of it was to remove the staple, previously held at Calais, to various towns in England, Wales, and Ireland, which are appointed by the statute itself. It is interesting to be able to ascertain what towns at that period were thought of sufficient commercial importance to have a staple assigned to them. Those chosen in England were Neof-Chastell sur Tyne (Newcastle-on-Tyne), Everwyk, or Deverwyk (Eboracum, York); Nicole, or Nichole (Lincoln); Norwich, Westminstre, Canterbiers (Canterbury); Cicestre (Chichester); Wincestre (Winchester); Excestre (Exeter); and Bristut (Bristol); in Wales, Karmardyne (Carmarthen); in Ireland, Develin (Dublin), Waterford, Corke, and Drouzda (Drogheda).

The staple merchandize named in this statute consists of those already mentioned, with the exception of tin. Wool and lead were directed to be weighed there, and the wool sealed. Each staple town had a port assigned to it, at which the staple goods brought to the town were exported, and where the duties were paid; and it is remarkable that at this period, so far was the policy of the navigation laws from being acted on, that the whole of the exportation was to be carried on by the foreign merchants only. Native merchants were prohibited on pain of felony from exporting any of the staple commodities. The boundaries of the staple were the walls of the town in which it was held; where it was held in an unwalled town, they were the same as those of the town itself. The boundaries of the staple at Westminster began at Temple Bar and extended to Tothill. All persons attending the staple were exempt from purveyance. Matters connected with it were not subject to the cognizance of the king's courts, and the king's officers were prohibited from interfering in places where the staple was held. The court consisted of a mayor, who was to be acquainted with the law merchant, and was elected every year by the merchants attending the staple, both native and foreign; he was attended by two constables, also elected by the merchants, and who held their office for life. Two alien merchants, one, as the statute says, 'towards the north,' probably a German, 'the other towards the south,' Italian, were to be chosen to be associate in judgment with the mayor and constables, and also six mediators of questions between buyers and sellers. Of these six persons, two were to be Germans, two Lombards, and two English. Correctors also, as well of strangers as of natives, were to be appointed, having knowledge of several trades, to record the bargains which were made by such persons as desired to have their assistance for that purpose. A variety of other officers, porters, packers, winders, workers, and other labourers of wool, were also to be appointed. Some lord, or other person of influence, was also to be associated to the mayor of the staple to advise and also to assist him with force where necessary. In matters of doubt reference was to be had to the privy council. The mayors, sheriffs, and bailiffs of the towns where the staple was held, or there adjoining, were also to attend the mayor and ministers of the staple to execute their commands. Complaints against the mayors were to be redressed by the chancellor and others of the privy council. A prison also was to be provided for the use of the staple, and the mayor and constables had power given them to keep the peace, and to arrest and imprison, their authority extending throughout the town in which the staple was held and the suburbs of it.

The law administered in the court of the staple, so far as regarded all matters connected with the staple, was the law merchant, and not the common law of the land, nor the custom of the place. But pleas of land, matters of felony, and maiming were to be determined by the common law, and for this purpose the mayor of the staple and other suitable persons were to be assigned as justices. An option was also given to the plaintiff even in matters regarding the staple to bring his suit in the courts of common law if he preferred doing so. In all cases justice was to be done without delay. If both parties in a suit were foreigners, all the jury were to be foreigners. If one party was native, the other foreign, the jury was to be half native, half foreign. Each staple was required to provide a seal; and a power similar to that already conferred by the statute of merchants was given to the mayor and one of the constables, to take recognizances of debts to be sealed by the seal of the staple. In London this authority was given to the chief justices, or, out of term, to the mayor and the recorder. The provisions of this statute were however more extensive and stringent than those of the statute of merchants. The delay of a quarter of a year after the time assigned for payment was taken away, and the mayor had power to arrest and imprison the debtor upon non-payment at the end of the time assigned. The debtor was to remain imprisoned until the debt was paid. It would appear that the clergy at this period were not restricted from trading, for there is a provision that if the debtor was an ecclesiastic, his person was to be free from arrest. The mayor had power immediately to seize the goods of the debtor within the staple, and to sell them or assign them to the creditor. If the debtor was not to be found within the staple, nor his goods of sufficient value, it was the duty of the mayor to certify the matter under the staple seal to the chancellor, who thereupon was to issue a writ to arrest the debtor without fail wherever he might be, and also to seize all his lands, tenements, and chattels throughout the kingdom. Upon these execution was to be done in the manner provided for by the statute merchant. The statute contains various other enactments relating to the internal regulations of the staple. It was made highly penal to create any disturbance within it. The rents of houses were to be fixed, &c.

A variety of other statutes were passed in the same and succeeding reigns, in some respects confirming, in others altering the provisions of the leading statute. As commerce became more extended, the staples appear to have fallen into disuse. Lord Coke, a great worshipper of antiquity, complains that in his time the staple had become a shadow; we have only now, he says, stapulam umbratilem, whereas formerly it was said that wealth followed the staple. The practice however of taking recognizances by statute staple, from the many advantages attending them, long continued. (11 Edw. I.; 27 Edw. III., caps. 1, 3, to 6, 8, 9; 2 *Inst.*, 322; *Com. Dig.*, tit. 'Stat. Staple;' 2 Saund. by Wms., 69; Reeves, *Hist. Eng. Law*, v. 2, pp. 161, 393.)

STAR, DOUBLE STAR, CLUSTER OF STARS, NEBULA. We distinguish the stars from the planets in much the same way as our ancestors did before us, though there is hardly one point of difference which is now left to its full extent. A contemporary of the publication of the 'Principia' (1687), engaged in writing an article like the present, would have stated that the only notion out of which antiquity described a star, was derived from its fixedness in the heavens; to which he would have added that these stars present no appearance of systematic arrangement, that their distance is too great to be measured, and that they exert no sensible attraction on the solar system. Not one point of this is now left except the last; the speculation described in MILKY WAY gives a high probability to the theory that the universe is a collection of vast systems of stars; observations of double stars have rendered it certain that many organized systems, regulated by mutual attraction, exist in space, besides our solar system; it is fully established that numbers of stars, once called fixed, have slow motion of their own in the heavens; and in one instance at least there is no room left for doubt that [PARALLAX OF THE FIXED STARS] the distance of one of the stars has been approximately ascertained. That no discoverable effect of attraction upon our system can be traced, is the only point in which the stellar astronomy of our own day coincides to the full extent with that of the time of Newton.

The apparent motions of the stars are first to be cleared of the effects of PRECESSION AND NUTATION, and also of ABERRATION, which depend on motions of our earth, as well as of the grand diurnal revolution. From the REFRACTION of our atmosphere, and from the various casualties to which the rays of light are subject in passing through it, proceed, besides the increase of apparent altitude alluded to in the article cited, a great many varieties of colour and general appearance, particularly that decided size which most of the stars appear to have. A good telescope reduces this phenomenon very much, in favourable states of the atmosphere; but even these instruments are not so perfect as to show the stars to be what there is no doubt they ought to be, mere luminous points. If the apparent diameter of 61 Cygni, the earth's atmosphere being entirely removed, were only one-third of a second, or one-thirtieth of that of Venus when smallest, it is now known that the diameter of that star must be equal to that of the earth's orbit.

Independently of relative position, the stars are distinguished by their colour and quantity of light, on which last in a great degree depends their apparent magnitude. A casual observer would hardly think that there was any difference of colour between one and another; but a little practice shows that a tinge of one or another colour predominates a little in the nearly white light which all the stars have in common; and a good telescope gives some stars an appearance which observers have not scrupled to call 'blood-red.' And when the two stars of a close double star are together in the field of a telescope, it most frequently happens that each star differs sensibly in colour from the other. But when we look at a star, we must remember that we see only the result of the treatment which its light has received from the atmosphere; and with a telescope the matter is in some respects worse, for there is no object glass which forms anything like a real image. 'When we look at a bright star,' says Sir John Herschel, 'through a very good telescope with a low magnifying power, its appearance is that of a condensed brilliant mass of light, of which it is impossible to discern the shape for the brightness; and which, let the goodness of the telescope be what it will, is seldom free from some small ragged appendages or rays. But when we apply a magnifying power from 200 to 300, the star is then seen (in favourable circumstances of tranquil atmosphere, uniform temperature, &c.) as a perfectly round well-defined planetary disc, surrounded by two, three, or more alternately dark and bright rings, which, if examined attentively, are seen to be slightly coloured at their borders. They succeed each other nearly at equal intervals round the central disc, and are usually much better seen, and more regularly and perfectly formed, in refracting than in reflecting telescopes. The central disc too is much larger in the former than in the latter description of telescope. These discs were first noticed by Sir William Herschel, who first applied sufficiently high magnifying powers to telescopes to render them visible. They are not the real bodies of the stars, which are infinitely too remote to be ever visible with any magnifiers we can apply; but *spurious* or unreal images, resulting from optical causes, which are still to a certain degree obscure.' The various appearances of stars, as seen in telescopes, particularly the resolution of stars which appear single into two or more, render them excellent objects, when classified, for the examination of the power and goodness of these instruments. Such a classification was made by Sir J. Herschel (*Mem. Astron. Soc.*); and the paper is reprinted at the end of the explanation (published separately) of the maps of the stars published by the Society for the Diffusion of Useful Knowledge.

The magnitude of a star is a notion formed by observers as to the apparent quantity of light which comes from them, on which they are divided into classes. Those which are visible to the naked eye are usually divided into six magnitudes, which, according to W. Herschel, emit quantities of light which are (roughly) in about the proportions of the numbers 100, 25, 12, 6, 2, and 1. But though practical astronomers are tolerably well agreed as to the mode of naming most of the principal stars in respect of magnitude, there are many about which they differ, and some as to which it is tolerably well known that the order of magnitude which adherence to old catalogues still procures for them, is not that which would have been given had they been new stars named in our day. The magnitudes of stars are in fact rather indeterminate after the first and second. An astronomer would hardly say that an appearance was like a star of the 'first or second' magnitude; the difference of the two is too well established, though as to the fainter stars of the first magnitude, and the brighter ones of the second, there may be little to choose between them. But it is very common to speak of an appearance as being of the 'second or third,' 'third or fourth,' &c. magnitnde, showing that the distinction between one magnitude and the next is not then very prominent. Sir John Herschel and Professor Struve, the two most assiduous observers of small magnitudes, usually differ (*Mem. Astron. Soc.*, vol. iii., p. 180) about a magnitude in their estimation of one star with another from and below Struve's fourth or Herschel's fifth magnitude, down to Struve's twelfth or Herschel's thirteenth. When therefore the reader, who is no astronomer, hears of the constant reference to stars of all magnitudes down to the sixteenth, he must look upon it as a rough mode of estimating the relative brilliancies of the stars, in which a numerical nomenclature is far from being held to imply numerical accuracy. Of late years it has been much the custom to invent intermediate magnitudes, as the 2·3 or $2\frac{1}{2}$ magnitude. This must be held to denote merely something between the second and third magnitude. Sir J. Herschel has recently distinguished between intermediate magnitudes, as follows:—The symbol 4·5 denotes a star nearer to the fourth than the fifth magnitude, and 5·4 one nearer to the fifth than the fourth.

Some stars (perhaps all) are variable in their magnitudes, and with periodical regularity, which is perhaps to be attributed to the effect of revolution round their axes; it being imaginable that different parts of a star should give different kinds or quantities of light, either or both. In some of these stars, long repetition of observations has determined the period of all the changes almost to a minute. The following table (*Cab. Cycl.* 'Astronomy') shows the best authenticated variable stars: there are others which are strongly suspected—*α* Cassiopeiæ for example:—

Of these the most remarkable are those which (for a time) disappear altogether. The *permanent* disappearance of stars occurs every now and then, though there may in most cases be a question whether the star itself which has disappeared ever existed otherwise than as a wrong entry in a catalogue. There are however a few instances in which a sudden appearance of a new star is recorded, followed, after a time, by its disappearance. Such a phenomenon made an astronomer, it is said, of Hipparchus; and certainly the star which appeared in Cassiopeia in 1572 was the introduction of Tycho Brahé to the character of a public astronomer. [BRAHE, TYCHO] Tycho Brahé himself thought, from historical evidence, that a star had appeared in Cassiopeia in 945 and 1264, that of his own time being in 1572, from which, if the historical evidence be correct, a new star might be expected to appear in that constellation in 1872 or thereabouts. But on examining his evidence, we find it exceedingly vague and deficient in antiquity. (*Comp. to Maps* *of the Stars*, p. 86.) The isolated phenomena connected with stars, as to their appearance and changes of appearance, are probably very numerous, and would require the assiduous attention of many observers. This is peculiarly the ground for the private observer; the public one is fully occupied in determining the places of the stars and planets for the wants of navigation and the advancement of our knowledge of the system of the universe. There does not exist any great work of detail on the phenomena of the sidereal heavens, but the inquirer must learn for himself from the original writings of those who have been most familiar with the actual appearances of the stars. The papers of W. Herschel [HERSCHEL], in the Philosophical Transactions, would be the first preliminary study for any one who is desirous of adding his contribution to the knowledge of the simple phenomena of the heavenly bodies.

| Star. | Period. days. | h. | m. | Variation of Magnitude. | Discoverers. | Date. |
|---|---|---|---|---|---|---|
| β Persei | 2 | 20 | 48 | 2 to 4 | Goodricke / Palitzch | 1782 / 1783 |
| δ Cephei | 5 | 8 | 37 | 3·4 to 5 | Goodricke | 1784 |
| β Lyræ | 6 | 9 | 0 | 3 to 4·5 | Goodricke | 1784 |
| η Antinoi | 7 | 4 | 15 | 3·4 to 4·5 | Pigott | 1784 |
| α Herculis | 60 | 6 | 0 | 3 to 4 | W. Herschel | 1796 |
| * Serpentis R.A. 15h. 41m. P.D. 74° 15′ | 180 | . | . | 7? to disapp. | Harding | 1826 |
| ο Ceti | 334 | . | . | 2 to disapp. | Fabricius | 1596 |
| χ Cygni | 396 | 21 | 0 | 6 to 11 | Kirch | 1687 |
| 367 (Bode) Hydræ | 494 | . | . | 4 to 10 | Maraldi | 1704 |
| 34 Cygni | 18 years | | | 6 to disapp. | Janson | 1600 |
| 420 (Mayer) Leonis | Many years | | | 7 to disapp. | Koch | 1782 |
| κ Sagittarii | Ditto | | | 3 to 6 | Halley | 1676 |
| ψ Leonis | Ditto | | | 6 to disapp. | Montanari | 1667 |

Leaving the general appearances of the stars, and referring to MILKY WAY for the most probable view of the primary groups of the universe, we come to the consideration of the circumstances out of which any future knowledge of these bodies will most probably be drawn. When observations of a star, made at two different periods, have been cleared of the effects of aberration and refraction, the only difference between the two places ought to be that due to precession and nutation, and any change of place which is not deducible from the latter is either error of observation, some unknown motion of the earth, or motion proper to the star. If the first be impossible or exceedingly unlikely, and if the same sort of discrepancy is found not to affect other stars, so that the second is not admissible, there remains only the third supposition. For example, there is a large number of stars which certainly have a slight apparent motion not attributable either to precession or nutation. It might first strike an investigator that this change might arise from a motion of the solar system in space, the effects of which might be perceptible on some stars and not on the rest, on account of the much greater nearness of the former to our system. If the motion of the solar system were the cause, it is obvious that the stars towards which we are moving would appear to open and recede from each other, while those which we are leaving would appear to approach each other. No such things take place; there is no part of the heavens in which the unexplained motions cause uniform increases or uniform diminutions of distance. All other solutions of the difficulty, which depend on the earth or solar system, are found equally inefficient; and there remains only the supposition that a great many stars, perhaps all, are actually in motion. It has been reasonably supposed that those which have most motion are comparatively near to the earth, and when it was requisite to choose a double star for the determination of the question of PARALLAX, 61 Cygni was selected, as being a star with a large proper motion; in fact, its right ascension alters yearly 5″·46, and its declination 3″·19. The experiment turned out favourably, and the parallax was discovered, and with it (roughly) the distance of the star from the solar system. And though light takes more than ten years to travel from this star to the earth, at the rate of two hundred thousand miles a second, yet so far from this being anything enormous, it rather cuts down the idea which was entertained of the distance of these bodies. The absence of all parallax, in spite of repeated efforts to obtain it, made many speculations upon the possibility of the nearest starlight being hundreds of years in reaching us. Among other stars which have a decided proper motion, we may notice Sirius, Procyon, 61 Virginis, α Bootis, A Ophiuchi, *p* Ophiuchi, and μ Cassiopeiæ.

The particular objects which are seen in the heavens are *stars*, simple points of light, and *nebulæ*, patches of an appearance of cloudy light. Single stars, under the telescope, very frequently become double, triple, quadruple, or even a large cluster; nebulæ are in some cases found to consist entirely of stars, but many remain which either are not composed of stars, or will not show themselves as such to the power of our present telescopes. It is necessary to say, in speaking of double stars, that they have been long known to exist, and that scores of observers have been diligently employed upon them during the last century and a quarter. So slowly however does the knowledge of the heavens expand itself, that in our own day, and within these four years, a periodical critic, in a learned review, quizzed the idea of there being such things as double stars, thinking he had got hold of a most amusing mistake of some writer in the Library of Useful Knowledge, and little dreaming that himself was destined to be handed down as a specimen of the ignorance which was possible in the middle of the nineteenth century upon a point on which metrical observations had been made from the time of Bradley.

When two stars are so close together that the naked eye shows them only as one, it is possible that the coincidence may be merely optical: that is, that the lines of their directions may be so close as to make an apparent coincidence, such as takes place between the sun and moon in an eclipse of the former, though the real distances may be very great. Such optical coincidence is suspected in various double stars, but only a long course of observation can settle the suspicion in either way. But it is now found that many double stars are connected with each other by the law of gravitation, each revolving in an ellipse about their common centre of gravity, and showing every evidence of each being retained by the other, according to the Newtonian law of gravitation. The following stars, γ Leonis, ε Bootis, ζ Herculis, δ Serpentis, and γ Virginis, were made out to be revolving double stars, by W. Herschel, in 1803; he had been examining these pairs under the idea of detecting the parallax from them, and in so doing he recognised their changes of relative position. Since that time, Castor, ξ Ursæ, 70 Ophiuchi, σ Coronæ, η Coronæ, ξ Bootis, η Cassiopeiæ, δ Cygni, μ Bootis, ε (4) and ε (5) Lyræ, λ Ophiuchi, μ Draconis, ζ Aquarii, ζ Cancri, and others, have been added to the list. The periods of revolution of several have been determined, ranging from 43 to 1200 years, and the other elements of several orbits have been established. The star η Coronæ has completed a revolution since it was first observed; but the triumph of prediction is the star γ Virginis. The two individuals composing this *binary** star, and which, at their greatest distance, are nearly 10″ apart, were computed by Sir J. Herschel as being to come to their nearest approach about the middle of 1834 or beginning of 1835. The whole time of revolution is upwards of 900 years, and the component stars had been gradually nearing each other since 1780, when they were more than 7″ apart. In his paper on the orbits of binary stars (*Mem. Astron. Soc.*, vol. vii.), written in 1831, Sir J. Herschel says, 'These elements are extremely remarkable. If they be correct, the latter end of

* A star is called *double* when the two components are too close to be seen by the naked eye; it becomes *binary* when they are discovered to be connected by gravitation.

the year 1833, or the beginning of the year 1834' (subsequent observations made the correction above noted), 'will witness one of the most striking phenomena which sidereal astronomy has yet afforded, viz. the perihelion passage of one star round another, with the immense angular velocity of between 60° and 70° per annum, this is to say, of a degree in five days. As the two stars will then however be within little more than half a second of each other, and as they are both large and nearly equal, none but the very finest telescopes will have any chance of this magnificent phenomenon.' Towards the end of 1835 the stars were found, by observations in England, to be united so closely that good telescopes would no longer show them separate. And a letter from Sir J. Herschel (dated from the Cape of Good Hope, in February, 1836, printed in the monthly notice of the Astronomical Society for June 10th of the same year), runs as follows: 'γ Virginis is at this time, to all appearance, a single star. I have tormented it, under favourable circumstances, with the highest powers I can apply to my telescopes, consistently with seeing a well defined disc, till my patience has been exhausted; and that lately, on several occasions, whenever the definition of the stars generally, in that quarter of the heavens, would allow of observing with any chance of success: but have not been able to procure any decisive symptom of its consisting of two individuals. On the 17th instant, being a night of uncommonly good definition for the season, I turned the twenty-feet reflector, as a preliminary trial, on γ Centauri, which was seen double, without difficulty, under a power of 320, and with the whole aperture open; and afterwards on Saturn, which was also seen with uncommon distinctness. It was then directed to γ Virginis, and the night being farther advanced, the air tranquil, and vision much improved, I fully expected to have been enabled to divide it, at least with the aid of a diminished triangular aperture, and all the magnifying power the nigh t would bear. I was however disappointed. It bore a magnifying power of 480 with sufficient distinctness, but without indicating the slighest elongation, or giving any symptom of its being otherwise than a single star. Had the centres of the two stars been only half a second asunder, I think I could not have failed to see a division between them.' It had been predicted that there would be half a second between the stars when at their nearest; it turned out that there was no perceptible distance, or that the stars seemed united. Before the time of Newton it would have taken thousands of years of observation to make as good a prediction as was procured from one single century.

Before Sir J. Herschel's letter arrived in England, Captain Smyth had most distinctly announced that he could not separate the two stars of γ Virginis, under favourable circumstances, and with magnifying powers of from 240 to 1200. The following is the result of that gentleman's observations, the angle of position meaning the angle made by the line joining the two stars with the direction of diurnal rotation at the meridian; and 1831, 38 meaning the time when 38-hundredths of the year 1831 had elapsed, and so on.

| Epoch of Observation. | Angle of Position. | Distance of the Stars. | Epoch of Observation. | Angle of Position. | Distance of the Stars. |
|---|---|---|---|---|---|
| 1831, 38 | 77° 54′ | 1″·65 | 1836, 15 | . . | round |
| 1832, 40 | 71° 26′ | 1″·14 | 1836, 25 | . . | blotty |
| 1833, 23 | 63° 38′ | not obs. | 1836, 30 | 350° 56′ | elongated |
| 1833, 44 | 62° 43′ | 1″·31 | 1836, 39 | 348° 39′ | elongated |
| 1834, 20 | 48° 49′ | 1″·02 | 1837, 21 | 265° 27′ | 0″·60* |
| 1834, 39 | 45° 29′ | 0″·85 | 1838, 28 | 235° 41′ | 0″·85 |
| 1835, 40 | 14° 59′ | 0″·50* | 1839, 40 | 217° 12′ | 1″·00 |
| 1836, 06 | . . | round | | | |

The very great increase of angular motion as the one star approached to its nearest point to the other (called its *periastre*), was at last more than 30° in a year: the *greatest* rate given by Sir J. Herschel, mentioned above, continuing of course only a short time. This great point, the revolution of the individuals of a double star about each other, according to the Newtonian law of gravitation, is now therefore well ascertained by the verification of predictions founded upon that law, the most decisive of astronomical tests. Thousands of stars have been well ascertained to be double, and in all probability the determination of their orbits will go on until the research loses its interest, and the orbital motion is reasonably inferred to be a rule without exception. A list of writings on double stars will be found in the appendix to the Explanation of the Society's Maps of the Stars already cited.

* Estimated.

It is as difficult to say where the subject of nebulæ should begin as it is impossible to prophesy where it will end. Clusters of stars, which are visibly clusters to the naked eye, are found in different parts of the heavens, of which we suppose it must be assumed that they belong to the great stratum in which our system is situated. [MILKY WAY.] There are clusters of stars which are not such to the naked eye, but take that character in telescopes of the most moderate power; there are others again, of more and more difficulty, or requiring better and better telescopes to resolve them into clusters, some of which are visible to the naked eye as nebulæ, or slight cloudy patches of light. Many of them, when resolved into clusters, exhibit their thousands and millions of stars, increased in closeness and collective effect from the borders to the centre. Lastly, there are nebulous appearances which remain nebulous under the best telescopes yet constructed; but whether these are really clouds of luminous matter, or whether better telescopes would resolve them also into stars, is of course undecided. The most complete list of these objects is the great catalogue of Sir John Herschel, published in the Philosophical Transactions in 1833, embracing all that can be seen in our latitude. The author of this catalogue spent some years at the Cape of Good Hope in making a survey of the southern hemisphere, the results of which are not yet published. Hardly anything in fact is known of the telescopic objects of the southern parts of the heavens, or of the telescopic appearance of remarkable visible objects: for example, there is no account of the celebrated *Nubeculæ* (*major* and *minor*), two very large patches of *Milky Way* not far from the south pole.

William Herschel's subdivision of these objects is into—1, *Clusters*, subdivided into globular and irregular; 2, *Resolvable Nebulæ*, suspected of being one day reducible to clusters by better telescopes; 3, *Nebulæ*, which give no appearance of stars; 4, *Planetary Nebulæ*, with round discs and equable light; 5, *Stellar Nebulæ*, round, with increasing brilliancy towards the centre; 6, *Nebulous Stars*, sharp and brilliant stars surrounded by discs of faint light. But this is only a first approximation to a classification. Sir John Herschel has added *annular nebulæ*, presenting the appearance of a ring; *long nebulæ*, presenting the appearance of elongated ellipses of light; *double nebulæ*, or nebulæ very close together in the manner of double stars. He has also remarked the frequent occurrence of stars very near to planetary nebulæ, which he suspects to be real satellites.

When the elder Herschel began his observations, the idea entertained of the stellar universe was that of stars distributed in numbers throughout, if not infinite space, at least an extent which, compared with our own system, might justify such a mode of speaking. The observations of the MILKY WAY, and HERSCHEL'S theory of it, give the notion that many nebulæ may be such strata of stars as that one in which we are placed: perhaps at such a distance that the whole of our system, to the farthest boundary of the Milky Way, may be seen from thence as nothing but a minute telescopic nebula. In our day, when the proper use of words is comparatively well understood, we are prepared to extend the meaning of the word *universe* to any necessary point, and the farther discovery leads us, the more are we prepared to admit into the universe. But if, having a notion of the universe as an enormous extent of stars, and afterwards learning that our cluster, which we supposed to be the whole, proves to be only one of many, we were to follow an antient practice, we should call such a cluster a universe, and say that there are many universes. And this mode of speaking is a very intelligible one; if we adopt it, we may thus express the following well grounded conjectures (but of course only as strong conjectures) which arise from the appearances of clusters and nebulæ.

1. Clusters and Nebulæ. The universe, properly speaking, contains many universal systems, or minor universes, at distances so great from each other, that what an antient astronomer might have supposed to be the whole length of tenanted space sinks into nothing as compared with the distance between two such minor universes or stellar systems.

2. Double Stars. It was formerly thought reasonable to suppose that each star was the sun of a solar system. To this it must now be added, that we have suns revolving

round each other, each probably attended by its planetary system; and in the case of triple and multiple stars, three or more suns.

3. Double Nebulæ. Should it be discovered, as is by no means unlikely, that the component individuals revolve round each other, there may be stellar systems each revolving round the other; each a universe according to antient notions.

4. Planetary Nebulæ. There is reason to doubt that these bodies are composed of stars: but if not, they are masses of some material, each of the extent of a universe according to antient notions, attended perhaps by satellite stars.

The number of stellar dispositions seems to be very varied, if appearances may be relied on; and the modes in which the mutual attractions are prevented from causing the universal destruction of any system are wholly beyond conjecture. On this point Sir J. Herschel remarks: 'If a nebula be nothing more than a cluster of discrete stars (as we have every reason to believe, at least in the generality of cases), no pressure can be propagated through it; and its equilibrium, or, to speak more correctly, the permanence of its form, must be maintained in a way totally different. It must rather be conceived as a quiescent form, comprising within its limits an indefinite multitude of individual constituents, which, for ought we can tell, may be moving one among the other, each animated by its own inherent projectile force, and deflected into an orbit more or less complicated, by the influence of that law of internal gravitation which may result from the compounded attractions of all its parts. I have shown elsewhere' (Sir J. H. here refers to his Astronomy, in the Cabinet Cyclopædia, p. 415), 'how a quiescent spherical form may subsist as the bounding outline of an immense number of equal stars uniformly distributed through its extent, each of which individually attracts all the others with a force inversely as the square of the distance, and whose united attractions compose an internal force on each, directly proportional to the distance from the centre of the sphere. In such a state of things each star might describe an ellipse in any plane, and in any direction in that plane, about the common centre, without the possibility of collision; but the sphere, regarded as a whole, would have no rotation about any axis. If the form be not spherical, and the distribution of the stars not homogeneous, the dynamical relations become too complicated to be distinctly apprehended; yet we may still conceive that something of an analogous result may subsist, and that both the external form and the internal density may be maintained (at least under certain conditions) for the mass as a quiescent whole, while all its elements are in a state of unceasing transfer and interchange.'

In the articles CONSTELLATION, CATALOGUE, &c., we have given some slight idea of the state of sidereal astronomy as to designation and nomenclature. The boundaries of the constellations are so ill defined, the ways in which the descriptions of catalogues clash with each other are so numerous, and the points on each of which there should be, and is not, common consent, increase so fast, that unless a remedy be applied, a limit can be foreseen to the diffusion, and perhaps even to the progress, of sidereal astronomy. One constellation will sometimes contain an isolated portion of another, just as a county or diocese sometimes actually surrounds a parish which belongs to another. Stars occur under different names; some catalogue-stars have never existed, or owe their creation to a wrong entry or a mistake in reading an instrument. Constellations are recognised by some astronomers and not by others, while the same names are repeated in different parts of the heavens. These defects are most conspicuous in the southern hemisphere. Some disposition to search for a remedy begins at length to be exhibited. In a communication lately made to the Astronomical Society, Sir J. Herschel has proposed a plan for a reconstruction of the southern hemisphere, with a proposal that the same thing should be done for the northern. This paper sets forth the defects of the present system, and we extract the description of the disadvantages which that system imposes on such observers as many of our readers may be, or may think of becoming.

'There is however another and a very important class of observers to whom the present system of constellations, and the actual state of the charts generally accessible, is a real and most serious grievance; I mean those who devote their attention to the physical departments of practical astronomy, such as require a perfect familiarity with the aspect of the heavens, as seen by the naked eye in the open air, whether for the purpose of pointing reflecting or other telescopes, not mounted meridionally or equatorially, to particular objects (such as double stars, nebulæ, &c.), or for that of photometrical determinations, and for the investigation of variable or periodic stars. These last are subjects of great and growing interest; and there is, I think, no exaggeration in declaring it *impossible* to go fully into them under the present system of nomenclature and distribution. The constellations are so numerous, and of such excessive inequality in extent—their boundaries interlock and interlace one another in a manner so capricious, and so impossible to follow out by the eye among the stars, that, if only for this reason, the map has to be referred to at every instant: and where, as is the case with every map I have ever used, *the leading stars in the map are not those which catch the eye by their brightness in the heavens*, there arises a necessity of alternately poring over the maps by candle-light, and rushing out into the darkness to compare the impression (usually a most erroneous one) left on the memory by such inspection with the reality as exhibited in the sky; a necessity not only fatal to all delicacy of vision, but actually injurious in a high degree to the organ itself; producing a painful irritation when pursued some hours in succession, which continues long after the exciting cause has ceased. The loss of valuable time moreover so arising is deplorable; and the want of satisfactory agreement in the result of successive nights' observations proves but too distinctly the influence of such unfavourable circumstances; while, in addition to these sources of annoyance, the mistakes arising from confusion of nomenclature have still to be guarded against with anxious vigilance. Considerable experience in this line enables me to say that I know of no class of astronomical observations more painful, laborious, and unsatisfactory; while on the other hand, with reformed constellations and charts adapted to the object in view, I am equally prepared to say that hardly any would prove more agreeable, easy, and popular. What is worst about the present system is, that all its difficulties and annoyances have to be undergone by every new observer, and by each at every resumption of his observations, after the lapse of any considerable interval of time; it being not merely familiarity *with the* heavens, but also with all the caprices, uncertainties, and errors of our artificial systems of representing them, which is required of him.'

It is obvious enough, to any one acquainted with the heavens, that no reformation of the constellations would be endurable, except one which made the boundaries of the new constellations to be parallels and secondaries to the equator, or parts of them. The only question is, whether the whole of the sphere should be mapped out in a *regular* manner, or whether constellations should be of different extents of right ascension and declination, so as always to enclose all the stars of a remarkable group in the same constellation. The latter plan is proposed in the paper from which we have cited. The subject is one which must undergo a good deal of discussion before any plan is fixed upon, and it will be long before the new mode is familiar to any but astronomers.

For maps of the stars we know of none which are better for the ordinary reader than the smaller set published by the Society for the Diffusion of Useful Knowledge. The gnomonic projection on which they are made, and which is explained in the accompanying treatise, has its disadvantages, as has every other; but for representing the whole heavens in few maps, we know of none superior to it. The PLANISPHERE combines some of the advantages of a map with some of those of a globe; but there is of course nothing comparable to the globe itself. An ingenious, and, considering its construction, by no means an expensive apparatus, was recently invented by Mr. Winter (and sold by Cary), of which we are credibly assured the results are useful in obtaining a knowledge of the stars. A hollow twelve-inch globe is *pierced* for stars, and a lamp is placed inside the globe. Through the holes in which the globe is pierced the light of the lamp is thrown on a hollow hemisphere of paper or calico of from four to six feet diameter, allowing from ten to twenty persons to see the representation of the starry heavens which obviously results. The visible hemisphere may thus be made apparent for any latitude and any time of day.

STAR-CHAMBER. The Star-Chamber is said to have been in early times one of the apartments of the king's palace at Westminster allotted for the dispatch of public business. The Painted Chamber, the White Chamber, and the Chambre Markolph, were occupied by the triers and receivers of petitions, and the king's council held its sittings in the Camera Stellata, or Chambre des Estoylles, which was so called probably from some remarkable feature in its architecture or embellishment. According to Sir Thomas Smith's conjecture, 'either because it was full of windows, or because at the first all the roofe thereof was decked with images or starres gilded.' (*Commonwealth of England*, book iii., cap. 4.) Sir William Blackstone proposes a conjecture that the Chamber received its name from its having been a place of deposit for the contracts of the Jews, called 'Itarrs,' under an ordinance of Richard I. (Blackstone's 'Commentaries,' vol. iv., p. 266, note.) Whatever may be the etymology of the term, there can be little doubt that the court of Star-Chamber derived its name from the place in which it was holden. 'The lords sitting in the Star-Chamber' is used as a well known phrase in records of the time of Edward III., and the name became permanently attached to the jurisdiction, and continued long after the local situation of the court was changed.

The judicature of the court of Star-Chamber appears to have originated in the exercise of a criminal and civil jurisdiction by the king's council, or by that section of it which Lord Hale calls the *Consilium Ordinarium*, in order to distinguish it from the *Privy Council*, who were the deliberative advisers of the crown. (Hale's *Jurisdiction of the Lords' House*, chap. v.; Palgrave's *Essay on the Original Authority of the King's Council.*) This exercise of jurisdiction by the king's council was considered as an encroachment upon the common law, and being the subject of frequent complaint by the Commons, was greatly abridged by several acts of parliament in the reign of Edward III. It was discouraged also by the common-law judges, although they were usually members of the council; and from the joint operation of these and some other causes the power of the Consilium Regis as a court of justice had materially declined previously to the reign of Henry VII., although, as Lord Hale observes, there remain 'some straggling footsteps of their proceedings' till near that time. The statute of the 3 Henry VII., c. 1, empowered the chancellor, treasurer, and keeper of the privy-seal, or any two of them, calling to them a bishop and temporal lord of the council and the two chief justices, or two other justices in their absence (to whom the president of the council was added by stat. 21 Henry VIII., c. 20), upon bill or information exhibited to the lord chancellor or any other, against any person for maintenance, giving of liveries, and retainers by indentures or promises, or other embraceries, untrue demeanings of sheriffs in making panels and other untrue returns, for taking of money by juries, or for great riots or unlawful assemblies, to call the offenders before them and examine them, and punish them according to their demerits. The object and effect of this enactment are extremely doubtful. It appears to have been the opinion of the courts of law at the time the statute was passed that it established a new jurisdiction entirely distinct from the ordinary jurisdiction of the council; for five years afterwards, in the eighth year of Henry VII., it was resolved by all the judges, according to the plain words of the law, that the only judges of the court under the statute were the lord chancellor, the treasurer, and the keeper of the privy-seal, the bishop and temporal lord being merely 'called to them' as assistants or assessors, and not as constituent members of the court. (*Year Book*, 8 Hen. VII., 13, pl. 7.) This view of the effect of the statute is confirmed by the fact that, more than forty years afterwards, the president of the council was expressly added to the judges of the court by the stat. 21 Henry VIII., c. 20; 'a decisive proof,' as Mr. Hallam observes, 'that it then existed as a tribunal perfectly distinct from the council itself.' (*Constitutional History*, vol. i., p. 70.) And this writer concludes a careful examination of the subject by the following propositions: '1. The court erected by the statute of 3 Henry VII. was not the court of Star-Chamber. 2. This court by statute subsisted in full force till beyond the middle of Henry VIII.'s reign, but not long afterwards went into disuse. 3. The Court of Star-Chamber was the old *concilium ordinarium*, against whose jurisdiction many statutes had been enacted from the time of Edward III. 4. No part of the jurisdiction exercised by the Star-Chamber could be maintained on the authority of the statute of Henry VII.' In the first of these propositions, Mr. Hallam is confirmed by Hudson, in his 'Treatise of the Court of Star-Chamber.' (*Collectanea Juridica*, vol. ii., p. 50.) On the other hand, both Lord Coke and Lord Hale consider the statute of Henry VII. as having merely introduced a modification of the antient jurisdiction. The former calls the above resolution of the common-law judges 'a sudden opinion,' and says it is 'contrary to law and continual experience.' And he contends that the statute did not create a new court, but was merely declaratory of the mode of proceeding in an antient court, previously known and recognised. (*Fourth Institute*, p. 62.) Lord Hale also speaks of the 'erection of the court of Star-Chamber by the stat. 3 Henry VII.' and says it 'was a kind of re-modelling of the *consilium regis*.' (*Jurisdiction of the Lords' House*, chap. v., p. 35.) However this may have been, there is no doubt that, previously to the time of Coke, this court, whether distinct, or only a modification of the antient jurisdiction, had again merged in the general jurisdiction of the lords of the council so completely as to justify his statement that the opinion expressed in the judicial resolution was 'contrary to continual experience.' Sir Thomas Smith, who wrote his 'Treatise on the Commonwealth of England' in the year 1565, makes no mention of a limited court, though he treats particularly of the court of Star-Chamber, and says that the judges were the lord chancellor, the lord treasurer, all the king's council, and all peers of the realm; and he ascribes the merit of having renewed the vigour of the court to Cardinal Wolsey. At the beginning of the reign of Elizabeth therefore, the court of Star-Chamber was unquestionably in full operation, in the form in which it was known in the succeeding reigns; and at this period, before it had degenerated into a mere engine of state, it was by no means destitute of utility. It was the only court in the land in which great and powerful offenders had no means of setting at defiance the administration of justice or corrupting its course. And during the reign of Elizabeth, when the jurisdiction of the Star-Chamber had reached its maturity, it seems, except in political cases, to have been administered with wisdom and discretion. (Palgrave's *Essay on the King's Council*, p. 105.)

The proceedings in the Court of Star-Chamber were by information, or bill and answer; interrogatories in writing were also exhibited to the defendant and witnesses, which were answered on oath. The attorney-general had the power of exhibiting ex-officio informations; as had also the king's almoner to recover deodands and goods of a felo-de-se, which were supposed to go in support of the king's alms. In cases of confession by accused persons, the information and proceedings were oral; and hence arose one of the most oppressive abuses of the court in political prosecutions. The proceeding by written information and interrogatories was tedious and troublesome, often involving much nicety in pleading, and always requiring a degree of precision in setting forth the accusation, which was embarrassing in a state prosecution. It was with a view to these difficulties that Lord Bacon discouraged the king from adopting this mode of proceeding in the matter of the pursuevants, saying that 'the Star Chamber without confession was long seas.' (Bacon's *Works*, vol. iii., p. 372.) In political charges therefore the attorney-general derived a great advantage over the accused by proceeding *ore tenus*. The consequence was, that no pains were spared to procure confessions, and pressure of every kind, including torture, was unscrupulously applied. According to the laws of the court, no person could be orally charged, unless he acknowledged his confession at the bar, 'freely and voluntarily, without constraint.' (Hudson's *Treatise of the Court of Star-Chamber.*) But this check upon confessions improperly obtained seems to have been much neglected in practice during the later periods of the history of this court. 'Therein,' says Hudson, writing in the reign of James I., 'there is sometimes dangerous excess; for whereas the delinquent confesseth the offence *sub modo*, the same is strained against him to his great disadvantage. Sometimes many circumstances are pressed and urged to aggravate the matters which are not confessed by the delinquent; which surely ought not to be urged, but what he did freely confess, and in the same manner. And happy were it if these might be restrained within their limits, for that this course of proceeding is an exuberancy of prerogative, and therefore great reason to keep it within the circumference of its own orb.' Upon admissions of immaterial circumstances thus aggravated and distorted into confessions of guilt, the Earl of Northumberland was prosecuted *ore tenus*, in the Star-Chamber, for being privy to the Gunpowder Plot, and was sentenced to pay a fine of 30,000*l.* and to be imprisoned for life; 'but by what rule,' says Hudson (*Coll.-Jurid.*, vol. ii., p. 63), 'that sentence was, I know not, for it was *ore tenus*, and yet not upon confession.' And it frequently happened during the last century of the existence of the Star-Chamber, that enormous fines, imprisonments for life or during the king's pleasure, banishment, mutilation, and every variation of punishment short of death were inflicted by a court composed of members of the king's council, upon a mere oral proceeding, without hearing the accused, without a written charge or record of any kind, and without appeal.

The judges of the Court of Star-Chamber were the lord chancellor or lord keeper, who presided, and when the voices were equal gave a casting vote, the lord treasurer, the lord privy seal, and the president of the council, who were members of the court, *ex officio*, probably by usage since the statute of 3 Henry VII. In addition to these were associated, in early periods of the history of the court, any peers of the realm who chose to attend. According to Sir Thomas Smith, the judges in his time were the 'lord chancellor, the lord treasurer, all the king's majesty's council, and the barons of this land.' (*Commonwealth of England*, b. iii., c. 5.) Hudson states that the number of attendant judges 'in the reigns of Henry VII. and Henry VIII. have been well near to forty; at some one time thirty; in the reign of Queen Elizabeth often times, but now (*i.e.* in the time of James I.) much lessened, since the barons and earls, not being privy councillors, have forborne their attendance.' He further states, that 'in the times of Henry VII. and Henry VIII. the court was most commonly frequented by seven or eight bishops and prelates every sitting-day;' and adds, 'that in those times, the fines trenched not to the destruction of the offender's estate, and utter ruin of him and his prosperity, as now they do, but to his correction and amendment, the clergy's song being of mercy.' (*Coll. Jurid.*, vol. ii., p. 36.) The settled course during the latter part of the reign of Elizabeth and the reigns of James I. and Charles I., seems to have been to admit only such peers as judges of the court as were members of the privy council.

The civil jurisdiction of the Star-Chamber comprehended mercantile controversies between English and foreign merchants, testamentary causes, and differences between the heads and commonalty of corporations, both lay and spiritual. The court also disposed of the claims of the king's almoner to deodands, as above referred to, and also such claims as were made by subjects to deodands and *catalla felonum* by virtue of charters from the crown. The criminal jurisdiction of the court was very extensive. If the king chose to remit the capital punishment, the court had jurisdiction to punish as crimes even treason, murder, and felony. Under the comprehensive name of contempts of the king's authority, all offences against the state were included. Forgery, perjury, riots, maintenance, embracery, fraud, libels, conspiracy, and false accusation, misconduct by judges, justices of the peace, sheriffs, jurors, and other persons connected with the administration of justice, were all punishable in the Star-Chamber.

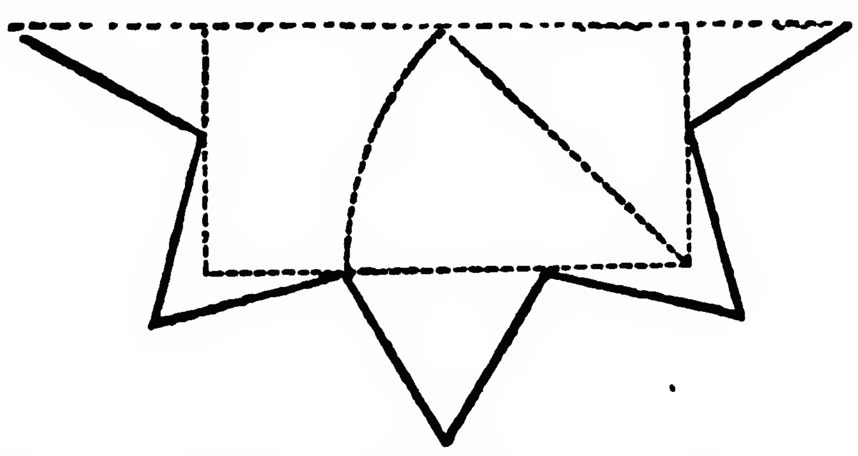
The Court of Star-Chamber was also occasionally used for declaring to the people occurrences of state. Thus in the times of Henry VII. and Henry VIII., the marriages and births of the king's children were here solemnly published; in like manner Queen Mary's marriage to Philip of Spain, the imputed treasonable practices of the Queen of Scots, and the particulars of the Earl of Essex's tumult, were officially declared in the Star-Chamber. It was also usual for the judges of assize previously to their circuits to repair to the Star-Chamber and there to receive from the court directions respecting the enforcement or restraint of penal laws. Numerous instances of this unwarrantable interference with the administration of the criminal law occur with reference to the statutes against recusants in the reigns of Elizabeth and James I.

A court of criminal judicature, composed of the immediate agents of prerogative, possessing a jurisdiction very extensive, and at the same time imperfectly defined, and authorized to inflict any amount of punishment short of death, must, even when best administered, have always been viewed with apprehension and distrust; and accordingly in the earlier periods of its history we find constant remonstrances by the Commons against its encroachments. As civilization, knowledge, and power increased among the people, the jurisdiction of the lords of the council became more odious and intolerable. Unfortunately, too, the court of Star-Chamber, which at one time appears to have been serviceable in the manner described by Sir Thomas Smith, 'as bridling such stout noblemen or gentlemen which would offer wrong by force to any manner of men, and could not be content to demand or defend the right by order of law,' degenerated in the reigns of James I. and Charles I. into a mere engine of state, and was employed as one of the main instruments for the assertion of prerogative pretension and the enforcement of illegal taxation. 'Having extended their jurisdiction,' says Clarendon, 'from riots, perjury, and the most notorious misdemeanours, to the asserting of all proclamations and orders of state; to the vindicating illegal commissions and grants of monopolies, no man could hope to be longer free from the inquisition of that court, than he resolved to submit to those and the like extraordinary courses.' (*History of the Rebellion*, book iii.) A measure which was introduced into the House of Commons in the last parliament of Charles I., to limit and regulate the authority of this court, terminated in a proposal for its entire abolition, which was eventually adopted without opposition in both Houses. The statute 16 Car. I., c. 10, after reciting Magna Charta and several early statutes in support of the ordinary system of judicature by the common law, goes on to state that 'the judges of the Star-Chamber had not kept themselves within the points limited by the statute 3 Henry VII., but had undertaken to punish where no law warranted, and to make decrees having no such authority, and to inflict heavier punishments than by any law was warranted; and that the proceedings, censures, and decrees of that court had by experience been found to be an intolerable burthen to the subjects, and the means to introduce an arbitrary power and government.' The statute then enacts, 'that the said court called the Star-Chamber, and all jurisdiction, power, and authority belonging unto or exercised in the same court, or by any of the judges, officers, or ministers thereof, should be clearly and absolutely dissolved, taken away, and determined, and that all statutes giving such jurisdiction should be repealed.'

STAR FORT, a kind of redoubt enclosing an area, and having its lines of rampart or parapet disposed, on the plan, in directions making with each other angles which are alternately salient and re-entering, as a star is usually represented. This construction is adopted when the work is intended to contain, for some time, the stores of an army, or to secure some important part of the position which the army occupies. The magistral line of the work may be traced by first laying down a polygonal figure, regular or irregular, as the ground may permit, and then upon each of its sides forming an equilateral triangle: the interior capacity and the quantity of fire will evidently be increased as the polygon has a greater number of sides, but the importance of the work is seldom so great as to render it necessary to form it on a polygon superior to a hexagon or an octagon; and the latter polygon, while it admits of being easily traced, allows the re-entering angles between the sides of the triangles to have a degree of obtuseness sufficient to avoid the risk that the defenders of the faces on each side of such an angle might fire upon one another. As soldiers are supposed to fire nearly perpendicularly to the face of the parapet behind which they stand, a greater obtuseness would cause the lines of fire to diverge so far from the direction of the adjacent face as to prevent the ditch of the latter from being effectually flanked.

A star-fort on an octagon may, if the ground is level, be traced by laying down a square, and, upon the middle of each of its sides, an equilateral triangle, whose base is one-third of the length of such side; or, more regularly, by transferring half the diagonal of the square to each side, from the four angles; the distances between the extremities of these half diagonals are the sides of an equilateral octagon, and upon these sides equilateral triangles may be formed. The subjoined cut represents the magistral line of half a star-fort with eight points, constructed in this last manner. If the polygon had more than twelve sides, the re-entering angles would be acute; and, agreeably to the above supposition concerning the direction in which soldiers fire, the defenders on the adjacent faces might annoy one another.

That the fire of musketry may be sufficiently effective, it is considered proper that the lengths of the several faces should not be less than thirty yards; and a star-fort whose faces are of much greater length is capable of containing a garrison more numerous than that which would be required



for the end proposed by such a work. A star-fort with six or eight points has a great advantage over a simple redoubt, though its construction is less simple: the crossing fires from the faces seriously impede the advance of the enemy towards the salient points; and the assailants, in passing the ditch, are completely exposed to the view of the defenders.

During the Seven Years' war, the king of Prussia's intrenched camp at Jauernick contained a star-fort on a rising ground in its centre, from whence the movements of the Austrians could be observed; and in this work the king's tent was pitched. The position taken up on the Nivelle by Marshal Soult, while the British army was acting in the south of France (1813), was protected by a strong star-fort: the work was constructed on a terrace below the summit of a mountain called the Smaller Rhune, and was intended to defend the entrance of a ravine. A platform below the summit of a ridge of high ground near the Bidassoa was, in like manner, fortified by a star-fort. (Napier's *History*, vol. vi.)

STAR-FISH. [ASTERIAS; STELLIRIDIANS.]

STARCH (called also *farina* and *fæculum*) is a proximate principle of plants, being chiefly found in the seeds of the larger grasses, or cereal grains, such as wheat; of many leguminous plants, such as peas and beans; and in the tubers of potatoes, and those of the New Holland Orchidaceæ (Lindley, in *Trans. Linn. Soc.*, vol. xviii., p. 426), and in the rhizomes of maranta, curcuma, zingiber, and several others; sometimes, but rarely, in the wood or bark of trees; and occasionally in the leaves of different plants. In all these instances it is associated with other principles, which are either employed along with it, or separated by different processes, according to the use intended to be made of it. In wheat it is associated with variable proportions of gluten, sugar, and gum; in potatoes, chiefly with gum and sugar. It is mostly lodged in the cells of the cellular tissue, and consists of granules, always white, generally of a roundish and seldom of an angular figure. The granules differ in size, often in the same seed, being generally smallest near the circumference. They differ also in different plants; and a table of their relative size has been constructed by Raspail (*Organic Chemistry*), chiefly with a view to distinguish the presence of one kind used to adulterate another. This test is not easy of application, as it requires a familiarity with microscopes and micrometers; and is moreover not to be implicitly relied upon, as the age of the plant, as well as the situation of the part from which they have been obtained, influences their size. The form of the granules, which is definite in each tribe, like the blood-discs in each tribe of animals, would be a more certain criterion, were not the difficulties of its application as great.

The granules are lodged mostly in the cells or compartments of the cellular tissue; and each granule consists of a membrane (beautifully marked, in some plants, such as the potato, with concentric circles: see Link, *Anatomisch-Botanische Abbildungen*, tafl. xvi., *fig.* 1), containing a transparent colourless material resembling gum. The membrane is insoluble in cold water or alcohol, but soluble in water of the temperature of 160° Fahr. In the process of germination of seeds, and the sprouting of potatoes and other tubers, the membrane is ruptured by the development of a principle termed *diastase*, and the contents rendered available for the growth of the plant.

The insolubility of the membrane in cold water affords a means of separating the starch from the gluten in wheat-flour, and from the fibrous matter in potatoes and other tubers. Wheat-flour is formed into a paste with water, and then kneaded under a stream of water so long as the water runs off of a milky appearance; what remains behind is chiefly gluten, while the water has carried off the starch suspended in it; and gum, sugar, and some phosphatic salts, either dissolved or suspended in it. The water charged with these matters is permitted to stand for a few days in summer, but for a week or two in winter, to allow the acetous fermentation to occur, by which the sugar and other principles are got rid of. The acid liquor termed *sours* is drawn off, and the starch thrown upon sieves, and washed; the bran and other impurities are retained on the sieves, while the starch is carried forward into large vessels called *frames*. In these the starch subsides, and the water, which has become perceptibly sour, drawn off, and the *slimes* removed. The starch is then washed, passed through a sieve, and finally allowed to subside. Thus purified it is put into boxes lined with canvass and perforated with holes, by which the superfluous water escapes. Afterwards it is cut into squares, put on bricks, and exposed to the heat of an oven, where it splits into irregular prisms. When free from any artificial admixture, it is perfectly white, and termed *white* or French starch; but in general azure (smalt) or indigo is added, when it is employed for stiffening linen, to which it imparts a more agreeable hue than the dull white of that material.

Starch, when pure, is nearly devoid of odour and taste, and is possessed of demulcent properties when boiled in water, with which it forms a hydrate of a jelly-like character. Its insipidity however hinders it from being very digestible in this state, or even when kneaded with cold water, and exposed to heat, to form biscuits. Its digestibility is greatly increased by fermentation, and hence bread or rusks are much more suitable to invalids than any unfermented preparations of flour. The best bread is formed by flour which contains the greatest proportion of gluten. The relative proportions of starch and gluten differ not only in the different cereal grains, but in the same species or variety, according to the season when they are sown, or the manure which has been applied to the land. Spring-sown wheat yields in the 100 parts—starch 70 parts, gluten 24; while autumn-sown wheat yields—starch 77 parts, gluten 19. (Davy, *Agricultural Chemistry*, p. 135 and 142.) The proportion of gluten is larger when the ground is manured with human urine, and as gluten is a compound of carbon, oxygen, hydrogen, and nitrogen, it is natural to expect that the application of so highly nitrogenous a liquid as human urine should furnish a larger produce. Nitrate of soda, or for some soils nitrate of potash (saltpetre), as manures, increase the quantity of gluten and albumen, another nitrogenous constituent of wheat, as well as the absolute quantity of produce per acre of hay and straw. The flour is of a superior quality for making bread, and absorbs more water, yielding a larger and more digestible bread from the same quantity of flour. (Daubeny's *Three Lectures on Agriculture*, p. 73 and 76.) Were a scientific system of agriculture to prevail in this country, one kind of wheat, treated with proper manure, would be raised and sold exclusively to the starch-manufacturer; while another kind, treated with its proper manures, would be raised for and sold only to the baker.

Starch exists in larger proportion in Carolina rice than in any other grain. As this, from the small portion of gluten which it contains (not more than 3½ per cent.), is not well suited to form bread, it would be well to use it for the manufacture of starch, and leave wheat to be consumed as bread.

Potatoes yield the purest starch, and it is procured with great ease, by simply rasping down the potatoes over a sieve, and passing a current of water over the raspings. The water passes through the sieve milky with the starch. By rest the starch subsides; it is then two or three times washed with pure water, and afterwards allowed to dry. The quantity of starch varies with the kind of potato used, the mode of cultivation, the time of setting, and, above all, the time of year when the process is applied. Potatoes in general afford from one-fifth to one-seventh of their weight of dry starch. (Davy's *Agricultural Chemistry*, p. 133.) The quantity of starch is at its maximum in the winter months, but as soon as the potato begins to sprout, the starch lessens, as does also the proportion of nitrogen, so that its nutritive properties are impaired. If however the process of isolating the starch be followed in the winter months, the result is, a sixth portion of the weight of the potatoes employed, in a condition fit not only for immediate use, but of easy transport, and capable of preservation for years. 'To those who live solely or even principally on potatoes, it must be of immense importance to have the nutritious part preserved when it is in the greatest perfection, instead of leaving it exposed to injury, decomposition, and decay.' (*On the Culture and Uses of Potatoes*, by Sir John Sinclair.)

Starch is most extensively used in the arts, but it is little employed in medicine, except for its demulcent properties, and as a vehicle for opiate injections. Patent white starch should alone be used in such a case. Starch forms with iodine a beautiful blue compound (iodide of starch); hence iodine is commonly employed as a test of the presence of starch. Raspail thinks that the blue colouring principle is of a volatile nature; and this is very probable, because a cold iodide of starch becomes colourless on the addition of boiling water. The blue colour is also destroyed by alkalis. It is of importance to bear in mind, that many vegetable substances, particularly such as contain gum and starch, render the tincture of guaiac blue; but starch is always precipitated from its watery solution by the addition of alcohol; while guaiacum is precipitated from its alcoholic solution by the addition of water.

STARGARD, or NEW STARGARD, is a city in the Prussian government of Stettin, in the province of Pomerania. It was formerly the capital of the government, and is now the capital of the circle of Saatz. It is situated in 53° 20′ N. lat. and 15° 20′ E. long., in a fertile and pleasant country, on the left bank of the navigable river Ihna, which flows through one of its suburbs, and falls into the Oder about 20 miles below the town. It is one of the best towns in Pomerania; is surrounded with a wall, and has three gates and three posterns. With the three small suburbs it has about 12,000 inhabitants, who have manufactures of woollens, linen, hats, stockings, leather, soap, tobacco, and also breweries and distilleries. There are in the town four churches, a gymnasium, an orphan asylum, three poorhouses, seven hospitals, and several schools, among which is a school for the education of land-surveyors, a provincial horticultural school, and a school for the instruction of mechanics. It is the seat of several public offices; among others, of the provincial board of the general commission for regulating the relations of the landlords and peasants, and the division of the commons in Pomerania. There are six annual horse and cattle fairs, two wool-fairs, one linen and two general fairs. The town has a good export trade in the productions of the country, especially corn, which goes down the Ihna to the Oder, and so to the Baltic.

STARGARD, a lordship, now called the *Duchy of Mecklenburg Strelitz*, is the most considerable of the two provinces of the grand-duchy of the same name, having an area of 630 square miles, with 70,000 inhabitants. There are eight towns, including Strelitz, the capital.

STARGARD (called *Old Stargard*) is a small town with about 1000 inhabitants.

STARK, WILLIAM, M.D., was born at Birmingham, in 1740, and educated for the medical profession, first at Glasgow, and then successively at Edinburgh, London, and Leyden, at which last place he took his degree in 1767. Returning to London in 1769, he commenced, chiefly at the recommendation of Sir John Pringle and Dr. Franklin, the course of experiments on diet, of which the termination, rather than the scientific results, has rendered him celebrated. To ascertain the effects of different quantities and kinds of food upon the human economy, he confined himself for periods of from four to fourteen days to certain articles of diet, and carefully registered the influence which they seemed to exercise on the several functions of the body. He began, for instance, with bread and water; then he added to them, in succeeding periods, sugar, olive-oil, and milk; then he took different kinds of animal food, and each in different quantities. His last plan (when his previous experiments had already rather disturbed his health) was to try the effects of a diet of bread or flour, with honey and infusion of tea or rosemary. After continuing this for ten days, it brought on diarrhœa and considerable weakness, and to remedy the former he immediately adopted a diet consisting exclusively of bread, cheese, and infusion of rosemary. This produced a totally opposite state of the intestines, and was speedily followed by a condition of low fever, with great disturbance of the general health, and inflammation of the glands of the small intestines, of which, after five days' severe illness, he died.

The termination of Dr. Stark's labours, within seven months of their commencement, is the more melancholy for the few results to which they led. Had he been able to continue them for as many years, it is probable they might have led to some valuable conclusions; though indeed they were but roughly conducted, and open to all the fallacies of experiments performed on one person for the purpose of ascertaining rules to be applied to all. His works were published by Dr. J. Carmichael Smyth, in 1788 (in one vol. 4to., London): they include the 'Journal of his Experiments,' and his 'Clinical and Anatomical Observations,' which, though few, give proof of much acuteness in the study of disease. Had their author's judgment equalled his devotion to the cause of science, he might well have been expected to rise to the highest eminence in medicine.

STARKENBURG. [HESSE DARMSTADT.]

STARLING. [STURNIDÆ.]

STARS, DOUBLE. [STAR.]

STARS AND NEBULÆ. [STAR.]

STASZIC, STANISLAV, president of the Polish Royal Society of Arts, and a distinguished patriot and philanthropist, was born in November, 1755, at Pila, of which place both his grandfather and father had been burgomaster. After studying at Göttingen and Leipzig, he passed two years at Paris, where he applied himself very sedulously to natural history and physics, and became acquainted with Buffon, D'Alembert, Raynal, and other eminent men. On leaving France, he made a tour through Switzerland, Italy, and Sicily, chiefly for the purpose of studying the geology of those countries. Furnished with considerable acquisitions in various departments of science, he returned to his native land, with the hope that his talents would procure for him some distinction and favour; but meeting with only coolness and indifference, which grieved him more on the account of his countrymen than on his own, he withdrew from society, devoting himself entirely to study, to the exercise of private benevolence, exhortation, and advice in his immediate sphere. Notwithstanding his numerous bounties to others, he was so frugal in all that concerned himself as to be enabled to amass a very considerable capital, with which he purchased an estate, of which he made grants to several families, among whom he parcelled it out. Although he never took an active part in public affairs, he was always ready to aid with his pen the best interests of his country. Among his writings of a political or statistical character, are his 'Warnings for Poland,' 'Statistics of Poland,' and the 'Political Balance of Europe;' to which may be added his 'Geography of the Carpathian Mountains,' and his 'Reflections on the Life of the Chancellor Andrew Zamoiski,' with which distinguished and enlightened patriot Staszic had for some time lived in daily and familiar intercourse, having been preceptor to his sons shortly after his return from abroad. Of purely literary productions he left but few, and even those were chiefly translations, viz. a prose version of Homer, Buffon's 'Epochs of Nature,' and Racine's poem on Religion, which last he translated at the age of fifteen.

More in compliance with the earnest desire of his mother than with his own inclination, Staszic had taken holy orders, and therefore exemplary as the general tenour of his conduct was, he did not display any great religious zeal, with the want of which he was accordingly reproached by his enemies, yet there is no reason whatever for suspecting him of religious indifference; and most assuredly his personal virtues were of the highest kind, and his patriotism of the noblest stamp. He died January 20th, 1806; and, in addition to the disposal of his estate at Rubieszow, as before mentioned, left considerable bequests to various public institutions and churches, including 200,000 zlots to the Hospital of Jesus, 100,000 to the Chemical Institute, and 45,000 to the Institute for the Deaf and Dumb at Warsaw.

STATE. [SOVEREIGNTY.]

STATEN ISLAND. [NEW YORK.]

STATER (στατήρ, *a standard* of value), or *Chrysus* (χρυσοῦς, *gold money*), was the name of a Greek gold coin, which, after being used from a very early period in some states, became, in the time of Philip II. and Alexander the Great, the general gold currency of Greece.

It is said to have been first coined in Lydia, to which the origin of silver money also is attributed by an antient tradition. (Herod., i. 94.) The stater of Croesus seems to have been the first gold money seen in Greece. (Herod., i. 54.) No undoubted specimen of this Lydian stater is in existence. According to Böckh, it was formed of the pale gold or electrum (¾ gold and ¼ silver) contained in the sands of the Pactolus.

Of the better known gold coins, most were of the same standard of weight as the Attic drachma, the Attic silver having at a very early period obtained a general circulation throughout Greece, and being reckoned extremely pure. The stater was generally equal in weight to two drachmæ, and in value to twenty. This was the case with the Macedonian stater, which the influence of Philip and Alexander brought into general circulation in Greece, and which continued to be coined by the later Macedonian kings after the same standard, or very nearly so. Many specimens of it exist.

The average weight of the staters of Philip and Alexander is a little under 133 grains. An assay of a stater of Alexander, made for Mr. Hussey, gave 115 grains of fine gold and 18 of silver, with no alloy. The silver here ought not to be reckoned as an alloy, and therefore the coin is equivalent to 133 grains of fine gold. Our sovereign contains 113·12 grains of fine gold. Therefore this stater was worth $\frac{133}{113\cdot12}$ of a sovereign, or a very little more than *1l. 3s. 6d.* If we calculate its value by the number of drachmæ it was worth, we find it only *16s. 3d.* The reason of this is that silver was much dearer in antient times than it is now. The higher value of the stater is the true one, as no material change has occurred in the value of gold.

In the states of Greece Proper the chief standards of money followed were those of Athens and Ægina. In both, the principal denominations of money were coined in silver, and it does not appear that the Æginetan system contained any gold coin.

At Athens there seems to have been no gold money in the flourishing times of the republic, if we except a coinage mentioned by the Scholiast to Aristophanes (*Frogs*, v. 719), which was of a very base gold, as is evident from the expressions used to describe it by Aristophanes (he calls it τὸ καινὸν χρυσίον, 'the new gold money,' v. 719, and directly afterwards πονηρὰ χαλκία, 'vile copper coins,' v. 724), and appears plainly to have been a solitary issue, put forth to meet the exigencies of the state; for it was in the year before the battle of Ægospotami, and the gold for the coins was obtained by melting down the statues of Victory. With this one exception, there is no mention of gold money by Athenian writers before the time of Philip, unless when they are speaking, as they frequently do, of foreign gold; and even this appears to have been scarce. There are also collateral arguments which go to prove that Athens had no gold currency of her own at the period named. There are however a few Attic gold coins in existence, but only about a dozen. Of these, three, which there is every reason to suppose genuine, are in the British Museum, and one in the Hunterian Museum at Glasgow. Their weights agree exactly with the Attic standard, being respectively 132·3, 132·7, 132·6, and 132·75 grains, or on the average 132·5875 grains, which is only about half a grain less than the Attic didrachm. The character of the impression is exactly like that of the old Attic silver, but the form of the coin is more like the Macedonian. Taking these facts in connection with the small number of such coins, it appears likely that when the rise of the Macedonian empire made gold plentiful in Greece, and the kings of Macedon began to coin gold, Athens, like other Grecian states, may have followed their example, and issued gold coins in imitation of her old silver, which however never came into very extensive circulation, as they were superseded by the Macedonian money

It is very clear however that foreign gold was in circulation at Athens quite as early as the Peloponnesian war. It was obtained doubtless in commerce, and as the tribute of the allies, many of whom had gold currencies. Among the denominations so used, the chief were the darics of Persia [DARIC] and the staters of the Greek cities of Asia and the neighbouring islands. In fact, the Greeks got nearly all their gold from Asia. The following were the principal coins of Greek states in circulation at Athens:—

Demosthenes (in *Phorm.*, p. 914, Reiske) informs us that a little after 335 B.C. the *Stater of Cyzicus* passed at Bosporus in the Tauric Chersonese for twenty-eight Attic drachmae. The existing coins vary from 160 to 120 grains, the former of which is greater, the latter less than the Attic, and both apparently derived from an element of 40 grains. The existing coins seem however to have been multiples of different standards. As the heaviest of the existing coins does not come up to the weight answering to the value assigned to the Cyzicene stater by Demosthenes, we must suppose that gold was dearer or silver cheaper than usual at Bosporus at the time referred to.

The *Staters of Lampsacus*, which may be recognised by the impression of a sea-horse, are of the standard of the daric. Two in the British Museum weigh about 129 grains each.

The *Stater of Phocaea* also appears, from the specimens given by Sestini (*Degli Stateri Antichi*), to have followed the standard of the daric. It was divided into sixths (ἕκται) and twelfths (ἡμίεκτα), of which the latter were equal in value to eight obols, and in weight probably to one, since the obol bore the same proportion to the didrachm in the silver coinage, that the ἡμίεκτον did to the stater in the gold.

Most of the cities of Ionia coined staters. Those of Chios, Teos, Colophon, Smyrna, Ephesus, and other places, now exist. There were also gold coins struck in Samos, Siphnus, Thasos, the Greek cities of Sicily, and Cyrene, at an early period. After the Macedonian coinage of staters, many Greek states coined them according to the same standard; we may mention Epirus, Acarnania, Aetolia, and Syracuse.

The coins in the system of the stater were the single, double, and half staters; these were very common: there were also, less commonly, quarters, thirds, sixths, and twelfths of staters.

The Attic silver tetradrachm was called stater in later times, but it is doubtful whether it was so called in the best ages of the republic.

The term stater was also applied to weight, meaning apparently any standard of weight. The Mina and Sicilian Litra were so called.

(Hussey, *Antient Weights and Money;* Wurm, *De Pond.*, &c.; Böckh, *Metrologische Untersuchungen.*)

**STATES GENERAL.** This term is from the French *Etats Généraux*, the assembly of the three orders of the kingdom: the clergy, the nobility, and the third estate. It is generally understood of the estates of the kingdom of the Netherlands, which at present consist of two chambers. They are called States General, to distinguish them from the states of the several provinces. [NETHERLANDS.]

**STATICS**, a subdivision of mechanics, meaning the part of the science in which equilibrating forces are considered, in opposition to DYNAMICS, in which the effects of forces producing motion are investigated: it is subdivided into the statics of rigid and of fluid bodies, the latter being called HYDROSTATICS. The general considerations in MECHANICS, FORCE, PRESSURE, POWER, WEIGHT, &c., and such articles as LEVER, INCLINED PLANE, PULLEY, WHEEL AND AXLE, WEDGE, SCREW, may be consulted; and also the articles VIRTUAL VELOCITIES, THEORY OF COUPLES, &c.

One foundation of statics was first given by ARCHIMEDES, and another by STEVINUS, as noted in MECHANICS. The former is the more rigorous, the latter being open to some objections of a serious character. The discoveries of Galileo turned the attention of philosophers upon dynamical problems, and the very easy connection which exists between the statical and dynamical measure of forces caused the theory of statics to be founded, almost up to the present day, upon dynamical principles. The taste for the purer form of statics has however revived, and we imagine that from henceforward it will be customary to make this science stand by itself.

The two great propositions of statics are that of the LEVER, demonstrated in the article on that word, and that of the COMPOSITION of pressures, mentioned, but not demonstrated. Which of these shall be chosen as the foundation of the science, and how the other shall be deduced from it, are two points on which every writer on the subject should think much, as the character of his work in the eyes of others will, in a great measure, depend on his treatment of these parts of the subject. The method of Archimedes is, in our opinion, the soundest of all; but we say it without denying the possibility of exhibiting a direct statical proof of the composition of pressures which shall be equally satisfactory. In those which have hitherto been given, there is a want of distinction between the mathematical and physical assumptions: the student leaves off with no very clear perception how far the proposition is one of mathematics, and how far one of physics. There is a general dislike and distrust of these proofs, which is evidence almost conclusive against them: any one who would improve them should not leave off until he has not only made a better separation of the physical axioms from the rest, but has put it in a form in which such separation is exceedingly obvious. Till this is done, the proofs in question will only stifle opposition, while the proposition of Archimedes forces conviction. If there be anything likely to be misunderstood in the latter [SUFFICIENT REASON], it applies as much to the former in all the cases which we have seen.

Statics, like all other mechanical sciences, is usually placed among mixed MATHEMATICS. But the line which separates it from the pure sciences is almost imperceptible, and it would seem more reasonable to invent a third and intermediate distinctive term, than to place statics and electricity under the same name, to distinguish them from geometry. It would be easy to show that all which is common to geometry and statics, and not to electricity, is more extensive, more striking, and more easily described, than the little which is common to statics and electricity, and not to geometry. In fact, when we say that both statics and electricity are concerned with properties of matter as distinguished from space, we have stated the whole of the common tie by which the two sciences are united: while geometry and statics possess in common almost equal degrees of evidence in their axioms, altogether the same rigour of deduction, and strong analogies in their theorems. As far as we know, Mr. Whewell is the only writer on this subject who has contended for the alteration of the location of statics: but he carries the idea farther than we can follow him, for (*Mechanical Euclid*, p. 159) he asserts that the axioms of statics are 'self-evidently true,' 'not to be learnt from without, but from within.' We shall enter further upon this point in the article SUFFICIENT REASON.

STATIONARY. This term requires introduction into mechanics in a manner corrective of the mistakes which have sometimes been made. One of these is pointed out in STABLE AND UNSTABLE. Instead of saying that a system acted on by its weight is in equilibrium only when the center of gravity is highest or lowest, it is there pointed out that all that is necessary is that the motion which the centre tends to take should be horizontal: or that the centre should be *stationary* as to ascent or descent, for the moment. Again, there is what is called the *principle of least action* [VIRTUAL VELOCITIES], which the mathematician will recognise in the theorem that the motion of a system is always such that $\Sigma\, m \int v\, ds$ is a minimum. Now all that is proved is that in the motion of a system, in the language of the calculus of VARIATIONS, $\delta\, \Sigma\, m \int v\, ds$ is $= 0$. Now all that this requires is that $\Sigma\, m \int v\, ds$ should be *stationary;* or that if a path infinitely near the path of motion should be chosen, $\Sigma\, m \int v\, ds$, calculated for the new path, should differ from the same calculated for the old path, by a quantity of an order inferior to those on which the difference of the paths depends. Sir W. Hamilton proposes to call this the principle of *stationary* action, instead of that of least action; the action of a particle whose mass is $m$ moving over an arc $s$ being a name given to $m \int v\, ds$, taken from one end of the arc to the other, where $v$ represents the velocity.

STATIONARY (Astronomy). All the planets appear at the earth to move alternately forwards and backwards in the heavens, the retrograde motion not continuing so long as the direct motion. For a little time at the beginning and end of the retrogradation, the planet appears to have no motion. This arises when the relative MOTION of the planet is really towards the earth. The planet's velocity may always be decomposed into two, one in the direction of the earth's motion, or its opposite, the other towards or from the earth. When it happens that the former motion is not only parallel to that of the earth, but equal to it, the planet cannot change its place in the heavens, but all its apparent motion is the remaining motion, directly to or from the earth. If the planet were so near that we could readily see alterations of its distance, we should say it was directly approaching or receding: but as we cannot see this phenomenon, we pronounce it stationary, and for some nights we lose the distinction between it and the fixed stars. [TROCHOIDAL CURVES.]

STATISTICS is that department of political science which is concerned in collecting and arranging facts illustrative of the condition and resources of a state. To reason upon such facts and to draw conclusions from them is not within the province of statistics; but is the business of the statesman and of the political economist. In order to exemplify the precise character and limits of statistics, the Statistical Society of London have aptly chosen for their emblem a wheat-sheaf, with the motto 'aliis exterendum.'

That it is necessary for a government, in order to govern well, to acquire information upon matters affecting the condition and interests of the people is obvious. Indeed the civilization of a country may almost be measured by the completeness of its statistics; for where valuable statistical records of antient date are found concerning a country not yet advanced in civilization, which would appear to contradict this position, we owe them to sovereigns or governments of uncommon vigour and sagacity. However rude the government of a country may be, it cannot attempt to make laws without having acquired the means of forming a judgment, however imperfect, as to the matters brought under its consideration. In this sense statistics may be said to be coeval with legislation; but as the latter has rarely been conducted upon any fixed principles, or partaken of the character of science, in the earlier ages of the world, we must attribute to statistics, as a department of political science, a much later origin. It is chiefly to the rise of political economy that we are indebted for the cultivation of statistics. The principles of that science, which are directly concerned about the prosperity and happiness of mankind, were not reduced to any system until the middle of the last century: since that time, political economy has been cultivated as an inductive science. The correctness of preconceived theories has been tested by the observation and analysis of facts, and new principles have been discovered and established by the same means. A limited knowledge of facts had previously been an obstacle to the progress of political economy; and on the other hand the neglect of that science caused indifference to statistical inquiries. It is well remarked by Mr. M'Culloch that 'observations are scarcely ever made or particulars noted for their own sakes. It is not until they begin to be in request as furnishing the only test by which to ascertain the truth or falsehood of some popular theory, that they are made in sufficient numbers and with sufficient accuracy.' For this reason, statistics which had been neglected until political economy rose into favour, have since been cultivated with continually increasing care and method, as that science has been further developed, and the knowledge of its fundamental principles more widely diffused.

This connection between political theories and statistics, while it has led to the collection of many data which would not otherwise have been obtained, has too often introduced a partial and deceptive statement of facts, in order to support preconceived opinions. This is sometimes unjustly objected to statistics, as if it were a defect peculiar to them. That facilities for deception are afforded by statistics cannot be denied; but fallacies of this kind, like all others, are open to scrutiny and exposure. Reliance need not be placed upon statements of facts nor on numbers, unless supported by evidence; and inferences from them should only be admitted according to the rules by which all sound reasoning is governed. Fallacies are difficult to detect in proportion to the ingenuity of the sophist and the ignorance or inexpertness of his opponents; but in political matters, opposite theories and opinions are maintained with equal ability, and facts and arguments are investigated with so much jealousy, that, in the end, truth can hardly fail to be established. Neither does any suspicion of partiality attach to such facts as are collected by a government without reference to particular theories. Until some one has shown the value of noting a certain class of facts with a view to his own inquiries, no pains are taken to obtain information of that nature from the best sources; but as soon as the importance of seeking any data is acknowledged, the collection of them becomes the business of impartial persons. The statist must be acquainted with the purposes to which the facts collected and arranged by him are likely to be applied, in order that the proper distinctions and details may be noted in such a manner as to give the fullest means of analysis and inference; but his services are greatest when he does not labour in support of a theory.

It thus becomes the duty of a government to apply all the means in its power in aid of statistics, not only for the administration of the affairs of state, but also for the furtherance of political science, and for general information. Abundance and accuracy must be the object of a government in collecting statistical facts.

We would lay much stress upon the collection of facts by the highest authority of the state, because the classes of facts most important in political inquiries can scarcely ever be searched out by other persons, who have not access to the offices of government, and who are without authority to demand information; while the government has ample means at its disposal, and can, without difficulty, and in the ordinary course of executive business, obtain statistical information of the highest value. In this and many other countries the respective governments are applying themselves earnestly to statistical investigations. In England a statistical department has been established at the Board of Trade to collect and arrange all the documents of a statistical nature that can be obtained through any department or agency of government. The admirably organised departments of the French government have abundance of statistical materials systematically collected, which they never fail to arrange in a very lucid manner, and to analyse with much ability. Great credit is due to the Belgian government for the diligence with which its several departments have engaged in statistics; and in March, 1841, the king appointed a central statistical commission. The object of this commission,' said the minister of the interior, in his Report to the king, 'will be to bring together in one common depository all the scattered information which is at present collected by the different departments of government; and it will propose models for the statements and tables employed in collecting and classifying the elements of official publications.' He adds, that 'if the commission carries out satisfactorily the object proposed, the government, the legislative chambers, and the country, will find in the official statistical publications, authentic documents calculated to throw light on all matters of discussion, to encourage useful works, and to make known annually the situation, the strength, and the material and moral resources of the kingdom.' The useful results of this commission, it may be hoped, will not be confined to Belgium. The world at large is interested in the statistics of any country; and improved methods of conducting statistical inquiries must be generally applicable.

But while governments are thus engaged, there is ample room for the labours of individuals. Local statistics of all kinds are open to them. The books and records of public institutions, facts relating to particular trades, to the moral and social state of different classes of society, and other matters apparently of local interest only, often present results as important as those derived from inquiries on a more extended scale. Good service also may often be done by a judicious selection and comparison of matters not brought together in official statements, with a view to the illustration of principles of science or experiments in legislation, and by suggestions and criticism, which may direct the attention of government to particular branches of inquiry, to improvements in the mode of carrying them on, or in the form in which they are published.

It would be useless to attempt an enumeration of the various matters that are included in the province of statistics, but for the more convenient consideration of the subject we propose to divide it into—1, Historical statistics, or facts illustrative of the former condition of a state; 2, Statistics of population; 3, of revenue; 4, of trade, commerce, and navigation; 5, of the moral, social, and physical condition of the people.

### 1. *Historical Statistics.*

The knowledge of the antient state of a country is obtained chiefly from its chronicles and histories. These are usually more minute in recording political events than in describing the state of the people either in regard to wealth or other circumstances. With such imperfect means it is the study of the historian to infer rather than discover the actual condition of a country in remote times. It is not often that we can find records of unquestionable authority containing the result of inquiries instituted by government; but when such exist, they are extremely valuable, and may be used by the statist in aid of political science with much effect. No country, perhaps, is more rich in such materials for statistical research than England, yet in the earliest periods of our history there were few occasions (as compared with modern practice) on which investigations of a general character were undertaken. Some of them however were so extensive as to merit particular notice.

The most antient statistical record in England is the 'Domesday-book' of William the Conqueror. It contains the results of a minute survey taken by commissioners appointed by that king, and completed in 1086. Ingulphus, a writer of that age, states this survey to have been made upon the model of an earlier work of the same nature, ordered by Alfred, and called the 'Roll of Winchester.' No such record however has been discovered, and its existence at any time is doubted. It has been supposed, with some appearance of probability, that the 'Dome-boc' of Alfred, which is not a statistical survey, but the code of Saxon laws, may have been confounded, by reason of the similarity of name, with the later work called 'Domesday.' This supposition is confirmed by the fact that the latter was also called 'Liber de Wintonia,' and 'Rotulus Wintoniæ,' as the inquisitions, when taken, were sent to Winchester, and there entered in a register. This survey extended to the names of the owners of all lands in the reign of Edward the Confessor, and at the time of the survey; the number of tenants and serfs of different ranks and denominations, the divisions, quantity, tenure, and value of lands, whether pasture or arable; forests, parks, or vineyards; the number and value of mills, salt, iron, and lead-works, fisheries, and other property; and whether any advance could be made in the value. (*Introduction to Domesday-Book.*) So minute was the inquiry, that in some counties the number of young cattle, sheep, and working horses is stated, and even how many hogs the woods will support. (Kelham's *Domesday Book Illustrated*, p. 4.) 'So very narrowly, indeed,' says the Saxon Chronicle, 'did he commission them to trace it out, that there was not a single hide nor a yard of land, nay, moreover (it is shameful to tell, though he thought it no shame to do it), not even an ox, nor a cow, nor a swine was there left, that was not set down in his writ.' (Ingram's *Saxon Chronicle*, p. 289.)

The information thus acquired must have been of great importance at that time. The possessions of the crown were defined, the military strength of the country ascertained, its wealth, resources, and capacity for taxation exhibited to a conqueror. The record also served as a register of appeal in cases of disputed titles, which must have been very frequent after the changes effected in property by the Conquest. As such its evidence is still relied on, more particularly in claiming exemptions from tithes.

The 'Hundred Rolls' of Edward I. are worthy of notice, in connection with the early statistics of this country. During the reign of Henry III. the revenues of the crown had been diminished by various usurpations and encroachments, and the people had been oppressed by unlawful exactions. Edward, on returning from the Holy Land after the death of his father, immediately appointed commissioners to enquire into these abuses, who collected evidence of the true state of the possessions and rights of the crown, and of feudal and manorial dues throughout the country.

Another antient and memorable work is the taxation of Pope Nicholas IV. In 1288 that pontiff granted the tenths of all the benefices in England to Edward I. for six years, towards defraying the costs of an expedition to the Holy Land. In order that the full value might be collected, a taxation was ordered, which was completed in 1292. By this record all taxes were regulated until the survey generally known as 'valor ecclesiasticus,' made in pursuance of an act passed in the 26th Henry VIII. (1534). By this survey the precise nature and value of all ecclesiastical property of every description was ascertained and registered. All livings have since been assessed for the purpose of taxation at the value stated in this survey, or, as it is popularly called, 'the king's books.' In regard to the statistics of the church, it may be as well to add that in 1646 surveys of church lands were made by order of the Parliament, which at the Restoration were deposited in the Library of Manuscripts at Lambeth Palace, and have lately been copied for the House of Commons, and placed in their library; and that finally commissioners appointed in the reign of William IV. have reported the present value of every ecclesiastical dignity and benefice both in England and Ireland.

We have referred to these works as being examples of records expressly statistical; and will only add that there are many other interesting records from which illustrations of the antient statistics of Great Britain may be collected. Many of the most important of these have been made accessible to the public by the Record Commission. They are valuable in an historical point of view, as exhibiting the condition of our country, its sources of wealth, the direction given to its industry, the relations of different classes of the people to each other, and the state of particular institutions in past times. The works of contemporary writers have a peculiar charm in relating the events and circumstances of their own times: they carry us back to the age in which they wrote with a distinctness and reality not to be attained by those who compile history from the works of others. But there is still greater reality and truth in records collected in remote times for particular objects, not intended so much for posterity as for the very age to which they owe their existence, and of which they bear the stamp and character. Such records are not only instructive as the best materials for history, but afford ample scope for the inquiries and deductions of the political philosopher. Relics of former times, of much less pretension than records of the class we have been referring to, are often of great statistical value, and may be turned to good account by acute and diligent men. Of this nature are all statements of prices, of the value of monies, the income and expenditure of persons of rank and fortune, the wages of different descriptions of labour, the food and clothing used by the several classes of people, and how and whence obtained: all these and numberless other facts, when viewed in connection with certain laws and other circumstances existing at the time, are most instructive. The 'Household Book' of the 5th earl of Northumberland, at his castles of Wresil and Lekinfield, in 1512, is an interesting specimen of records of this character. Nor can we omit mentioning with pleasure three relics of antiquity lately published for the Roxburgh Club by Mr. Botfield, viz. 1, 'The Household Roll of Eleanor, Countess of Leicester,' A.D. 1265; 2, 'Accounts of the Executors of Eleanor, Queen Consort of Edward I.,' A.D. 1291; and 3, 'Accounts and Memoranda of Sir John Howard, First Duke of Norfolk,' A.D. 1462 to 1471. Contributions to our knowledge of this description of facts are most welcome to statists; and there are many sources from which they may yet be made. The 'Chronicon Preciosum' of Bishop Fleetwood shows in what abundance such facts may be collected; and the able 'History of Prices' by Mr. Tooke is a sufficient illustration of their importance to political economy.

### 2. *Population.*

One of the most obvious purposes to which statistics can be applied is that of ascertaining the population of a country, which is the foundation of its strength and resources. In very early times, when perhaps nearly every other branch of statistical knowledge was neglected, we find that pains were taken to learn the number of the people. In warlike nations it was indispensable to be acquainted with the number of fighting men that could be brought into the field; and as civilization developed itself, matters of civil administration and economy became involved in the inquiry.

The antient Egyptians appear to have taken great care in recording the number of their people. They had public registers, in which an exact enumeration of the inhabitants was entered. (Jomard, *Mém. sur la Population comparée de L'Egypte Ancienne et Moderne.*) These registers (ἀναγραφαί) were sacred, and were kept by the priests. Diodorus Siculus (i., 31), in stating the population of Egypt under the antient kings, alludes to these registers as his authority, as if they might have been consulted in his time, although he does not affirm that he had seen them himself. Unfortunately no trace of these records has been found, and they are rarely mentioned by antient authors; but that they did exist, enough has been said by them to leave no doubt. When this system of registration was first established we have no means of learning, but if it existed during the earlier dynasties of Egypt, it must be accounted unquestionably as the most antient of all recorded enumerations of a people; and the great antiquity of that interesting country, and the early age in which it had attained a high state of civilization, while nations that have since flourished had scarcely any existence, render it probable that no attempt at a census could have been previously made in any other part of the globe. China is the only country in which the antiquity of public chronicles or records kept by the priests would lead us to look for mention of censuses in an earlier age than those of Egypt; but although regular annals of all public events are said to have been kept without intermission since the reign of Yao (B.C. 2357), no enumeration is noticed of an earlier date than A.D. 609, in the reign of Yang-ti. (Du Halde, *Description de l'Empire de la Chine*, vol. i., p. 264; *Historical and Descriptive Account of China*, by Hugh Murray and others, vol. ii., p. 249.)

The sacred account of the census taken by King David, in the eleventh century B.C., is interesting. The king said to Joab, the captain of the host, 'Go now through all the tribes of Israel, from Dan even to Beersheba, *and number ye the people*, that I may know the number of the people.' 'And Joab and the captains of the host went out from the presence of the king to number the people of Israel.' When they had gone through all the land, they came to Jerusalem at the end of nine months and twenty days, and Joab gave up the sum of the number of the people unto the king; and there were in Israel 800,000 valiant men that drew the sword; and the men of Judah were 500,000 men.' (2 *Samuel*, xxiv.)

The census of the Romans was of a very extensive kind, and conducted in a manner that secured its accuracy. It was first established by Servius Tullius, the sixth king of Rome, about 576 B.C. Every head of a family was required to make a declaration before the censors of all his estates and possessions, his wife, children, and slaves. This census was generally taken every five years. A more perfect institution for acquiring knowledge as to the military strength of a country, and for purposes of taxation, could not have been devised. It appears also that there was a register of births and deaths, but only as regards persons liable to military service. The emperor M. Aurelius made a rule that all children should be registered by name within thirty days after their birth, but the provision apparently applied only to Rome. (Jul. Capitol., *M. Ant.*, c. 9.)

Most of the governments of Europe in modern times have taken pains to ascertain the population of their own dominions, and many have entered into the inquiry with great minuteness of detail.

In Great Britain there have been five complete censuses, viz. in 1801, 1811, 1821, 1831, and 1841. The population at earlier periods had indeed been ascertained by inference and estimate, as from the 'Domesday Survey;' from the accounts of persons liable to the poll-tax in 1377, and of houses paying the hearth-tax at the Revolution. The parish register returns of births and deaths, which were collected in 1801, as far back as 1700, and of marriages from 1754, also furnished the means of calculating to a certain extent the population at different periods during the last century, but no actual enumeration was taken by government previously to 1801. Since that time the censuses have shown the number of families and of males and females in each parish, distinguishing those employed in agriculture from those engaged in trade, manufactures, and handicraft. The parish register returns have also been continued, and in 1836 a complete civil registration of births, marriages, and deaths was established, from which the most accurate statistical results are anticipated. The law now requires every birth to be registered, with the following particulars, viz. the time and place of birth, the name and sex of the child, the name and surname of the father and mother, the rank or profession of the father, &c. In like manner every death is recorded, with the names, sex, age, and rank or profession of the deceased, together with the cause of death. All these particulars are entered by registrars appointed all over the country (of whom there are 2197), having certain districts assigned to them. They are under the control of superintendent registrars, who preside over larger districts conterminous with the Poor Law unions. These also are under the directions of the registrar-general in London.

Marriages are registered by clergymen of the established church, by registrars of marriages, who register marriages solemnised in their presence in registered places of worship, or in the superintendent registrars' offices. Certified copies of all the entries in these several registers of births, deaths, and marriages are transmitted to the general registrar, and preserved in his office. Indexes are there prepared, and an annual abstract of the births, marriages, and deaths is made up and laid before parliament. This system extends only to England and Wales.

In Ireland two excellent enumerations were taken in 1821 and 1831; and another in 1841, simultaneously with that of Great Britain.

In France censuses have been taken in 1791, 1801, 1806, 1821, 1831, and 1836, and will be repeated every five years. The adult males and females, divided into married or widowed, have been carefully distinguished from children and unmarried persons. Exact accounts have also been made of the births, marriages, and deaths, and comparisons instituted with a view to determine the increase of population and the rate of mortality. (*Rapport du Ministre du Commerce*, 1835.)

Enumerations have been made in the Austrian empire (the last of which was in 1834) of a very complete nature;

and official returns of births, marriages, and deaths are annually collected and published by the government.

The government of Holland took a census in 1838, in which the religious persuasions of the people were ascertained, and the numbers of each sect enumerated.

A valuable census was also taken in Belgium in 1836, with full details of the births, marriages, and deaths in town and country, and other materials for the advancement of statistical knowledge.

In Prussia the taking of the census forms part of the ordinary duty of the local police. It is done every third year, with elaborate classifications of age, sex, and religion, with a view to the administration of the laws relating to public instruction and military service.

In Sweden returns of the population are made by the clergy of each parish every fifth year, and arranged by the Table Commission. The clergy are also obliged to return annually the number of births and deaths in their parishes.

In Norway and Denmark also enumerations have been taken containing many particulars as to the condition of the people.

A recent census of Sardinia in 1838 is one of the fullest that has been made. The name of every person, as well as his age, occupation, place of birth, domestic condition (whether single or married), and religious profession was ascertained, and the information thus collected was abstracted and arranged in various tables. (*Journal of Statistical Soc.*, April, 1840.)

In other European states enumerations more or less complete have been made.

Population is the groundwork of the whole political structure of the federal government of the United States of North America; representatives and direct taxes being apportioned among the several states according to their respective numbers. It was accordingly directed in the first article of their constitution that an actual enumeration should be made within three years after the first meeting of the congress, and within every subsequent term of ten years. (*Constitution of United States*, Art. 1.) This census has since been regularly taken. The free white persons are distinguished from the free coloured persons and slaves, and their ages and occupations stated. The last census of the United States was taken in 1840.

Although the immediate object of enumerations has been political or fiscal, principles most important to the happiness and social improvement of mankind have been deduced from them. If no other benefit had been derived from statistical researches than a system of life-insurance and annuities, founded upon a knowledge of the average duration of life, tens of thousands will have had reason to regard the labours of statists with gratitude. From data limited in number and partial and defective in character, accurate tables of mortality could not be constructed. Every enlargement of statistical knowledge has been rapidly applied to the elucidation of the great problem of the average value of human life; but data more extensive and more minute are still required to perfect vital statistics. Mortality tables are constructed by taking the average of all classes of lives. It is notorious however that certain occupations are injurious to health, and tend to shorten life; while others are highly conducive to longevity. This fact should be taken into account in estimating the probable duration of the life of any person. For instance, persons in comfortable circumstances are likely to live long; while the labouring poor of crowded cities, living in ill-ventilated rooms, engaged perhaps in unwholesome employments, liable to frequent privation, and in many cases addicted to habits of intemperance, have a more limited chance of attaining an advanced age. A mortality table may strike a perfectly fair average of all classes, but the same law of mortality is clearly not applicable to each of these extremes. At present there are no sufficient data for such calculations, but the civil registration of births and deaths may eventually enable actuaries to determine the value of life in every great division of the people. The superior value of a female life, at a given time, as compared with a male life of equal age, has been established by the distinction of sexes maintained in our statistical inquiries as to population and births and deaths; and results not less important may be deduced from further distinctions and classification.

The circumstances of different countries are various, and the purposes for which they have taken censuses have been peculiar to each. Some had partially in view the illustration of vital statistics, but little uniformity can be expected where no means have been taken to effect it. It is not improbable that eventually most of the European states will seek the same information, in nearly the same way, and then instructive comparisons may be drawn. In the meanwhile it is important that whatever information is already possessed by foreign governments, with respect to their population, should be communicated. Much has already been obtained through British consuls, and for commercial purposes cannot be too highly prized. The actual commercial state of a country may be presented to view by statements of imports, exports, and consumption, but its capacity for improved commercial intercourse cannot well be estimated without a knowledge of its population.

3. *Revenue.*

The collection of facts concerning the revenue of a state is nothing more than a correct system of book-keeping in the various departments concerned in the receipt and issue of public money, and any neglect or failure in this respect is unpardonable. The mode of stating and arranging revenue accounts is a business of much intricacy, and from its importance demands great attention on the part of a government. An imperfect classification of the several heads of income and expenditure, a want of uniformity in the accounts of different departments or of the same departments at different periods, or an absence of well-devised enumerations and distinctions in detail, will defeat many of the objects for which public accounts are prepared. A government must know not only the total income of the state, but also the various sources from which it is derived; the productiveness of each tax, and of each class of taxes; the gross amount and the net amount received, with the items causing the difference; the charges of collection and other payments out of the income in its progress to the Exchequer; and the actual payments into the Exchequer (after all deductions) available for the purposes of expenditure. It is important that accounts containing such particulars should be uniform from year to year, for the purpose of comparison. For instance, where any alterations have been made either in the amount or in the mode of assessing or collecting a tax, the effect of such alterations upon the revenue can only be ascertained by comparing the produce of the tax before and after their enactment. Equal care is necessary in preparing accounts of expenditure. The classification of them will of course be determined in a great degree by financial circumstances peculiar to each country. It may be sufficient therefore to say that they should exhibit as faithful a statement of every description of outlay, whether on account of permanent charges, or varying and incidental expenses, as a merchant or banker would consider necessary in the management of his books.

In this country accounts are annually laid before parliament, which, in form and arrangement, may serve as favourable specimens of financial documents. Previously to 1797 the accounts were imperfect and very immethodical. In that year a committee of the House of Commons suggested new forms, which gave a more clear, detailed, and comprehensive view of the national resources than any that had been known before. The arrangement then adopted was continued till 1822, when further improvements were introduced.

These 'annual finance accounts' are divided into eight classes:—1, public income; 2, public expenditure; 3, consolidated fund; 4, funded debt; 5, unfunded debt; 6, disposition of grants; 7, arrears and balances; 8, trade and navigation. Each of these classes exhibit comprehensive abstracts of that branch of finance to which they relate; and appendices are affixed which contain numerous accounts in detail that could not conveniently form part of the general tables. Thus in the class account the whole produce of the customs is found, together with that of other taxes; and in an appendix the produce of each article liable to customs duties is added.

In addition to these accounts numerous returns concerning each branch of revenue and expenditure, and illustrative of every theory and experiment in finance, are continually ordered by parliament. These contain a mass of information unequalled perhaps in the official records of any country. They have been digested and systematised from the year 1820, and collected into very valuable volumes by the statistical department of the Board of Trade; by whom also annual volumes are published, continuing to the latest period the same information. To these volumes we shall have occasion to refer more fully.

The financial accounts of France have been the subject of investigation by Dr. Bowring, who was deputed for that purpose by the British government; and his Reports would lead us to form a very high estimate of their present condition. He says:—'The public accounts of France have, from the year 1808, been undergoing a succession of changes, all tending to unity and similarity of form in the different departments, and to the ultimate centralization of the whole in the department of the Treasury. These objects have been at length wholly effected by the introduction of a number of gradual improvements; and at this moment (1831) the books of the Ministry of Finance constantly present as complete a table of the financial situation of the country as the best regulated commercial establishment offers of its own transactions. M. Lafitte assured me, and the authority of the minister of finance is doubly valuable from his previous experience as a man of business, that he believed the present system was scarcely susceptible of melioration; that he had found the machinery complete, and its working both easy and efficient.' (1st *Rep.*, p. 3.)

The whole of this system is explained and illustrated in detail in these Reports. In the Second Report there is also a very interesting historical notice of the financial condition of France in former times, of the confusion of the accounts, and the complicated evils arising from a want of system. In this respect France may stand as an example to other nations, to show the indispensable necessity of care in the public accounts and attention to financial statistics.

Dr. Bowring has likewise investigated the public accounts of the Netherlands, which he has analysed in a Report in 1832. He states:—'On a general survey of the public system of accounts in Holland, though it cannot be deemed entitled to unqualified praise, yet many of its parts are worthy of approval and adoption.' (*Rep.*, p. 143.) With respect to Belgium, the recent revolution had caused disorder in all the financial departments of government. Since that time however great attention has been paid to all departments of statistics; and the published accounts of Belgian revenue and expenditure now appear sufficiently clear and detailed.

4. *Trade, Commerce, and Navigation.*

The fullest information that can be obtained of the state of trade and navigation should be collected by a government and published for the benefit of the people. The more publicity that is given to every description of statistical knowledge, the more productive will it be of good to the state, by stimulating inquiry and enlarging the circle of political intelligence; but in this branch of statistics it is more peculiarly necessary to lay before the people every information which may enable them to prosecute their commercial enterprises with judgment and effect. For this purpose the last class of the annual finance accounts alluded to above are of little or no value; but the returns ordered by parliament from time to time comprise much valuable information, though of an irregular description, and often for broken periods. Committees of both Houses are also in the habit of calling for documents to illustrate the subjects of their investigations, from which defects in other returns may often be supplied, and which are of themselves very important. These however have for the most part been 'framed so as to suit the passing occasion, or to illustrate the particular views of individuals. Returns of the same nature have for instance been made sometimes to comprehend the whole of the United Kingdom, and at other times to restrict the information to Great Britain. Occasionally too a link is wanting, without which it is impossible to arrive at any satisfactory conclusion upon the subject with which it is connected.' (*Preface to Statistical Tables of the Board of Trade.*) To remedy these defects, the statistical department of the Board of Trade was established. It began its labours by arranging and abstracting the information already distributed through the Parliamentary Papers, and by supplying defects and omissions. When that was accomplished, the collection and arrangement of every statistical fact that could be obtained through any department of government was commenced, and has been continued annually since 1833. Amongst the most important statements are those 'which exhibit the general view of our commercial intercourse with every part of the world, particularising the imports from and exports to each foreign country, as well as the trade between the United Kingdom and its colonies and dependencies.' (*Ibid.*) The statistics of foreign countries form a valuable addition to our own. The state of the whole world would be laid out before a merchant to direct his operations, if the statistics of every country could be presented to him in as perfect a form as the British government have prepared those relating to the United Kingdom. Pains have been taken to supply this knowledge. Series of questions have been directed to British consuls abroad, who have availed themselves of the means which their connection with foreign governments afforded to furnish the information required. The importance of this branch of statistics is so strongly felt, that doubtless no trouble will be spared in extending it as much as possible. Besides the ordinary means of collecting information concerning foreign countries by corresponding with consuls, commissioners have occasionally been sent abroad to seek such knowledge on the spot. In this way we have come into possession of facts that could not have been obtained by other means. Valuable reports have been printed on our 'Commercial Relations with France;' on the 'Commerce and Manufactures of Switzerland;' on the 'Statistics of Tuscany, Lucca, the Pontifical and Lombardo-Venetian states, with a special reference to their commercial relations;' on the 'Prussian Commercial Union;' on 'Egypt and Candia;' and on the 'Commercial Statistics of Syria.'

One excellent mode of gathering together the statistics of foreign states requires to be diligently carried out. We have ministers accredited to the governments of every civilised country, through whom an interchange of all official documents of a statistical character might be effected. The principle of this plan has indeed been partially recognised in the case of France, Belgium, and Würtemberg, whence collections have been forwarded to England, in exchange for British Parliamentary Papers: but a regular system of interchange is needed. Whatever information is possessed by a foreign government should be immediately transmitted to England; and when reduced to an intelligible and concise form, should be published with the other documents as 'Foreign Statistics.'

The trade of our colonies with this kingdom, with foreign countries, and with one another, forms another important branch of statistical inquiry, which was imperfectly and irregularly attended to before 1832. As all the official persons in the colonies are servants of the British government, nothing was wanting but a system of transmitting regularly such accounts as were called for. This system is now in full operation, and our colonial statistics of commerce are perhaps as complete as need be desired.

In the arrangement of such masses of facts, great care is necessary to avoid confusion or delay. Already the accumulation of materials is such that a large volume is published annually by the Board of Trade; and the digesting it and preparing it for press is a work of such labour that it is more than two years in arrear; that is to say, when published it refers not to the preceding year, but to two years back. The expediency of dividing this work into consecutive parts, to be published when prepared, would be worth considering. The time required for obtaining information from the colonies has made it necessary to publish it in a separate part; and if further subdivisions could be made of a similar kind, parts of the work need not wait for the completion of the whole.

The statistical compilations of the Board of Trade have not in any degree superseded the custom of moving for returns in Parliament. Documents of all kinds are constantly ordered, as before, and the information contained in them is of great value; yet the want of system which has been alluded to above, continues to detract from their value. Measures for ensuring uniformity and correctness by means of official inspection have already been under consideration, and the importance of the object leaves little doubt that they will shortly be carried into effect.

Many of the tables published by the governments of France and Belgium, illustrative of the condition of these countries in reference to commerce, deserve much praise, both on account of the variety of facts contained in them, and of the clearness and simplicity with which they are arranged.

5. *Moral, Social, and Physical Condition of the People.*

The statistics of revenue and of commerce fall directly within the cognizance of the executive departments of government, and may be collected in the ordinary course of business. When a system is established, the working of it is little more than mechanical. But inquiries into the moral, social, and physical condition of a people are, for the most part, occasional and extraordinary, and usually originate with the legislature. In this country there are two modes of conducting such inquiries, viz. by Parliament itself, or by commissioners appointed by the Crown. When the former is preferred, the labour is usually confided to a committee, who examine witnesses, and call for any papers that may be required by them. Matters that need personal investigation on the spot cannot be conveniently undertaken by Parliament, and commissioners are then entrusted with the duty. The Reports of Parliamentary Committees and Commissions furnish the chief materials for legislation. The subjects to which they relate are as various as are the interests and circumstances of a great people; for the eye of the legislature is upon all things. To attempt any examination would be useless; but it may not be uninstructive to notice briefly as examples some classes of subjects which have been investigated.

To begin with the religious condition of the people. In 1834 an inquiry into the means of religious instruction in Ireland was undertaken. Commissioners ascertained on the spot the number of persons in each parish in communion with the Established Church; the number of resident and non-resident ministers; the periods at which divine service was performed, and the average number of persons usually attending; the number of places of worship belonging to Roman Catholics, Presbyterians, and Protestant Dissenters, the number of ministers officiating in each, the proportion of the population belonging to each of such persuasions, the periods at which divine service is performed in each of their chapels, and the average number usually attending; the means of education, the number and description of schools, and the kind of instruction afforded; and lastly, whether adequate provision was made for the religious instruction and general education of the people of Ireland. The manner in which this information was collected is fully explained by the commissioners in their Report.

A commission has also been appointed to ascertain the extent of church accommodation in Scotland. The revenues of the church in England and Ireland have been fully investigated by commissions. Though in Ireland the number of persons of each religious persuasion has been discovered, no attempt to ascertain this fact in England has yet been made, and it is perhaps questionable whether much advantage would be derived from such an inquiry. In 1830, a return of the number of churches, chapels, and places of worship of each religious denomination was sought for; but the answers were so confused and unintelligible, that the county of Lancaster alone was thought perfect enough to be printed. Upwards of fifty sects were mentioned in them. In the censuses of Prussia, Belgium, and Sardinia, the religious persuasion of each person has formed one of the series of questions to which answers were obtained. The necessity of such inquiries will depend upon the peculiar circumstances of each country with respect to church government, and the laws relating to religion. Where any legislative or executive object is in view, the inquiry may be made with advantage; but without any such object, mere curiosity perhaps would scarcely be thought to justify it.

The state of education has of late years occupied the attention of most of the countries of Europe. The Prussian compulsory system of state education involves the most extensive knowledge as to its observance. The classification of ages to which we referred in speaking of their census is adopted in furtherance of the general system of enforcing the attendance of children at schools and the contribution of their parents to the expenses of their support. This system forms part of the ordinary administration of the state, and the statistics of education are therefore collected not by any special agency, but by simple registration.

The government of France, having a superintendence over the schools, and an organised system of instruction throughout the whole kingdom, is enabled to collect systematically authentic accounts relating to education. There is a minister of public instruction, and under his authority twelve inspectors visit the several departments and ascertain the state of education. The reports of the minister are generally of an extremely interesting character, and illustrate the operations of the educational system in every point of view.

As there is no national system of education in this country under the superintendence of government, our information as to the existing state of education has been collected not systematically, but by special inquiries. In 1833, on the address of the House of Commons, circulars were sent to the overseers of every parish in England and Wales desiring answers as to the number of schools of every description, the number, sex, and age of scholars, and from what funds the schools were supported, with other particulars. An abstract of their answers was prepared and printed. In the following year a return somewhat similar with regard to Scotland was obtained from the presbyteries; and in 1838 a committee of the House of Commons circulated a number of queries, and obtained answers from a large proportion of the schoolmasters in Scotland relative to the system of administration and instruction pursued in their schools; the number, sex, and age of scholars, the books used, the salary of the schoolmaster, the amount of school fees, &c. These answers were abstracted and published in 1841. Parliamentary committees have also at different times taken evidence upon the subject of education in England and Scotland; nor would it be irrelevant to mention the extensive investigations of the Charity Commissioners, which embraced, among other charities, most educational establishments enjoying any endowment or bequest. [SCHOOLS, ENDOWED.] In Ireland the means of general education formed part of the inquiries of the Commissioners of Public Instruction in 1834-5, to which we have already referred.

The collection of facts concerning crime is simply a matter of registration in the several tribunals which administer justice. In the classification and arrangement of them, much light may be thrown upon the operations of the various laws for the prevention and punishment of offences; and thus, in forming criminal tables, the distinctions recognised by the law should be as nearly as possible adhered to. The state of crime in Great Britain is annually exhibited in tables. The offences are divided into six classes, under each of which the particular crimes are specified; together with the number of persons committed for trial or bailed; whether convicted or acquitted; the punishment if convicted, and the causes of acquittal if acquitted; and the age, sex, and degree of instruction of the persons committed for trial or bailed. Uniformity is preserved from year to year, and thus excellent means of comparison are afforded, especially in the event of any alterations in the law.

The Metropolitan Police Commissioners also publish abstracts of the state of crime within their district, observing a similar classification of offences, and distinguishing the profession or trade of all persons charged with each description of offence.

In France elaborately classified criminal tables are published annually, which state the particulars included in the English tables, but arranged in a different manner, and distinguish the professions of the accused, and whether they inhabit rural or city communes. To these are prefixed an explanatory Report by the minister of justice.

The criminal tables prepared by the Belgian minister of justice are very simple and well arranged. Offences against the person and against property are separated, and the number of cases in which each offence has been committed is stated under these divisions upon opposite sides of the page. The number of crimes of which the authors are unknown; the number of persons charged, and convicted or acquitted, with the punishments awarded, form columns in these tables, and at the top of the pages referring to each province the population of the province is printed in a conspicuous type.

The most extensive inquiries perhaps that have been undertaken with reference to the social and physical state of the people of this country have been those connected with the administration of the poor laws. They have been conducted both by committees and commissions, and have brought to light the whole social state of the poorer classes. In Ireland the investigations into the condition of the people were more extensive than those instituted in England, and the Reports of the commissioners embody more statistical information upon that country than can easily be found in any other works with which we are acquainted. We will only add that information has been collected by the same means concerning the condition of children and young persons employed in factories, of hand-loom weavers, and of persons engaged in various branches of industry.

STA'TIUS, P. PAPI'NIUS, a Roman poet, born at Naples, A.D. 61. His father was an eminent grammarian and poet, and was in consequence much distinguished by the patronage of Domitian. The son was educated at

Rome and his early genius met with like encouragement from the emperor; he gained the prizes in the poetical contests held at that time at Alba and elsewhere. His popularity is described by Juvenal (*Sat.*, vii., 82). His tragedy or poem of 'Agave' has not been preserved; neither is the poverty of Statius, which is spoken of by Juvenal, noticed or accounted for elsewhere, though such inconsistencies of circumstance are not unusual in the lives of poets. In the year 80 A.D., according to Dodwell (*Annales Statiani*), he married Claudia, a widow, of whom he makes frequent and affectionate mention in his writings: having no issue by her, he adopted a son. His great success drew upon him the jealousy and ill-will of his rivals, among whom Martial is thought to allude to him under the name Sabellus, and to have slightingly omitted his name while making honourable mention of his contemporaries generally.

When he was no longer able to maintain his superiority in the poetical contests, Statius withdrew to the retirement of Naples, where he died, A.D. 96. He wrote—1, 'Sylvæ,' a collection of 32 poems distributed in 5 books, on various subjects, such as passing events or passing thoughts would suggest. They are more of a lyric than of an epic character, and are written chiefly in hexameters, and occasionally in the alcaic, sapphic, and other metres. The last book appeared in the last year of the author's life.

2, 'Thebais,' an epic poem in 12 books, giving an account of the Theban war between Eteocles and Polynices: in this work he has borrowed much from Greek sources, and in particular from the 'Thebais' of Antimachus.

3, 'Achilleis,' an unfinished epic poem in 2 books, the further progress of which was arrested by the death of the poet.

The 'Sylvæ' are the most interesting of the poems of Statius. In them we find examples of trifling subjects treated with lyric playfulness of fancy, the poet's thoughts appear in the easy garb of private life, and his domestic feelings and affections are unaffectedly revealed (see the beautiful address to his wife, 'Sylvæ,' iii. 5). Many curious particulars illustrative of the manners and way of life of the Romans of that time may be gathered from this work.

As an epic poet, Statius belongs to a school of later Roman writers, the successors and imitators of Virgil, and, like them, he is characterised by a learned obscurity of allusion, a tasteless and unskilful use of metaphor, and a strained yet feeble mode of expression, masking in pompous language the simplest thoughts, and seeking to surprise the reader by rhetorical artifice, rather than to call up the feelings which true poetry suggests. The few facts in the life of Statius are nearly all furnished by passages in his own poems, which are quoted at length by Crusius, 'Lives of the Roman Poets,' i., 12mo., and the principal dates are fixed by Dodwell, 'Annales Statiani:' other authorities quoted by Baehr, 'Geschichte der Römischen Literatur,' are, 'Crinit., 'De Poett. Latt.;' Lil. Gyrald., 'De Latt. Poett. Diall. IV.;' Voss, 'De Poett. Latt.;' Funcc., 'De imminent L. L. senectat.;' Fabricii 'Bibl. Lat.,' ii.; 'Saxii Onomast.,' i. 273. The principal edition of Statius are: Edit. princ., 1470, Venet., 1483, fol.; Bernartius, Antwerp, 1595; ed. Fr. Tiliobroga (Lindenbrog), Paris, 1600, 4to.; rec. Crusius, Paris, 1618, 4to.; J. Fr. Gronovii, Amstel., 1653, 24mo., cum comment. ed. F. Hand., Lips., 1817, 8vo.

STATUARY; STATUE. [SCULPTURE.]

STATUTE. Bills which have passed through parliament and received the royal assent become acts of parliament [BILL IN PARLIAMENT], and are sometimes, though not often, spoken of collectively as forming the body of statutes of the realm. But a more restricted application of the word is that generally in use, by which private acts of parliament [BILL IN PARLIAMENT] are excluded, and even public acts when their purpose is temporary and they soon lose their efficiency. The application is still more restricted when the measures of the early parliaments are the subject in question, there being many acts passed and having received the royal assent which are to all intents and purposes of the class of public acts and to be found at large on the Rolls of Parliament, which are not accounted statutes in the sense in which that word is ordinarily used.

No strict and proper definition can however be given of those results of the deliberations in parliament to which the king has signified his assent, which are now called the statutes of the realm, and it would seem that we are thrown upon this mode of distinguishing them from other enactments of early times—that they were at a very remote period separated from the rest, written in books apart from the rest, and received by the courts of law as of co-ordinate authority with the antient customs of the realm.

It may seem also that they have, with very few exceptions, a more general and extended bearing than the other public acts which are found upon the rolls of parliament.

Three volumes, preserved in the court of Exchequer, and now in the custody of the Master of the Rolls, contain the body of those enactments which are called statutes. One volume contains the statutes passed before the beginning of the reign of Edward III.; and the other two, those from 1 Edward III. to 7 Henry VIII., all very fairly written. These may be considered as the manuscript of the early statutes of superior dignity, if not of superior antiquity as to the earlier portions, to the many similar collections which are to be found in the libraries of the inns of court, of the universities, of the British Museum, and in some other depositaries public and private. These numerous manuscript copies of the statutes are in substance pretty nearly the same, though some of these collections contain statutes which are not admitted into others. These books are not considered in the light of authorized enrolments of the statutes. For the authentic and authoritative copies, if any question arises, recourse must be had (1) to what are called the statute rolls at the Tower, which are six rolls containing the statutes from 6 Edward I. to 8 Edward IV., except from 8 to 25 Henry VI.; (2) to the inrolments of acts of parliament which are preserved at the Rolls chapel from 1 Richard III.; (3) to exemplifications and transcripts with writs annexed, signifying that they were transmitted by authority to certain courts or other parties, who were required to take notice of them, of which many remain in the Exchequer and elsewhere; (4) in those since 12 Henry VII., to the original acts in the parliament office; (5) the rolls and journals of parliament; (6) the close, patent, fine, and charter rolls at the Tower; on which statutes are sometimes to be found.

With the parliament of the reign of Richard III. began the wholesome practice of printing, and in that manner publishing, the acts passed in each session. This followed very soon on the introduction of printing into England. Before that time it had been a frequent practice to transmit copies of the acts as passed to the sheriffs of the different shrievalties to be by them promulgated. And the practice of printing the sessional statutes has continued.

Before the first of Richard III. the aid of the press had been called in to give extended circulation to the older statutes. Before 1481 it is believed that an abridgment of the statutes was printed by Lettou and Machlinia, which contains none later than 33 Henry VI., 1455. To the next year is assigned, by those who have considered this subject, a collection, not abridged, from 1 Edward III. to 22 Edward IV. Next to these in point of antiquity is to be placed a collection printed by Pynson about 1497, who also, in 1503, printed what he entitled 'Antiqua Statuta,' containing Magna Charta, Charta de Foresta, the Statutes of Merton, Marlbridge, and Westminster primum and secundum. This was the first publication of those very early statutes.

In the reign of Henry VIII. the first English abridgment of the statutes was printed by Rastall; and during that reign and in the succeeding half century there were numerous impressions published of the old and recent statutes in the original Latin and French, or in English translations. Barker, about 1587, first used the title 'Statutes at Large.'

In 1618 two large collections of statutes, ending in 7 James I., were published, called Rastall's and Pulton's. Pulton's collection was several times reprinted with additions.

In the eighteenth century an edition, in six folio volumes, was published by Mr. Serjeant Hawkins in 1735, containing the statutes to 7 George II. Cay's edition, in 1758, in the same number of volumes, contains the statutes to 30 George II. Continuations of these works were published as fresh statutes were passed; and another work in 4to., of the same kind, was begun in 1762, well known by the designation of Ruffhead's 'Statutes at Large.' Pickering's edition is in 8vo., and ends with 1 George III.

None of these collections had ever been published by authority of the state, and though able men had been employed upon them, they have been thought by many inquirers not adequate to the dignity and importance of the subject, and to be liable moreover to some serious objections. And this led a committee of the House of Commons, who, in 1800, were appointed to inquire into the state of the Public Records, to recommend, among other things, that 'a complete and authoritative edition of all the statutes should be published.' When the commission was appointed for carrying into effect the recommendations of this committee, they proceeded to the execution of this project; and finally, between the years 1810 and 1824, they produced, in a series of large volumes, a critical edition of the statutes (including the early public charters), ending with the close of the reign of Queen Anne. This is what is now considered the most *authentic* edition of the statutes, and it is supplied with a valuable index. It forms ten folio volumes. In the large introduction to that work there is a more particular account of the former editions of the statutes and of the means for making such a work as this complete.

STATUTES OF LIMITATION. There appear to have been no times limited by the common law within which actions might be brought; for though it is said by Bracton (lib. 2, fol. 228), that, 'omnes actiones in mundo infra certa tempora limitationem habent;' yet, with the exception of the period of a year and a day, mentioned by Spelman (*Gloss.*, 32), as fixed by the antient law for the heir of a tenant to claim after the death of his ancestor, and for the tenant to make his claim upon a disseisor, all the limitations of actions in the English law have been established from time to time by statute. Certain remarkable periods were first fixed upon, within which the cause of action must have arisen. Thus in the time of Henry III., the limitations in a writ of right, which was then from the time of Henry I., was by the Statute of Merton, c. 8, reduced to the time of Henry II.; and by the Statute of Westminster, 1, c. 8, the period within which writs of right might be sued out was brought down to the time of Richard I. (Co. Lit., 114, b.)

I. As to limitations of actions and suits relating to real property.

1. And first of limitations as to land and rent generally.

By the 4 Hen. VII. c. 24, a fine with proclamations was made a bar to all persons having rights of entry at the time of the fine being levied, and not under any disabilities, if they did not claim within five years after proclamation made; and to persons under disabilities, if they did not claim within five years after the removal of their disabilities; and to all persons not having present right of entry, if they did not claim with five years after their right of entry accrued, except they were under disabilities, and then within five years after the removal of their disabilities.

The first general statute establishing regular periods for the limitation of actions relating to land was the 32 Hen. VIII., c. 2, whereby a writ of right on the seisin of an ancestor was confined to sixty years, and a possessory action on the seisin of an ancestor to fifty years, and no real action, droitural or possessory, could be maintained by any person on his own seisin after a lapse of thirty years; formedons in reverter and remainder were required to be sued within fifty years; and it was enacted that no avowry or cognizance should be made for any rent or service after fifty years from the seisin of the ancestor or any other person.

By the 21 Jac. I., c. 16, the period for all writs of formedon was limited to twenty years; and it was enacted generally that no person should make entry into any lands but within twenty years next after his right of entry accrued. This act contained a saving of the right of entry of persons who at the time when such right first descended or accrued were minors, *femes covert, non compotes mentis*, persons imprisoned or beyond the seas, and their heirs, provided they made entry within ten years after the removal of their respective disabilities.

By the 10 and 11 Wm. III., c. 14, it was enacted that no writ of error for reversing a fine, recovery, or judgment should be brought after twenty years.

By the 4 Anne, c. 16, § 16, it was enacted that no claim or entry made of or upon lands should be effectual to avoid a fine levied with proclamations, or be sufficient within the statute 21 Jac. I., c. 16, unless an action were commenced within one year of such entry or claim, and prosecuted with effect.

By the 9 Geo. III., c. 16, the right of the crown to sue or implead for any manors, lands, or other hereditaments (except liberties or franchises) was limited to sixty years. Before this act, the rule that *nullum tempus occurrit regi* was universal; and it still prevails as a maxim of law, except where abridged by statute. The same maxim applies to the duchy of Cornwall, which, though it vests in the crown from time to time, so long as there is no eldest son of the sovereign, or other person entitled to the dignity, is not within the above statute.

The next statute upon this subject is the important act of the 3 and 4 Wm. IV., c. 27, by which great changes were made in the remedies for trying the rights to real property, and which embodies the greater part of the present law of limitations relating thereto.

In order to understand this act, it is necessary to advert to the definitions of the words 'land,' 'rent,' 'person through whom another claims,' and 'person,' contained in the first section. The word 'land' extends to 'manors, messuages, and all other corporeal hereditaments whatsoever, and also to tithes (other than tithes belonging to a spiritual or eleemosynary corporation sole), and also to any share, estate, or interest in them or any of them, whether the same shall be a freehold or chattel interest, and whether freehold or copyhold, or held according to any other tenure;' and the word 'rent' extends 'to all heriots and to all services and suits for which a distress may be made, and to all annuities and periodical sums of money charged upon or payable out of land (except moduses or compositions belonging to a spiritual or eleemosynary corporation sole);' and the 'person through whom another person is said to claim' means 'any person by, through, or under, or by the act of whom, the person so claiming became entitled to the estate or interest claimed, as heir, issue in tail, tenant by the curtesy of England, tenant in dower, successor, special or general occupant, executor, administrator, legatee, husband, assignee, appointee, devisee, or otherwise; and also any person who was entitled to an estate or interest, to which the person so claiming, or some person through whom he claims, became entitled as lord by escheat;' and the word 'person' extends 'to a body politic, corporate, or collegiate, and to a class of creditors or other persons, as well as an individual.' There seems reason to think that the word rent here, and also in sect. 42 of the act, refers to rents charged upon land only, and not to conventional rents payable by tenants to their landlords (*infra*, sect. 42). It has been determined that turnpike-road trusts are not comprised in this section, and are consequently not affected by subsequent enactments. (3 Beav., 22.)

By section 2, no person can make an entry or distress, or bring an action to recover any land or rent, but within twenty years after the right to make such entry or distress, or bring such action, accrued to the claimant, or some person through whom he claims. The action for rent here spoken of is the action of ejectment. The action for debt or covenant for rent reserved, belongs to personal actions, and will be afterwards considered. It has been decided under this section, and with reference to the next, that a person claiming an annuity charged on land, under a will, who has never received his annuity, is barred by it, unless he bring his action within twenty years of the death of the testator. (3 Bing., N. C., 544.)

By section 3, the right to make an entry or distress, or bring an action to recover any land or rent, is to be deemed to have accrued at the times following:—(1) When the person claiming, or some one through whom he claims, has been in possession of the rents and profits of such lands, and has been afterwards dispossessed or has discontinued such possession or receipt, the right is to be deemed to have accrued at the time of such dispossession or discontinuance of possession, or at the last time when such rents or profits were received. (2) When the person claiming claims as being entitled, immediately upon the death of some person deceased, who died in possession, the right is to be deemed to have accrued on the death of that person. (3) When the person claiming claims under some grant, appointment, or assurance, by some instrument (other than a will) to him, or some person under whom he claims, from a person who was, in respect of the same estate, in possession or in receipt of the rents and profits of the land or of the rent, when no person entitled under the instrument has been in such possession or receipt, the right is to be deemed to have accrued at the time at which the person claiming, or the person through whom he claims, became entitled by virtue of such instrument. (4) When the estate or interest claimed has been in reversion or remainder, and no person has been in possession or in receipt of the rents and profits in respect of such future interest, the right is to be deemed to have accrued when such estate or interest became an estate or interest in possession. (5) And when the estate or interest is claimed in respect of a forfeiture or breach of condition, the right is to be deemed to have accrued when the forfeiture was incurred, or the condition broken. (Sect. 4) But when such right by reason of any forfeiture or breach of condition, first accrued in respect of an estate or interest in reversion or remainder, and the land or rent has not been recovered by virtue of such right, the right to make an entry or distress, or bring an action, is to be deemed to have accrued at the time when such estate or interest became an estate or interest in possession, as if no such forfeiture or breach of condition had happened. (Sect. 5) And the reversioner is to be considered as having a new right, commencing from the time of the estate or interest vesting in possession by the determination of the prior estates, notwithstanding he, or some person through whom he claims, may at any time previously to the creation of the estate which has determined, have been in possession or receipt of the rents and profits of such land or of such rent.

An administrator for the purposes of this act is to claim from the death of the intestate (sect. 6). This section removes, for the purposes of the act, that distinction which existed, under the old law, between executors and administrators, by which the right of the former was considered to commence from the death of the testator, and that of the latter from the grant of administration.

The right of a person claiming subject to a tenancy at will, or of the person through whom he claims, is to be deemed to have accrued either at the determination of the tenancy, or at the expiration of one year from the commencement of the tenancy; but no mortgagor or cestuyque trust is to be considered a tenant at will to his mortgagee or trustee within the meaning of the clause (sect. 7).

The right of a person claiming subject to a tenancy from year to year, or other period, without any lease in writing, or of the person through whom he claims, is to be deemed to have accrued at the determination of the first of such years, or other periods, or at the last time when any rent payable in respect of such tenancy has been received (which shall last happen) (sect. 8).

Where rent amounting to 20*s.* and upwards, reserved by a lease in writing, has been wrongfully received, and no payment of such rent has afterwards been made to the person rightfully entitled thereto, the right of the person entitled is to be deemed to have accrued at the time at which the rent reserved by such lease was first so wrongfully received (sect. 9).

The three last sections alter the old rule of law, that the mere receipt of rent by a stranger was not evidence of adverse possession against the legal owner, for it was no disseisin, though the stranger made a lease-reserving rent, unless he made a actual entry.

No person is to be deemed to have been in possession merely by reason of having made an entry (sect. 10). This clause will have the effect of shortening the time within which an ejectment can be brought within the 21 Jac. I., c. 16, and the 4 & 5 Ann., c. 16, s. 14; for by those statutes a party might enter just before the expiration of the 20 years, and commence his action within one year after.

No right of entry or distress, or of bringing an action, is to be preserved by continual claim upon or near any land (sect. 11). This alters the old law, whereby an actual entry made every year and day, by the person entitled, or his attorney, was sufficient to prevent the right of entry being tolled by descent or barred by the statute of limitations. (Litt., ss. 414, 415.)

The possession or receipt of rents and profits of one or more coparceners, joint-tenants, or tenants in common, of the entirety, or of more than his or their undivided share or shares, for his or their own benefit, or the benefit of any person or persons other than the person or persons actually entitled to the other share or shares, is not to be deemed the possession of such last-mentioned person or persons, or any of them (sect. 12). This alters the old rule, that the entry of one coparcener, joint-tenant, or tenant in common, was the entry of all, so as to prevent the statutes of limitation from attaching.

The possession of the younger brother or other relation of the person entitled as heir is not to be deemed the possession of the person entitled as heir (sect. 13). This abolishes the law of *possessio fratris*, under which it was held that if a man seised of lands had two children, and the younger son or sister entered by abatement, without the heir ever having been in possession, the statute did not operate against the heir, on account of the intendment of law that the younger had entered claiming under the same title of heir to the father.

The enactments contained in the above-mentioned sections, from the 3rd to the 13th inclusive, are intended to remove one of the great difficulties attending the investigation of titles under the old law, namely, the determination of the time at which adverse possession commenced. Whether possession was adverse or not, was frequently a question of fact to be determined by a jury, and therefore necessarily subject to great uncertainty, and the question was often further embarrassed by the several rules of law before mentioned, as well as by the principle formerly laid down, that possession, rightful in its commencement, did not become wrongful or adverse as against the true owner by being continued beyond the period at which the right of the party in possession ceased.

An acknowledgment in writing of the title of any person actually entitled to any land or rent, given to him or his agent, signed by the party in possession or receipt of the rents and profits, or of the rent, is to be equivalent to the actual possession of the rent and profits, or of the rent, and the title to such land or rent is to be deemed to have accrued at the date of such acknowledgement (sect. 14). Formerly parol acknowledgements were admitted to have this effect. The requiring an acknowledgement in writing is adopted by analogy to the statute 9 Geo. IV., c. 14, as to actions on simple contract, and to the statute 3 & 4 Will. IV., c. 42, s. 5, as to actions on specialties. As the possession of one coparcener, joint tenant, or tenant in common is not the possession of another (sect. 12), so as to take the case out of the statute, it seems to *follow* that an acknowledgement in writing made to or by *one coparcener*, joint tenant, or tenant in common, will *not be evidence* to establish or impugn the title of another.

Persons under the disability of infancy, coverture, idiotcy, lunacy, unsoundness of mind, or absence beyond seas, or persons claiming under them, notwithstanding the period of twenty years shall have expired, are to be allowed ten years after the person to whom the right first accrued has ceased to be under any disability or has died (which shall have first happened) (sect. 16). It is to be observed that imprisonment is not a disability under this act, as it was under 21 Jac. I., c. 16, s. 2.

But no entry, distress, or action is to be made or brought by any person under disability at the time of his right accruing, or by any person claiming under him, but within forty years from the time at which the right first accrued, though such disability should have continued during the whole of such forty years, or although the term of ten years from the time at which the person to whom the right first accrued ceased to be under any disability, or died, should not have expired (sect. 17).

In the case of a person under disability at the time that his right accrued dying under such disability, no further time beyond the said term of twenty years next after the right accrued, or the said term of ten years after the death of such person, is to be allowed by reason of the disability of any other person (sect. 18).

No part of Great Britain and Ireland, nor the adjacent islands, is to be deemed beyond seas, within the meaning of the act (sect. 19).

It was held upon the construction of 21 Jac. I., c. 16, s. 2, that the saving in that clause extended only to the persons upon whom the right first descended, so that when the statute once began to run as against him, no subsequent disability could prevent its operation; but that the right of entry subsisted for ten years after the cessor of the disability or death of the person to whom the right first accrued, however long that disability might have continued. The present statute confirms the first rule, and establishes the limit of forty years as to the second. It has been held that where no account could be given of a person within the exception of the statute of James I., he is to be presumed to be dead at the end of seven years from the last account of him 6 East, 84); but there is no presumption of law as to the time at which his death actually took place, which is a question for a jury to determine upon the facts of the case. (1 Stark, *N. P. C.*, 121; 2 Nev. and M., 219.)

Where the right of any person to an estate in possession has been barred, and such person has at any time during the period of limitation been entitled to any other estate, interest, right, or possibility in reversion, remainder, or otherwise, in or to the same land or rent, no entry, distress, or action is to be made or brought in respect of such estate, &c., unless in the meantime such land or rent has been recovered by some person entitled to an estate, interest, or right which had been limited or taken effect after or in defeasance of such estate or interest in possession (sect. 20). This is an alteration of the old law, under which a person might have availed himself of a right of entry at any time within twenty years after it accrued, although in the meantime the same person might have had a different right in the same land or rent which had been previously barred by more than twenty years' adverse possession.

When the right of a person who is tenant in tail of any land or rent is barred by lapse of time, no entry, distress, or action is to be brought by any person claiming an estate or interest which the tenant in tail might have barred (sect. 21).

Possession adverse to a tenant in tail is to run on against the parties claiming estates or interests which he might have barred (sect. 22).

These clauses make a great alteration of the law as it stood under the statute of James, by which the twenty years commenced only from the time at which the right to enter actually accrued, and therefore each remainder-man had a new right commencing from the time of the determination of the prior estates.

When a tenant in tail makes an assurance which does not bar those in remainder, they are to be barred at the end of twenty years' possession under such assurance, reckoning the twenty years from the time at which such assurance, if then executed, would, without the consent of any other person, have barred them (sect. 23). This clause gives to an assurance executed by a tenant in tail in remainder, without the consent of the protector, followed by twenty years' possession under it, reckoning from the time at which the remainder should, according to the limitations of the estate tail, have vested in possession, the same effect in barring the remainders over as an assurance by him with the protector's consent. Formerly no length of possession under a conveyance by lease and release could have the effect of a fine or recovery in barring the issue in tail, or the remainders over, and therefore when an ejectment was brought by any of the heirs in tail, the defendant was bound to show that the conveyance to him or his ancestor had been by fine or recovery.

No suit in equity is to be brought for the recovery of any land or rent but within the time when the plaintiff, if entitled at law, might have brought an action (sect. 24). This clause confirms the doctrine already established in courts of equity.

In cases of express trust, the right of the *cestuy que trust* to bring a suit against a trustee, or person claiming through him, is not to be deemed to have accrued till a conveyance has been made to a purchaser for a valuable consideration, and then only as against such purchaser and persons claiming under him (sect. 26). In cases of express trust, no time, as between the *cestuy que trust* and trustee, can operate as a bar to the right of the former; and the above-mentioned clause applies as between the *cestuy que trust* and strangers only. The possession of the trustee is that of the *cestuy que trust*, and the possession of the *cestuy que trust* cannot be adverse to the trustee, unless where there has been actual ouster of the trustee by the *cestuy que trust*, or where the latter denies the title of the trustee. Though no time bars a direct trust, as between trustee and *cestuy que trust*, a court of equity will not allow a man to make out a case of constructive trust at a great distance of time, and after long acquiescence, but will in such cases apply rules as to length of time by analogy to the statutes of limitation. (17 Ves., 97.)

In cases of concealed fraud, the right of a person to bring a suit in equity for the recovery of land or rent of which he, or the person through whom he claims, has been deprived by such fraud, is to be deemed to have accrued at the time when the fraud was, or, with reasonable diligence, might have been discovered; but nothing in this clause is to affect the title of a purchaser for valuable consideration who was not a party to the fraud, and had, at the time of his purchase, no notice of such fraud (sect. 26). This principle had already been established in courts of equity.

Nothing in the act is to interfere with the jurisdiction of equity in refusing relief on the ground of acquiescence or otherwise, to any person whose right to bring a suit may not be barred by the act (sect. 27). It has been laid down in many cases in the courts of equity, that the concurrence of the *cestuy que trust*, with full knowledge of the circumstances, in a breach of trust by his trustee, or even acquiescence without original concurrence, may bar him of his relief. (3 Swanst., 4, *et seq.*)

Where a mortgagee has remained in possession of the rents of land, or in receipt of any rent comprised in his mortgage for twenty years, the mortgagor's right to bring a suit for redemption will be barred, unless in the meantime an acknowledgment of his right has been given to the mortgagor, or some person claiming his estate, or the agent of such mortgagor or person, in writing, signed by the mortgagee or person claiming under him; in which case the suit must be brought within twenty years after the date of such acknowledgment. Where there are several mortgagors, an acknowledgment to one is to be as effectual as if given to all; but where there are several mortgagees, such acknowledgment is to be effectual only against such of them as have given it; and the persons claiming under them, and the persons entitled to estates or interests after or in defeasance of their estates or interests, and where the mortgagees giving such acknowledgment are entitled to a divided part of the land or rent, but not to an ascertained part of the mortgage money, the mortgagor is to be entitled to redeem such divided part, on payment of a proportionate part of the mortgage money (sect. 28). It was settled, before this act, that twenty years' possession by a mortgagee was a bar to the right of redemption, unless there was in the meantime some acknowledgment of the mortgagor's right; and for this purpose a parol acknowledgment, if clearly made, was considered sufficient. The possession of the mortgagee is not, like an adverse possession at law, inconsistent with the equitable title of the mortgagor; but it was considered that twenty years' negligence on the part of the mortgagor ought to protect the mortgagee from any further liability to account. There is no saving of the rights of redemption of mortgagors under disabilities.

At the determination of the period limited by the act for making an entry or distress, or bringing any action or suit, the right of the person entitled to the land or rent, for the recovery of which such entry, distress, action, or suit might have been made or brought, is to be extinguished (sect. 34).

The receipt of rent from the tenant from year to year, or lessee, is to be deemed, as against such tenant from year to year, or lessee, or any person claiming under him, to be receipt of the profits of the land (sect. 35).

By section 36, all real and mixed actions, except ejectment, and the actions of dower and *quare impedit* hereafter referred to, were abolished after the 31st of December, 1834; but it is provided by sect. 38, that any person whose right of entry had, at the passing of the act, been taken away by descent cast, discontinuance, or warranty, may bring a real action within the same period during which he might, under the provisions of the act, have made an entry, had his right of entry not been taken away.

Since the 31st day of December, 1833, no descent cast, discontinuance, or warranty can toll or defeat any right of entry or action for the recovery of land (sect. 39). By the old law, descents of corporeal hereditaments in fee simple to the heir of the disseisor, who had been five years in possession without entry or claim on the part of the person entitled, took away the right of entry. (Co. Litt., 240 b.) A discontinuance is defined by Coke to be 'an alienation made or suffered by tenant in tail, or by any that is seised *in autre droit*, whereby the issue in tail, or the heir or successor, or those in reversion and remainder, are driven to their action and cannot enter.' Warranty of lands at common law was in general held to toll the right of entry of the heir. (Co. Litt., 365 a, 393 b, Butler's notes.) The effect of this section of the act is to preserve to the claimant his right of entry, that is to say, his right to bring an action of ejectment, notwithstanding descent cast, discontinuance, or warranty, during the whole period of limitation.

Since the 31st December, 1833, no money secured upon land by any mortgage, judgment, lien, or otherwise, or charged upon land by way of legacy, can be recovered by action or suit, but within twenty years after the right to receive the same accrued, unless in the meantime some part of the money or interest thereon has been paid, or some acknowledgement in writing of the right thereto signed by the person liable to payment or his agent, to the person entitled thereto or his agent; in which case the action or suit must be brought within twenty years after such payment or acknowledgement (sect. 40). This clause is a statutory confirmation of what was formerly established by decision as to money secured upon land, namely, that possession of the land by the mortgagor or person otherwise liable for payment of the money, without payment or demand of principal or interest for twenty years, was sufficient to raise the presumption of satisfaction. It has been determined that the limitation in this clause applies to bills of foreclosure, which are in substance suits to recover the money secured by mortgage. (9 Sim., 570.) With respect to legacies, there has been some variety of decision. Formerly it seems to have been thought that there was no limitation as to the time within which a legacy might be demanded, but in the later cases the court of equity appears to have adopted twenty years as the limit.

The above-mentioned section secures to the mortgagee to whom a payment of principal or interest has been made, or an acknowledgment in writing has been given, his right of action or suit as to the money for twenty years from the time of such payment or acknowledgment, and in the latter case his right of entry, distress, or action for the recovery of the land is during the same period secured to him by the 14th section; but it being considered doubtful whether the 2nd section did not bar this right, when the act relied on as taking the case out of the statute was a payment of principal or interest, the 7 Wm. IV. and 1 Vic., c. 28, was passed, reserving to the mortgagee the right of entry, distress, and action for the recovery of the land for twenty years from the last payment of principal or interest, although more than twenty years may have elapsed since the right first accrued.

Arrears of dower, or damages for such arrears, are not to be recoverable by any action or suit beyond six years before the commencement of the action or suit. Before the act, there was no limitation either at law or in equity to a claim for arrears of dower during the life of the heir (sect. 41).

Since the 31st day of December, 1833, no arrears of rent or of interest in respect of any money charged in any manner on land or rent, or any damages in respect of such arrear of rent or interest, can be recovered by any distress, action, or suit, but within six years next after the same respectively became due, or next after an acknowledgment in writing given to the person entitled thereto or his agent, signed by the person by whom the same was payable, or his agent; except where there has been a prior mortgagee or other incumbrancer in possession within one year next before an action or suit is brought by any person entitled to a subsequent mortgage or other incumbrance on the same land, in which case the arrears of interest may be recovered for the whole time during which such prior mortgagee or incumbrancer was in possession, though it exceed the term of six years (sect. 42). It had already been established in equity, by analogy to the rule at law, that an account of rents and profits could not go back beyond six years before the filing of the bill, and in many cases where a party had neglected his rights, and where there was no disability on the one side, or fraud on the other, the court has refused to carry the account farther back than the filing of the bill. (1 Ball and B., 130.) This discretionary jurisdiction seems to be within the saving of the 27th clause of the act. It seems that the above section refers to rents charged upon land only, to which it had been held that the former statutes did not apply, and not to conventional rents (2 Bing., *N. C.*, 688), the limitations as to which are provided for by the 21 Jac., c. 16, § 3, and the 3 and 4 Wm. IV., c. 42, § 3.*

This clause contains no exception in favour of persons under disabilities.

2. Of limitations as to tithes and other ecclesiastical property.

On the principle that *nullum tempus occurrit ecclesiæ*, it was held that none of the earlier statutes of limitation had any application to actions and suits relating to tithes.

The first statute on the subject is the 53 Geo. III., c. 127, as to arrears of tithe, which enacts that no action should be brought for the recovery of any penalty for not setting out tithes, nor any suit instituted in any court of equity, nor in any ecclesiastical court, to recover the value of any tithes, unless within six years from the time of such tithes becoming due.

No limitation existed of the time within which suits might be prosecuted for establishing a right to tithe; nor could the validity of any modus decimandi, or of any right to exemption or discharge from tithes, be established, but by antient prescription, or by proof of a composition real existing before the stat. 13 Eliz., c. 10, until the enactment of the 2 & 3 Wm. IV., c. 100.

By section 1 of that act, all prescriptions for any modus decimandi, or for exemption or discharge from tithes by composition real or otherwise, are, in case the render of tithes in kind shall afterwards be demanded by any person except a spiritual or eleemosynary corporation sole, or by any corporate body, to be deemed valid in law, upon proof of payment or render of such modus in the one case, and enjoyment of the exemption in the other, for 30 years' next before such demand, unless the commencement of such payment, render, or enjoyment be shown at some time prior to such 30 years, or the payment, render, or enjoyment be shown to have been under some deed or writing; and if such proof be extended to 60 years before the time of such demand, the claim is to be deemed absolute and indefeasible, unless such payments, render, or enjoyment be shown to have been under some deed or writing. This clause applies to the right of the crown and of the duchy of Cornwall. Where the render of tithes is demanded by any spiritual or eleemosynary corporation sole, such prescription as aforesaid is to be valid and indefeasible upon showing such payment or render made, or exemption enjoyed during the period in which two persons in succession have held the office or benefice in respect whereof such render of tithes is claimed, and for three years after the appointment, institution, or induction of a third person, provided that, if such period do not amount to 60 years, it shall be necessary to show such payment or render made, or enjoyment had during such further number of years, either before or after, or partly before and partly after, as shall with the said period amount to 60 years, and three years after the appointment of such third person as aforesaid, unless it be shown that such payment or render was made or exemption enjoyed under some deed or writing.

Every composition for tithes made or confirmed before the passing of the act by decree of a court of equity in a suit in which the ordinary, patron, and incumbent were parties, and not since set aside, abandoned, or departed from, is to be held valid; but no modus, exemption, or discharge is to be deemed within the act unless proved to have existed and been acted upon at the time of, or within a year before the passing of the act (sect. 2).

By section 4 it is provided that the act shall not extend to cases where tithes have been demised by deed for any term of life or number of years, or where any composition for tithes has been made by the person or body corporate entitled to them with the owner or occupier of the land for any such term or number of years, where such demise was subsisting at the time of the passing of the act, and an action or suit instituted for the recovery or enforcing payment of tithes within three years after the expiration, surrender, or other determination of such demise or composition.

By section 5 it is provided that where lands have been held or occupied by the person entitled to the tithes thereof, as rector, vicar, or other person, or by any lessee of, or any person compounding for tithes with, or any tenant of such rector, vicar, or other person, the time of such holding or occupation shall be excluded in the computation of the several periods mentioned in the act.

And by section 6, the time during which any person otherwise capable of resisting any claim to a modus or exemption from tithe shall be an infant, idiot, non compos mentis, feme covert, or lay tenant for life, or during which any action or suit shall have been pending and diligently prosecuted till abated by the death of parties, is to be excluded in the computation of the above-mentioned periods, except where the claim is declared by the act to be absolute.

By section 8, no presumption is to be allowed in support of any claim, upon proof of exercise of the right claimed for a less period of time than that specified in the act as applicable to the particular claim.

* In the observations upon section 2, omit the words, 'The action for rent here spoken of is the action of ejectment;' and in the following sentence of the same paragraph, instead of 'action for debt' read 'action of debt.'

It has been stated that tithes and moduses or compositions for tithes, in the hands of any other persons than spiritual or eleemosynary corporations sole, are included in the first section, and consequently in the subsequent enactments of 3 & 4 Wm. IV., c. 27; and by sect. 29 of the same act, no ecclesiastical or eleemosynary corporation sole can bring an action or suit to recover any land or rent but within the period during which two persons in succession have held the office or benefice in respect of which such land or rent is claimed; and six years after the appointment of a third person thereto, if such period amount to 60 years; and if not, then during such further period as will make up 60 years from the period at which the right to bring such action or suit first accrued.

The 34th section of the same act, as to the final extinction of right after the period of limitation, is applicable to tithes ecclesiastical as well as other property.

And by sect. 43 no person claiming tithes can bring a suit in any spiritual court but within the period fixed by the act for actions and suits at law or in equity.

In considering the operation of the 2 & 3 Wm. IV., c. 100, and the 3 & 4 Wm. IV., c. 27, upon claims to tithe by persons other than spiritual, or eleemosynary corporations sole, it should be observed that the period of 30 years mentioned in the former act is fixed with reference to claims as between the landowner and the tithe-owner, while the period of 20 years in the latter is applicable, as far as respects tithes, to actions and suits between claimants to the tithes. Cases however may arise to which there will be some difficulty in applying this distinction, and it seems that, at least in cases where there has been no payment of tithe for twenty years, the second section of the latter act will operate as a bar to the claim of the tithe-owner, though probably contrary to the intention of the legislature.

But the questions as to tithes upon these statutes, though they must still exist for some time to come, have become of less importance since the enactment of the 6 & 7 Wm. IV., c. 71, and the subsequent acts for the commutation of tithes for fixed rent-charges, which in the course of a few years will be carried into effect throughout England.

3. Of limitations as to advowsons.

By the statute of Westminster the second (13 Edw. I., c. 25) writs of *quare impedit* could not be sued out after six months, where a parson had been presented to a living by a person not entitled.

By the 1 Mary, sess. ii., c. 5, it was declared that the 32 Hen. VIII., c. 2, should not extend to writs of right of advowson, *quare impedit, jure patronatus*, and writs of *darrein presentment*. Before this statute, it seems to have been held that if the incumbent of a living had lived 60 years and died, and a stranger had presented, the patron could not maintain *quare impedit* or *darrein presentment*. (Co. Litt., 115 a.)

The 7 Ann., c. 18, which enacted that no usurpation should displace the right of a patron, in effect took away all previous limitations of suits as to the right of patronage.

The 3 & 4 Wm. IV., c. 27, s. 30, enacts that from the 31st day of December, 1833, no *quare impedit* or other action, nor any suit to enforce a right of presentation to any church, vicarage, or other ecclesiastical benefice, is to be brought after the expiration of the period during which three clerks in succession shall have held the same, all of whom obtained possession adversely to the right of the person claiming, or of the person through whom he claims, if the times of such incumbencies together shall amount to sixty years, and if not, then after such further period as with the times of such incumbencies shall make up the period of sixty years.

By section 31 of the same act, incumbencies where the clerk has been presented upon a lapse, by the crown or the ordinary, are to be reckoned within the period, but not incumbencies when the clerk has been presented by the crown after a promotion to a bishopric.

By section 32, persons claiming a right to present by virtue of any estate, interest, or right, which the owner of an estate tail in the advowson might have barred, are to be deemed to claim through the person entitled to such estate tail, and their right is to be limited accordingly.

By section 33, no advowson is to be recoverable after the expiration of a hundred years from the time at which a clerk obtained possession of the benefice adversely to the right of the person claiming, unless a clerk shall subsequently have obtained possession of the benefice on the presentation of the person so claiming, or some person through whom he claims, or some other person entitled to a share or right derived under the same title.

The 34th section of the same act as to the final extinction of right after the period of limitation, applies to advowsons.

There is no saving of the rights to advowsons of persons under disabilities.

4. Of limitations as to other incorporeal rights.

Before the 2 & 3 Wm. IV., c. 71, no right of common or other profit or benefit out of land, except tithes, rent, or services, could in general be established but by proof of immemorial custom or prescription; though in certain cases the courts both of law and equity had been in the habit of establishing titles to such property by means of the doctrine of presumed grants. (2 Starkie *on Evid.*, 669.)

By section 1 of that act, no claim which can be made at common law, by custom, prescription, or grant, to any right of common or other profit or benefit to be taken or enjoyed from or upon any land, except the matters in the act afterwards provided for, and except tithes, rent, and services, is, after an uninterrupted enjoyment of thirty years, to be defeated only by proof of such enjoyment having commenced at any time prior to the thirty years; and where such uninterrupted enjoyment has been for sixty years, the right is to be deemed absolute and indefeasible, unless it appear that the right was enjoyed under some deed or writing.

Right of common of pasture appendant exists by the common law, and belongs to every tenant whose lands are part of a manor (2 *Inst.*, 86; 2 Bl., *Com.*, 33); but all other rights of common must formerly have been established by custom, prescription, or grant (1 Bac., *Ab.*, 616, et seq.), and the rights to them will now be regulated by this act. By the statute of Westminster 2 (13 Edw. 1, c. 25), a writ of assize might be brought for right of common appendant or appurtenant, but as that and the other real actions for rights of common (Comyn, *Dig.*, *Common*, i.) are now abolished by 3 & 4 Wm. IV., c. 27, s. 36, there will be no remedy for rights of common after twenty years' adverse possession; for it was held, before the act, that, after that period, the commoner's right of entry was given, and that he must resort to his assize of common. (2 Taunt., 159, 160.) The same limitation applies to the incorporeal rights mentioned in the subsequent sections of the act.

By section 2, no claim to any way or other easement, or to any watercourse, or to the use of any water, is after an uninterrupted enjoyment of twenty years to be defeated only by proof of its having commenced prior to that period, and, where such uninterrupted enjoyment has been for forty years, the right is to be deemed absolute and indefeasible, unless it appear that the right was enjoyed under some deed or writing.

By section 3, when the use of light for any dwelling-house, workshop, or other building has been actually enjoyed for twenty years without interruption, the right is to be deemed absolute and indefeasible, notwithstanding any local usage or custom to the contrary, unless it shall appear that the same was enjoyed under some deed or writing.

By section 4, the periods mentioned in the act are to be taken to be those immediately preceding the commencement of an action or suit as to the matter to which such period relates; and no act is to be deemed an interruption unless submitted to for a year after the party interrupted had notice.

By section 6, no presumption is to be allowed in favour of a claim upon proof of the exercise or enjoyment of the right for a less period than that mentioned in the act as applicable to the particular claim. Before the passing of the act, enjoyment of incorporeal rights for a period of twenty years was generally sufficient to raise the presumption of a grant. But this rule can no longer be applied to the rights included in the first section, which has fixed another period of thirty years for raising such presumption, and it has been decided, upon the construction of the act, than an enjoyment for twenty years of a right comprised in the second section, while the land was held under a term of life, as it cannot by the eighth section of the act give any title as against the owner of the fee, does not give even a presumptive title against the termor. (1 C., M. & R., 211, 223.)

The time during which any person otherwise capable of resisting any claim to any of the matters mentioned in the act, shall have been, or shall be in part, idiot, or *non compos mentis, fême covert*, or tenant for life, or during which any suit or action pending shall have been abated by the death of parties, is to be excluded in the computation of the above-mentioned periods, except where the right or claim is declared by the act to be absolute (sect. 7). The act contains no saving in favour of persons beyond seas or in prison.

When land or water, over or from which any way, watercourse, or use of water has been enjoyed, or has been held under any term, life, or years, exceeding three years from the granting thereof, the time of enjoyment, during the continuance of such term, is to be excluded from the term of forty years, in case the claim shall, within three years after the end, or sooner, determination of the term be resisted by any person entitled in reversion expectant on the determination of the term (sect. 8). This clause applies only to a way or watercourse, and use of water, and therefore the saving cannot include the rights which are the subjects of the first and third sections. The consequence seems to be, that as to those rights the reversioner may, contrary to the former law on the point, be bound by the acquiescence of the owner of the particular estate.

II. As to Limitations of Personal Actions and Suits relating to Personal Property.

1. Of actions of assault and battery.

By the 21 Jac. I, c. 16, s. 3, all actions of trespass, of assault, battery, wounding, imprisonment, or any of them, must be commenced and sued within four years after the cause of action arises.

2. Of actions of slander.

By the 21 Jac. I, c. 16, s. 3, all actions on the case for words must be commenced and sued within two years next after the words spoken.

Upon the construction of this part of the statute it has been determined—1, That an action for *scandalum magnatum* is not within the statute; 2, That it is confined to slander of the person, and does not extend to actions for slander of title, which is a cause of specific damage; 3, That if the words used are actionable, the statute is a bar, though specific damage has ensued; but if the words are not actionable, and specific damage has arisen from them, entitling the plaintiff to an action, the statute is no bar. (5 Bac., *Ab.*)

3. Of actions arising upon simple contract, and actions founded in wrong.

By the 21 Jac. I, c. 16, s. 3, all actions of trespass *quare clausum fregit*, actions of trespass, detinue, trover, and replevin for taking away goods and cattle, actions of account and upon the case (except merchant's accounts), actions of debt grounded upon lending or contract without specialty, and actions of debt for arrearages of rent, must be commenced and sued within six years next after the cause of action arises.

The same period of limitation is established by the 53 Geo. III., c. 127, s. 5, for the recovery of penalties for not setting out tithes, and for bringing suits in equity or in the ecclesiastical courts, for the recovery of the value of tithes; and by the 3 & 4 Wm. IV., c. 42, s. 3, for actions of debt upon awards, where the submission is not by specialty, for actions or fines due in respect of copyhold estates, for actions against a sheriff for escapes, and for money levied under a writ of *fieri facias*.

Formerly there was no limitation applicable to a suit for a legacy, though in some cases presumption of payment was admitted; but the 3 & 4 Wm. IV., c. 27, s. 40, which fixes the period of limitation to twenty years, is applicable to all legacies, whether charged on real estate or not.

Before the statute of the 3 & 4 Wm. IV., c. 42, there was no remedy for injuries done to the real estate of a person deceased, in his lifetime, nor against the estate of a person deceased, in respect of wrongs done by him in his lifetime to the property of another; but now, by sect. 2, executors may bring an action of trespass, or trespass on the case, for an injury done to the real estate of a deceased person in his lifetime, and for which he might have maintained an action, at any time within a year after the death of such person; and any such action may be brought against the executors or administrators of a person deceased, for an injury done by him in his lifetime to the real or personal property of the plaintiff, within six calendar months after they shall have taken upon themselves the administration of the deceased's estate, provided in each case that the injury was committed within six months of the death of such person.

In actions on the case in which the gist of the action is the consequential damage, the time of limitation runs from the time of the occurring of the damage. In actions of assumpsit upon contracts, the time runs from the date of the breach. (5 Bac., *Ab.*, 230.)

It would seem that in cases of fraud the statute does not begin to run, but from the discovery of the fraud. This rule, as before stated, is now established by statute as to actions relating to real property.

In cases of intestacy, where the cause of action was complete before the intestate's death, the statute, having once begun to run, continues as against the administrator, even before the grant of the letters of administration; but when the cause of action was not complete as against the intestate, the statute was held not to run against the administrator until the grant. (Willes, 27; 5 B. and Ald., 204.) The latter rule has, as before stated, been altered as to real property, but not, it seems, as to personalty.

The limitation as to arrears of rent in the statute of James does not apply to rents reserved by indenture.

For the purpose of settling the questions that had existed as to what was a sufficient commencement of an action to take the case out of the statute, it is provided by 2 Wm. IV., c. 39, § 10, that 'no first writ shall be available to prevent the operation of any statute whereby the commencement of the action may be limited, unless the defendant shall be arrested thereon or served therewith, or proceedings to or toward outlawry shall be had thereupon, or unless such writ and every writ (if any) issued in continuation of a preceding writ shall be returned *non est inventus*, and entered of record within one calendar month next after the expiration thereof, including the day of such expiration, and unless every writ issued in continuation of a preceding writ shall be issued within one such calendar month after the expiration of the preceding writ, and shall contain a memorandum indorsed thereon or subscribed thereto, specifying the day of the date of the first writ; and return to be made in bailable process by the sheriff or other officer to whom the writ shall be directed, or his successor in office, and in process not bailable, by the plaintiff or his attorney suing out the same, as the case may be.' This enactment applies to all personal actions.

The fourth section of the statute of James, and the 6th section of the 3 and 4 Wm. IV., c. 42, both contain a proviso, that if judgment in any of the above-mentioned actions be given for the plaintiff, and afterwards reversed by error, or a verdict pass for him, and upon matter urged in arrest of judgment, judgment be given against him, or if the defendant should have been outlawed, and should afterwards reverse the outlawry, the plaintiff, or his heirs, executors, or administrators, may commence a new action or suit, within a year after such reversal of judgment, judgment, or reversal of outlawry.

The 7th section of the statute of James contains an exception in favour of infants, *fêmes covert*, *non compotes mentis*, and persons imprisoned and beyond seas, who may bring their actions within the times mentioned in the act, after the removal of their disabilities; and the 4 and 5 Ann., c. 16, § 19, enacts that in case of the absence of the defendants beyond seas, any action for seaman's wages, or any of the actions enumerated in the above-mentioned clause of the statute of James, may be brought within the times mentioned in the statute, after the return of the defendants from beyond seas.

Sect. 4 of the before-mentioned act of 3 and 4 Wm. IV., c. 42, contains, as to the actions enumerated in it, a saving of the right of persons under disabilities, and against defendants absent beyond seas, exactly similar to the above, except that it does not extend to persons imprisoned.

By sect. 7 of the last-mentioned act, no part of the United Kingdom or of the adjacent islands is to be deemed beyond seas within the meaning of that act or of the 21 Jac. I., c. 16.

Questions had frequently arisen as to the effect of subsequent promises and acknowledgments to take a case out of the statute of James. Thus it was held that no acknowledgment was sufficient in a case of tort or breach of duty to take the case out of the statute, while in a case of debt not only a verbal promise, but even a mere acknowledgment of the existence of the debt was held sufficient, not against the party making it only, but his co-contractor. To settle such questions, it was enacted by 9 Geo. IV., c. 14, § 1, reciting the act of James, that in actions of debt, or upon the case, grounded on any simple contract, no acknowledgment should be deemed sufficient, unless it were in writing, signed by the party chargeable thereby; and that where there were two or more joint contractors, or executors, or administrators of any contractor, the written promise of one or more of them should not bind the others. But it was expressly provided that nothing in the act contained should alter, take away, or lessen the effect of any payment of principal or interest by any person whatsoever; so that it would seem that this species of acknowledgment will, according to the old doctrine (2 Saund., 63, *j. n.* (*t*), be effectual, not against the party making it only, but his co contractor. Also (by sect. 6) no indorsement or memorandum of payment upon a promissory note, bill of exchange, or other writing made by or on behalf of the party to whom payment should be made, should be deemed proof of such payment to take the case out of the statute; and (§ 4) that the act of James and that act should apply to simple contract debts alleged on the part of a defendant by way of set-off.

4. As to actions arising upon specialty.

Before the 3 & 4 Wm. IV., c. 42, there was no statutable limitation to actions upon specialties, though the courts held that payment was *primâ facie* to be presumed after twenty years.

By the 3rd section of the above act, actions of debt for rent upon an indenture of demise, actions of covenant or debt upon bond or other specialty, and actions of debt or *scire facias* upon recognizance must be commenced and sued within twenty years after the cause of such actions or suits arises. If the 3 and 4 Wm. IV., c. 27, § 42, applies to actions on specialty, it is so far repealed by this act; but the better opinion seems to be that the former act applies to rents which are a charge upon land only, and not to conventional rents, whether reserved by indenture or otherwise. (2 Bing., *N. C.*, 688.)

The savings on the ground of disability of the plaintiff and absence of the defendant, and the limitations after judgment or outlawry reversed, are the same as for actions of debt not on specialty by the same act.

By sect. 5, it is provided, in accordance with the enactment of 9 Geo. IV., c. 14, as to actions on simple contract, that if any acknowledgment has been made, either by writing signed by the party liable by virtue of such indenture, specialty, or recognizance, or his agent, or by part payment, or part satisfaction, on account of any principal or interest then due thereon, the person entitled may bring his action for the money remaining unpaid and so acknowledged to be due, within twenty years after such acknowledgment, or part payment, and in case of the plaintiff being under any of the disabilities mentioned in the 4th section of the same act, or absence of the defendant beyond seas at the time of such acknowledgment being made, then within twenty years of the removal of such disability, or the return of the defendant from beyond seas.

III. Of Limitations of Actions on Penal Statutes.

By the 31 Eliz., c. 5., s. 5 (which act repeals a previous one, the 7 Hen. VIII., c. 3, upon the same subject), all actions, suits, bills, indictments, or informations for any forfeiture upon any statute penal, whether made before or since the act, whereby the forfeiture is limited to the queen, her heirs, and successors only, must be brought within two years after the commission of the offence; and all actions, suits, bills, indictments, or informations for any forfeiture upon any penal statute, whether made before or since the act (except the statute of tillage), the benefit and suit whereof is limited to the queen, her heirs, and successors, and *to any other that shall prosecute in that behalf*, must be brought by the person sueing within one year after the commission of the offence; and in default of such prosecution, the same may be brought by the queen, her heirs or successors, at any time within two years after the end of that year; and any action, suit, bill, indictment, or information brought after the time limited is to be void. It is provided that where a shorter time is limited by any penal statute, the prosecution must be within the time so limited.

The limitation in the above act extends to offences of omission as well as commission (2 Chit., *R.*, 429), and to actions brought by the common informer alone. (1 Raym., 78.) If an offence prohibited by a penal statute be also an offence at common law, it has been held that a prosecution for the common law offence is not restrained by the statute. (4 Mod., 144.)

It was doubted whether a suit by a common informer on a penal statute which first gives an action to the party grieved, and after a certain time to any one who will sue, was within the restraint of the statute; but it is now settled that it is. (Bull., *N. P.*, 195.)

A prosecution by the party grieved was not within the restraint of the statute; but now, by the 3 & 4 Wm. IV., c. 42, s. 3, all actions for penalties, damages, or sums of money given to the party grieved by any statute now or hereafter to be in force must be brought within two years after the cause of such actions or suits. It is provided that nothing in that section should extend to actions the time for bringing which is especially limited by any statute. The saving in that act in the case of the disability of the plaintiff and the absence of the defendant beyond seas, and also the limitation as to further proceedings after judgment or outlawry reversed, apply to actions by the party grieved.

By the 24 Geo. II., c. 44, s. 1, actions against justices of the peace and constables or others acting in obedience to their warrants are limited to six calendar months.

There is no time limited by any statute for indictments for felonies and other misdemeanours when there is no forfeiture to the queen or to the prosecutor, but the acts of general pardon which have been passed from time to time have the effect of limitations. The last of such acts was the 20 Geo. II., c. 52.

IV. Of the exceptions to the operation of the Statutes of Limitation.

The exceptions in the several statutes of limitation in favour of infants and other persons under disabilities have been already stated. It has been held that as the words of the statutes as to absence beyond seas are express, Scotland is not included in the exception. If the plaintiff was in England at the time that the cause of action accrued, the statute runs as against his personal representative, though abroad at the time of his death. The absence of one of several co-plaintiffs will not prevent the statute from attaching, for it lays the others under no disability of sueing. If the right of action or suit be vested in a trustee, the *cestuy que trust*, though under disability, will be bound by the laches of the trustee who neglects to sue within the time provided by the statute, and he will have no remedy but against the trustee.

It has been stated that, in cases of express trust, the statutes of limitation have no application as between trustee and *cestuy que trust;* and that in cases of fraud they operate only from the time of the discovery of the fraud. The exception in the 21 Jac. I., c. 16, s. 3, as to merchants' accounts, applies in general to tradesmen and to all persons whatsoever having mutual accounts and dealings, but not to a case where the items are all on one side, as in that between a tradesman and his customer. The accounts must also be open and current, for if the last item be beyond the six years, the statute operates against the whole. (2 Saund., 124, 127 *a*, n.; Bull., *N. P.*, 150.)

Where a debtor creates by his will a trust of real or personal estate for the payment of his debts, such a trust will prevent the statutes from operating upon a debt not barred at the time of the creation of the trust, that is, from the death of the testator; but such a trust will not, it seems, have the effect of reviving debts barred by the statute at the time of the testator's death. (5 Bac., *Ab.*, 244.)

Proceedings in bankruptcy are held to create a trust for the benefit of the creditors, so as to take a debt out of the statute; and proceedings under the act for the relief of insolvent debtors will have the same effect. A decree in a creditor's suit also creates a trust for the benefit of the creditors so as to prevent the operation of the statute; but the trust dates only from the decree, and the mere pendency of a suit has no such effect. (2 Daniel, *C. P.*, 155, 156.)

In general, in personal actions the statutes of Limitation do not run against the estate of a person who has died intestate, in respect of claims accrued after his death, until the appointment of an administrator, though the rule is altered by 3 & 4 Wm. IV., c. 27, s. 6, as to rights to chattel interests in land, and apparently also as to money charges on land, besides arrears of dower and arrears of rent or interest of money charged on land. And if there be no personal representative against whom actions may be brought, the rights of claimants against the deceased's estate are unaffected by the statutes, as no laches can be attributed to them until an administrator is appointed. (5 B. and Ald., 204.)

It seems that if a bill be filed in chancery which is afterwards dismissed, the matter being properly cognizable at law, and the Statute of Limitations attaches in the meantime on the demand, the court will preserve the plaintiff's right, at least in cases where he was stayed from proceeding at law by some act of the court, or where there are equitable circumstances attending the case. (1 Vern., 74.) In the same manner, if an action be commenced in one court within the time of limitation, and afterwards removed into another by proceedings on the part of the defendant, the plaintiff's right of action will not be barred. (5 Bac., *Ab.*, 238.)

It has been shown what acknowledgments are sufficient in real and personal actions and suits to take the case of the plaintiff out of the operation of the statutes.

It has been held that if a debtor, after his debt is barred by the statute, publish an advertisement in the Gazette or other newspaper, that all persons having debts owing to them by him will receive payment on application, the operation of the statute will be defeated. (Prec. in Chan., 385.)

V. As to what courts are bound by the Statutes of Limitation.

The Statutes of Limitation extend to all the actions, real and personal, above enumerated; and all other actions on the case brought in any court of common law in England; but it does not appear that they can apply to actions respecting any interest in or description of real property except those properly comprised in them.

Courts of equity, in respect to legal titles and demands, seem to have been held bound by the statutes as well as the common-law courts, but with respect to equitable titles and demands, they were not within the statutes, and were only influenced in their determinations by analogy to the statutes. By 3 and 4 Wm. IV., c. 27, s. 24, suits in equity, with respect to real property falling within the definition of land or rent in that statute, are subjected to the same limitations as actions at law, but it would seem that suits in courts of equity respecting any other description of real property, and suits respecting personal property, except legacies, which are expressly included in the 40th section of the above-mentioned act, are not within the statutable limitations, but are governed by the rules of limitation adopted by the practice of those courts.

In cases of charities the jurisdiction of courts of equity is not within the statutes. But though a charity is never considered in equity as absolutely barred by the statutes, or by any rule of limitation analogous to them, the court nevertheless takes notice of a long adverse possession in considering the effect and construction of instruments under which claims are set up on its behalf. (2 J. & W., 321.)

It was formerly held that though the Statute of Limitation was a bar to the claim of a debt, it was not a bar to discovery in equity as to when the debt became due, but the point seems now to be settled otherwise, on the rule adopted that a plea or demurrer, good as to the relief, extends to the discovery. (Mitf., 269.) It was formerly thought that the statute was a good bar to a bill of revivor if the proper representative did not proceed within six years after the abatement of a suit, and if there had been no decree, but it has since been decided otherwise (1 M. & C., 121), so that it would seem that there is no limit to the time at which a suit in equity, once commenced by the filing of a bill, may be revived. A decree, being in the nature of a judgment, cannot be affected by the Statutes of Limitation, though the court has sometimes refused to carry a decree for an account into execution after a great length of time, and under peculiar circumstances of laches.

Formerly the Statute of Limitation was no plea to a suit in the spiritual court or in the Court of Admiralty, where they proceeded according to their law, and in matters of which they had cognizance. (5 Bac., *Ab.*, 233.) By the 4 and 5 Ann., c. 16, s. 17, suits and actions for seamen's wages in the Court of Admiralty must be commenced and sued within six years. By the 3 and 4 William IV., c. 27, s. 43, persons claiming tithes, legacies, or any other property for the recovery of which an action or suit at law or in equity might have been brought, cannot bring a suit or other proceeding in any spiritual court for the same but within the period during which they might have brought their action at law or suit in equity. Also by the 27 Geo. III., c. 44, s. 1, suits in the Ecclesiastical Court for defamatory words must be commenced within six calendar months, and (sect. 2) suits for fornication, incontinence, or for striking or brawling in a church or churchyard, must be brought within eight calendar months after the commission of the offence. But, except in these cases, it does not appear that the Statutes of Limitation have any application to suits in the Ecclesiastical or Admiralty Courts.

VI. As to the manner of pleading the Statutes of Limitation.

The Statutes of Limitation must in general be pleaded positively by the defendant in any action at law, who wishes to take advantage of them, and he cannot give them in evidence (5 Bac., *Ab.*, 244); and it has been held in equity that unless the defendant claims the benefit of the statutes by plea or answer, he cannot insist upon them in bar of the plaintiff's demand. (Mitf., 277.)

By the 2 and 3 William IV., c. 100, s. 7, in actions or suits as to moduses and exemptions from tithes, it is sufficient to allege that the modus or exemption, or discharge claimed, was actually exercised for the period mentioned in the act as applicable to the case; and if the other party intends to rely upon any matter of fact or law not inconsistent with the simple fact of the exercise and enjoyment of the matter claimed, it must be specially alleged, in answer to the allegation of the party claiming, and cannot be received in evidence on any general traverse or denial of the matter claimed.

By the 2 and 3 William IV., c. 71, s. 5, in actions and suits relating to the prescriptive rights mentioned in that act, it is sufficient, in pleading such a right, to allege it generally without averring its existence from time immemorial, in all actions on the case and other pleadings, when such an allegation was sufficient before the passing of the act; and in pleading to actions of trespass and other pleadings, where before the passing of the act it was necessary to allege the right to have existed from time immemorial, it is sufficient to allege the enjoyment of the right by the occupiers to have existed during the period mentioned in the act as applicable to the case, without claiming in the name of the owner of the fee, and if the other party intends to rely upon any matter of fact or law not inconsistent with the simple fact of enjoyment, it must be specially alleged, and cannot be received in evidence, upon any general traverse or denial of the plaintiff's allegation.

(Bacon, *Ab.*, art. 'Limitation;' Chitty's *Statutes; and Report of Real Property Commissioners.*)

**STAUNTON, SIR GEORGE LEONARD**, was the eldest and only surviving son of Colonel George Staunton of Cargin in the county of Galway, Ireland, a gentleman of small fortune, but descended from a very antient English family. He was born at Cargin on the 19th of April, 1737, and received his education partly in Galway and partly in Dublin, until he entered his sixteenth year, when the delicate state of his health, and a tendency to consumption, rendered necessary an immediate removal to a warmer climate. His father accordingly sent him to Montpellier in the south of France, where he remained some years, and having completed his studies in the college of that city, he took a medical degree.

In the year 1760 he returned to England, and resided for some time in London, where he occupied himself in contributing some valuable essays to the periodical publications of that day, and formed an acquaintance with many eminent literary men of the time, especially Dr. Johnson, who, in the year 1762, upon his intended embarkation for the West Indies, wrote him a most affectionate valedictory letter. This letter is preserved in Boswell's 'Life of Dr. Johnson,' and bears a very high testimony to Mr. Staunton's merits at that early period.

Mr. Staunton practised for a short time in the West Indies as a physician, but he held at the same time considerable official situations in the islands, and having acquired a competent fortune, which he invested in estates in the island of Granada, he returned to England in 1770. In 1771 he married Jane, the second daughter of Benjamin Collins, Esq., of Milford, near Salisbury, and a banker in that city; but the disorder into which his West Indian property fell in his absence obliged him very soon to return to Granada, where he continued to reside until the capture of the island by the French in 1779.

During this period Mr. Staunton devoted himself with considerable success to the practice of the law, a profession much more congenial to his talents and habits than that of medicine, and he was appointed, by the crown, attorney-general of the island. In 1774 Lord Macartney went out to Granada as governor, and a very warm intimacy and friendship was soon formed between that nobleman and Mr. Staunton, which ended only with their lives. Mr. Staunton's established influence and character in Granada rendered his aid and support of essential advantage to the administration of the new governor, and these and other services his lordship warmly and affectionately acknowledged.

Upon the capture of the island by the French, Lord

Macartney and Mr. Staunton were both sent to France as prisoners of war. Lord Macartney immediately proceeded to England on his parole, but Mr. Staunton remained some time longer at Paris, and had the address and good fortune to obtain, under circumstances of peculiar difficulty, his lordship's exchange, as well as his own. Lord Macartney was thus enabled to avail himself of the appointment which the East India Company had conferred upon him, of the government of Madras, and Mr. Staunton accompanied him to India as his confidential secretary. In this character he was in fact his lordship's chief adviser on all the various transactions of his arduous and upon the whole successful government.

Nothing could have been apparently more adverse to Mr. Staunton's interests than the capture of Granada. His house and plantation, which unfortunately lay in view of the enemy when they were landing, were totally pillaged and destroyed. Everything moveable was taken away; and the land itself was afterwards in part confiscated and given away to Frenchmen upon frivolous pretences. The recovery of any part of the wreck of his fortune was rendered hopeless by his sudden and compulsory departure from the island, and he was reduced to the necessity of commencing, as it were, the world anew.

These circumstances, seemingly so unpropitious, were nevertheless in the end of great advantage to him, for they led to his immediate removal to a more suitable sphere for the exercise of his talents.

While in India, Mr. Staunton was engaged in a series of missions of great importance. On a very critical occasion, when the civil and military authorities at Madras were at issue, he undertook the delicate and possibly hazardous office of executing an order of the government, placing under arrest the commander-in-chief of the army, Major-General Stuart; and he thus preserved, by his vigour and promptitude, both the tranquillity of the settlement and the supremacy of the civil government.

But the transaction in which his diplomatic abilities were chiefly displayed was the negotiation of a treaty of peace with Tippoo Sultan in 1784, by which the safety of our Indian possessions was secured at a crisis of great difficulty and peril. For this service he was immediately raised to a baronetcy, and the East India Company conferred on him a pension of 500*l.* a year for life. On his return to England he also received the degree of Honorary Doctor of Laws from the University of Oxford.

Lord Macartney, as well as Sir George Staunton, remained at home unemployed from this time until 1792, when the determination of the government to send a splendid embassy to the court of Pekin called them both again into active service.

At this period, Sir George, having succeeded to his patrimonial estate by the death of his father, and having made a moderate yet sufficient addition to it by his own exertions, was little covetous of further public employment; but the novelty of this undertaking, and the very extensive sphere of public utility to which it seemed to lead, gave it a degree of interest in his mind altogether independent of its pecuniary advantages. Although the negotiations were to have been opened by Lord Macartney, it was to Sir George Staunton that the government chiefly looked for the final and complete accomplishment of the objects of the mission, and with this view he was provided with separate credentials as minister plenipotentiary, to be acted on in the absence or after the departure of the ambassador.

Sir George's health fell a sacrifice to his exertions upon this occasion. A few months after his return to England he was seized with an attack of paralysis, from which he never entirely recovered, and after a painful struggle of about six years, he gradually sunk into the grave. He however happily retained his intellectual faculties in full vigour to the last. He gave to the world a remarkable proof of this, in his published narrative of the proceedings of the Chinese embassy, a work which was not only read with great interest and avidity at the time, but is still referred to as one of the first authorities on all matters connected with China.

Sir George died in London, on the 14th January, 1801, in the sixty-fourth year of his age, and was buried in Westminster Abbey, where an elegant monument, by the late Sir Francis Chantrey, was some years after erected to his memory. He was succeeded in his title and estates by his only son, the present Sir George Thomas Staunton, M.P. for Portsmouth.

**STAUNTO'NIA**, a genus of plants of the natural family of Menispermaceæ and tribe Lardizabaleæ, named in compliment to Sir George Staunton, who introduced many plants from China on his return from the mission with Lord Macartney. This genus is remarkable as being one of those which is common to China and the Himalayan Mountains, and has hence afforded useful inferences respecting the districts where the tea-plant might be successfully cultivated. The genus is characterised by having monœcious flowers; the male having a six-leaved calyx, with the leaflets in two rows. Petals six or wanting. Stamens six, opposite to the petals, distinct or monadelphous. Anthers adnate, opening outwards. Rudiment of ovary. The female flower has the calyx of the male. No petals. Six sterile dwarfish stamens. Ovaries three, distinct, oblong, with many ovules. Stigmas sessile, simple furrowed. Berries often fewer than three, divaricate, fleshy, opening longitudinally on their inner side. Seeds numerous, oblong-ovate, or reniform. Embryo minute in base of a fleshy albumen. Radicle inferior. The species are divided into two subgenera: *Stauntonia* being without petals and having monadelphous stamens; *Holboellia* having six gland-like petals, and the stamens free. The species form large climbing shrubs, with alternate petiolate peltately digitate leaves. Leaflets leathery in texture, three-nerved, very entire, with all the petiols swelled and jointed at both extremities. Racemes fascicled, axillary, a few flowered at the base of the branches. Flowers white, externally purple, fragrant, berries large and purple. The Himalayan species are found in Nepaul and in 30° of N. latitude, at elevations of 5000 and 6000 feet. Their fruit, having a sweetish pulp, is eaten by the natives of these mountains, and they might no doubt be acclimated in the gardens of this country, as they experience a considerable degree of cold at the elevations where they are found.

**STAUROLITE**, *Staurotide*, *Grenatite*. This mineral is a silicate of alumina and iron; it occurs crystallized, the primary form being a right rhombic prism. Cleavage parallel to the lateral planes, and both diagonals. Fracture conchoidal, uneven. Hardness, scratches quartz with difficulty. Colour reddish-brown. Streak white. Transparent; translucent. Lustre vitreous and somewhat resinous. Specific gravity 3·724. The crystals often intersect each other. Does not fuse by the blow-pipe, but becomes nearly with borax it is slowly converted into a dark green transparent glass. Found in France, Spain and Portugal, Switzerland, and North America.

Analysis of a specimen from St. Gothard, by Klaproth:—Silica, 37·50; Alumina, 41·00; Oxide of iron, 18·25; Oxide of manganese, 0·50; Lime, 0·00.

**STAVANGER.** [CHRISTIANSAND.]

**STAVEREN.** [FRIESLAND.]

**STAVESACRE.** [DELPHINIUM.]

**STAVROPOL.** [SIMBIRSK.]

**STAYNER, SIR RICHARD**, was a naval commander under the Protectorate and during the early part of the reign of Charles II. Nothing is known of his parentage or of the date of his birth. He is first noticed as having, in conjunction with Captain Smith, taken a Dutch East Indiaman of 800 tons burthen, which had four chests of silver on board. In 1656 Captain Stayner had three frigates under his command, when he fell in with the Spanish flotilla, which consisted of eight sail. He attacked them: two were captured, one burnt, two sunk, two driven on shore, and one escaped into Cadiz. Stayner is said to have returned to England with treasure amounting to 600,000*l.* sterling. In 1657 he sailed with the fleet under Blake for the purpose of intercepting the Spanish West India flotilla, which had taken shelter in the bay of Santa Cruz. The Spanish ships were well arranged, and strongly supported by batteries on shore. Blake, though he saw that he could not bring out the ships, resolved to attempt their destruction; and, on the 20th of April, Stayner was sent in to begin the attack. He was followed by Blake, with the rest of the fleet. In a few hours the Spaniards had fled to the shore, the batteries were silenced, and the whole of the ships burnt. A more detailed account of this gallant enterprise is given in the article BLAKE. For his conduct in this affair Stayner was knighted by Cromwell. Sir Richard Stayner held a command in the fleet under Montague, afterwards earl of Sandwich, when he went to receive Charles II. His knighthood was confirmed by Charles, and he was constituted rear-admiral of the fleet. He had no further opportunity of distinguishing himself, and is supposed to have died in or soon after 1661.

(Campbell's *Lives of the Admirals*; Charnock's *Biographia Navalis*.)

STE. CROIX, DE, GUILLAUME EMMANUEL JOSEPH GUILHEM DE CLERMONT LODE'VE, an eminent French historian, was born at Mormoiron near Carpentras, in the Comtat Vénaissin, January 5, 1746, of a noble family. He was educated among the Jesuits of Grenoble, and afterwards, in 1761, entered the army with a captain's commission in the French cavalry, and as aide-de-camp to his uncle the Chevalier Sainte Croix. On the death of his uncle the same year, he changed his regiment and obtained a company in the Grenadiers de France; after serving between six or seven years he left the army, and, abandoning an active life, gave himself up entirely to the study of history. His literary labours soon obtained him distinction, and he had the honour of being crowned three times by the Académie des Belles-Lettres, of which he was made a foreign member in 1772, being at that time resident at Mormoiron, not then in the French dominions. In 1770 he married Mad'lle d'Elbène, by whom he had two sons and a daughter. In 1791 he shared in the troubles of the times, being driven from his home and thrown into prison; his property was sequestered and his papers and books destroyed. He succeeded by means of a disguise in escaping to Paris soon afterwards. These calamities were followed by severe domestic afflictions which embittered his latter years. He died March 11, 1809.

Sainte Croix's works are numerous. Besides contributing many articles to the 'Journal des Savans,' the 'Magasin Encyclopédique,' the 'Archives Littéraires,' the 'Mémoires de l'Académie des Belles-Lettres,' he published the following works:—'Examen Critique des Anciens Historiens d'Alexandre le Grand,' Paris, 1775; second edition, Paris, 1804. This work was translated into English by Sir Richard Clayton, 1793. 'L'Ezour-Vedam, ou Ancien Commentaire du Vedam, contenant l'Exposition des Opinions Religieuses et Philosophiques des Indiens,' Yverdon, 1773. 'De l'Etat et du Sort des Colonies des Anciens Peuples,' Philadelphie, 1779. 'Observations sur le Traité de Paix conclu en 1763 entre la France et l'Angleterre,' Yverdon, 1782. 'Mémoires pour servir à l'Histoire de la Religion Secréte des Anciens Peuples, aux Recherches Historiques sur les Mystères du Paganisme,' Paris, 1784. 'Histoire des Progrès de la Puissance Navale d'Angleterre,' Yverdon, 1782. 'Les Anciens Gouvermens Fédératifs, et de la Legislation de Crète,' Paris, 1798.

(For further information see the *Notice Historique*, by Sylvestre de Sacy, prefixed to the Catalogue of Sainte Croix's library, Paris, 1809, 8vo.)

STE. MARIE, at present the only settlement which the French preserve on the eastern coast of Madagascar, is an island whose centre is in 16° 45′ S. lat. and 50° 55′ E. long. It is called by the natives Nossi-Ibrahim, and is separated from Madagascar by a channel, which in its narrowest part is about three miles across, but towards the northern extremity of the island widens to ten miles. The island extends in length from south-west to north-east about thirty miles, and varies in width between five and eight miles. The circuit is nearly seventy miles. A narrow arm of the sea, not far from its most southern extremity, separates a small part of the island at high water from the remainder. The southern part of Sainte Marie is surrounded by a reef, rising above the level of the sea, but there are several openings in it, three of which are deep enough for large vessels. The shores of the island are in general low and swampy, except in a few places of small extent, where they are of moderate elevation. The interior consists of hills apparently isolated, but arranged in chains in the direction of the island from south-west to north-east. The highest of them are from 160 to 200 feet above the sea-level. Their slopes are gentle, and admit cultivation to the very summit; some of them are used as pasture-ground. The soil is bad, except a narrow tract in the interior, which may cover one-fifth of the area of the island, and which is regularly cultivated by the natives. The channel which divides Sainte Marie from Madagascar is a vast roadstead, with good anchorage, and safe, even during the western gales, which rarely occur. From this channel an inlet enters eastward into the island, which is more than 2200 fathoms long, and about 1100 fathoms wide, and constitutes the harbour of Port Louis. At the entrance of the harbour is a small island, called L'Ilot Madame. The passage south of this island can only be navigated by small vessels, but the northern passage is deep enough for frigates. At this place the French settlement has been made, as it affords a safe anchorage for several vessels, and as the interior of the harbour is almost entirely filled up with shoals. The island is watered by many streams, and the water is generally good.

The climate is very moist. The wet season begins in March and continues to August. In May, June, and July, it rains nearly without intermission, and sometimes in August. But even between August and the end of February rain is frequent. The number of days on which rain falls is stated to vary between 220 and 240, and it is presumed that there are few places on the globe on which a greater quantity of rain descends. The heat is excessive in January and February, when the thermometer sometimes rises in the afternoon to 100°, and varies during the remainder of the day between 88° and 92°; but in the night it descends considerably, so that at sun-rise it sometimes is at 70° and even 68°. During the rainy season the winds in general vary between south-west and south-east, and only occasionally blow from the east or north-east, generally in February and March. In the dry season the winds vary between south-east and north-east; they rarely blow from the south or south-west. The land-breeze, which blows from Madagascar, is felt during the night and early part of the day, and the sea-breeze sets in at noon. In the dry season the breezes are very feeble, but during the rains they nearly always blow with great force. The hurricanes, which are so terrible on the islands of Mauritius and Bourbon, are felt much less in Madagascar, and particularly at Sainte Marie. The natives rear cattle and cultivate rice, mandioc, and some other vegetables; and a great part of the island is covered with forests, which contain many timber-trees. The French settlers introduced several tropical productions, and they continue to cultivate coffee, cloves, sugar, and some vegetables. A considerable number of the natives live on the produce of their fisheries, fish being very abundant at certain seasons of the year. Dried fish is exported to several places in Madagascar.

The population is composed of natives and foreigners. In 1836 it was below 5000 individuals, of whom about 4000 were natives, or Malgashes, as the inhabitants of Madagascar are called. There were also 67 persons paid by the French government, 13 European settlers, and some blacks. The foreign population did not exceed 700 individuals. The French have built a few houses at Port Louis, and fortified L'Ilot Madame. In the vicinity of Port Louis are a few plantations, in which the French cultivate the articles of export for the European market. The natives inhabit about 40 villages chiefly situated in the interior of the island.

The commerce of Sainte Marie is not important, and is only carried on with the islands of Bourbon and Madagascar. Bourbon receives from Sainte Marie and other ports of Madagascar, cattle, beef, pork, suet, a few hides, land-turtles, game, rice and paddy, and some timber; and sends to it some cotton-stuffs of French and English manufacture, spirits, salt, soap, some articles of hardware, arms, and crockery.

The French began to form settlements on the eastern coast of Madagascar as early as 1642, but they had no stability, as they were frequently changed, abandoned, and again taken possession of. The few places occupied by them at the beginning of the present century were taken by the English in 1811, and destroyed. In 1818 and 1819 the French again took possession of Sainte Marie, Titingue, Foul Point, Fort Dauphin, and Sainte Lucie; and in 1821 Sainte Marie was regularly settled by a colony of seventy-nine persons. But a war soon broke out between the French and Radama, the king of Madagascar, who took Fort Dauphin and the other places in 1825, with the exception of Sainte Marie. In 1829 the French began an active war with the queen of Madagascar, who had succeeded Radama, and retook several places, as Titingue, Foul Point, and Tamatave; but after the revolution of 1830, all these possessions were again abandoned, and thus Sainte Marie has remained the only French settlement on Madagascar.

(*Notices Statistiques sur les Colonies Françaises*, Paris, 1840.)

STEALING. [LARCENY.]

STEAM is the name given in general to the vapours arising from moist or liquid bodies when subjected to the action of heat: in the mechanical applications however water is the liquid used; we shall therefore, in this article, treat steam as the vapour of water.

Steam, naturally, like other gases, is transparent and colourless, its visibility in air arising from its partial liquefaction, whence arise small vesicles of water enclosing steam, which are capable of reflecting light. From their great number, the light which they reflect or transmit, coming to the eye from all angles of incidence, and being a combination of the primary coloured rays, is white, as in snow, the foam of a cascade, &c.

As the application of heat has generally an expansive effect on bodies, so water converted into steam occupies more than 1700 times its former space. The action of heat in liquefying ice, on the contrary, slightly diminishes its bulk, which remarkable exception to the general effects of caloric is explained by an alteration of the relative positions of the solid elementary crystals of ice in passing into its liquid form, and arising from the repulsive action of heat; for it is easy to conceive how an alteration in the axes of a multitude of such infinitely small crystals, produced itself by repulsion, would bring the whole to occupy a smaller space than before. (Biot, *Physique.*)

When ice or snow is in the process of liquefaction, a mercurial thermometer plunged in it will remain constantly at the same height, whatever heat is applied, until the whole mass is dissolved. This heat, latent to the thermometer, but measurable by a calorimeter, is the caloric of liquefaction. Continuing after this stage to apply more heat, the thermometer in the water will be observed to indicate rising temperatures proportional to the surplus of heat thus given. If the heat be applied to the bottom of the vessel containing the water, the lowest stratum of the water expanded by the heat becomes specifically lighter than the incumbent strata; it therefore rises, making way for a descending current of the colder parts, which in their turn rise, and thus the heat becomes diffused through the whole mass. Upon a further application of heat, globules of vapour formed at the bottom rise along the sides of the vessel, but become liquefied in reaching strata of inferior temperature. When these bubbles become larger and more frequent, their condensation is attended by a series of sounds commonly called *singing;* and after they have acquired sufficient heat to reach the surface, and sufficient elasticity to overcome the pressure of the atmosphere, the vapour passes into the air in the form of steam, and the water is then said to boil. The further application of heat converts gradually the whole of the water into steam, during which the thermometer again becomes stationary, showing the absorption of latent heat; but after this stage has been completed, it proceeds again to indicate degrees of temperature nearly proportional to the surplus heat then applied. Hence we have two fixed points for the thermometer; that of melting ice, 0° Centigrade, or 32° Fahrenheit; and that of boiling-water, 100° Centigrade, or 212° Fahrenheit. [THERMOMETER.]

The point of ebullition will occur at lower temperatures by diminishing the pressure, 30 inches being the ordinary height of the barometer [BAROMETER]; we may diminish its altitude by ascending a mountain, or we may draw away a portion of the air by means of the AIR-PUMP; steam will then be produced at a proportionally lower temperature. When we continue to apply heat to ordinary steam, under a constant bulk, its elasticity rapidly increases, and it is then termed *high-pressure;* steam of the ordinary temperature being termed *low-pressure.*

The following table gives the temperature of boiling water and the corresponding pressures of the air as observed by Dr. Dalton and Sir J. Robison, those of the former are marked by the letter D, those of the latter by R:—

| | Heat of boiling water. | Corresponding pressure of air. |
|---|---|---|
| R | 215° | 31·8 |
| R | 214° | 31·2 |
| R | 213° | 30·6 |
| — | 212° | 30· |
| R | 211° | 29·4 |
| R | 210° | 28·8 |
| R | 209° | 28·2 |
| D | 200° | 22·8 |
| D | 180° | 15·2 |
| D | 160° | 9·45 |
| D | 120° | 3·27 |
| D | 100° | 1·97 |
| D | 80° | 1·03 |



Upon the important subject of the relations between the temperature and elasticity of steam, a multitude of experiments have been made by Watt, Southern, Ure, Dalton, Arago, &c. The following table for high-pressures is from the observations of Southern:—

| Atmospheres. | Barometers. | Temperatures. |
|---|---|---|
| 1 | 29·8 | 212° |
| 2 | 59·6 | 250·3 |
| 4 | 119·2 | 293·4 |
| 8 | 238·4 | 343·6 |

The following is a table abridged from Dr. Ure's, showing the elastic force of the vapour of water in mercurial inches, with the corresponding temperatures, in which, it may be observed, that Dr. Dalton is confirmed in giving some elastic force even at the temperature of freezing:—

| Temp. | Elast. | Temp. | Elast. | Temp. | Elast. | Temp. | Elast. |
|---|---|---|---|---|---|---|---|
| 32° | 0·20 | 170° | 12·05 | 270° | 86·30 | 300·6° | 140·90 |
| 55 | 0·42 | 180 | 15·16 | 273·7 | 91·20 | 302 | 144·30 |
| 65 | 0·63 | 190 | 19·00 | 277·9 | 97·80 | 303·8 | 147·70 |
| 75 | 0·86 | 200 | 23·60 | 280 | 101·90 | 305 | 150·56 |
| 80 | 1·01 | 212 | 30·00 | 283·8 | 107·70 | 306·8 | 154·40 |
| 90 | 1·36 | 220 | 35·54 | 285·2 | 112·20 | 308 | 157·70 |
| 100 | 1·86 | 230 | 43·10 | 287·2 | 114·80 | 310 | 161·30 |
| 105 | 2·10 | 240 | 51·70 | 290 | 120·15 | 311·4 | 164·80 |
| 120 | 3·30 | 245 | 56·34 | 294 | 126·70 | 312 | 167·00 |
| 130 | 4·37 | 250 | 61·90 | 295·6 | 130·40 | | |
| 140 | 5·77 | 255 | 67·25 | 297·1 | 133·90 | | |
| 150 | 7·53 | 260 | 72·30 | 298·8 | 137·40 | | |
| 160 | 9·60 | 265 | 78·04 | 300 | 139·70 | | |

Various tables of the same kind have been constructed and published by the French academicians at the desire of government, and also by a committee of American gentlemen, which however do not harmonise with the first-named tables.

Various empiric formulæ have been attempted, and some on particular hypotheses have been calculated to represent the relation between the elastic force of steam and the temperature. As they all deviate from the observed results at very high or very low pressures, we shall here mention only a few of the more celebrated.

Laplace's formula (from Dalton's experiments):—

$$F_n = p.\,(10)^{\alpha n - \beta n^2}$$

where $F_n$ is the force at a temperature $n°$ centigrade, and $p.$ the pressure of the atmosphere $=0·76$ metres, and

$$\alpha = 0·0154547;\ \beta = 0·0000625826.$$

Ivory's formula (from Ure's experiments):—

$$\text{Log.}\ \frac{e}{30} = \alpha t - \beta t^2 + \gamma t^3,$$

where

$$\alpha = ·0087466;\ \beta = ·000015178;\ \gamma = ·000000024825.$$

Dr. Young's formula is remarkable from its simplicity:—

$$F = (1 + 0·0029t)^7.$$

Formula of the French Academy:—

$$F = (1 + 0·7153t)^5,$$

the degrees being here centisimal.

The general formula between the pressure, density, and temperature for all gases is

$$p = \kappa\rho(1 + \alpha\theta)$$

$p$ being the pressure, $\rho$ the density, and $\theta$ the temperature; $\kappa$ and $\alpha$ are constants peculiar to the gas. If now we consider the *absolute* heat V to be a function of the temperature, we can deduce from this, by the integration of a partial differential equation, the relation

$$\frac{p^{\frac{1}{\gamma}}}{\rho} = \phi(\text{V}) \ \ldots\ldots \quad \text{(Poisson, } \textit{Mec.}\text{, vol. ii.)}$$

If therefore the *absolute* heat were constant (*i.e.* the sum of the latent and sensible heat), we should upon determining $\gamma$ by observation, have the complete solution of the relation between the elasticity and temperature for each gas. The results in the case of steam are, as above mentioned, however, but approximations, and in extreme temperatures by no means close. Sir J. Lubbock has therefore modified the hypothesis, by supposing that the expression for the absolute heat ought to contain one term proportional to the temperature; thus, according to his view we should have

$$V=C+D(1+a\theta),$$

which combined with the former equations (supposing $p'$ to be the pressure corresponding to $\theta'$) gives

$$\frac{1+a\theta'}{1+a\theta}=\frac{p^{\frac{1-\gamma}{\gamma}}-E}{p'^{\frac{1-\gamma}{\gamma}}-E}=\frac{p'\rho}{p\rho'}$$

and comparing the results of this formula with observations of Dr. Ure, from 123° to 224° Fahr., the errors are all within the limits of observation, some positive and some negative. (*Heat of Vapours*, by J. W. Lubbock, Esq., Lond., 1840.)

It has recently been observed that the discharge of steam from boilers is accompanied by a development of electricity. The facts are at present too little methodized to be introduced here. The reader may consult on this subject the *Phil. Mag.*; and Sturgeon's *Annals*.

STEAM-ENGINE. In conformity with the plan of this Cyclopædia, a general outline of the principles of the engine will be here given, the reader being referred to different articles connected with the subject, or to works written specifically on the steam-engine, for more detailed information.

The claim to the invention of the steam-engine has been made a subject of national contention; but the conclusion, arrived at from the discussions which this has originated, seems to be, that, in common with all other important applications of physical principles, no individual can lay claim to the invention. Whatever may have been the nature and date of its origin, it has been reared to its present gigantic stature by the fostering care of different countries, and, without detracting from or underrating the efforts of others, England may be justly proud of her share of the glory, a share readily conceded by our competitors.

Considering therefore dispute the as unprofitable, and the discussion of dates of patents and improvements as uninteresting, we shall incorporate all that is requisite of the history of the engine with our account of it.

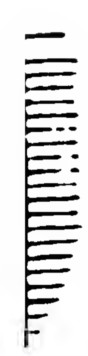
A steam-engine may be defined generally, as an engine by which the force arising from the properties of elasticity and of instantaneous condensation possessed by steam are transmitted to produce a continuous rotatory motion, either of a fly-wheel to constitute a reservoir of power for the purposes of driving machinery, or for any other uses that power may be put to.

Admitting this definition, the earlier steam-engines, as they are commonly called, those of the Marquis of Worcester (1663), and the improved forms of it contrived or suggested by others, and even Captain Savery's (1698), which was long employed in this country, were only *pumps* for raising water: a partial vacuum was formed in close vessels by the condensation of steam within them, the atmospheric pressure raised the water to a certain height; from whence it was forced higher by the elasticity of the steam admitted to act on its surface.

Passing over all these therefore as foreign to our subject, the first engine which it is necessary to describe is that of Newcomen (1705), as constituting the connecting link between the steam-pumps alluded to, and the modern engine, of which it contained the germ, and into which it was converted by the genius of WATT.

In the subjoined diagram, A represents a *cylinder* open at the upper end, fitted with a *piston* B, and rendered air-tight by having water on it to the depth of several inches: the *piston-rod* was suspended by a chain from the arched end of a *beam* C, turning on an axle, and having a pump-rod at its other extremity, loaded so as to counterpoise the weight of the piston, and to raise it to the top of the cylinder. This cylinder was placed over the *boiler* D, with which it communicated by a steam-pipe E, furnished with a cock F to open or close the passage. G is a cistern fixed above the cylinder, to the bottom of which a pipe H passed, also provided with a cock I.

When the piston was depressed to the bottom of the cylinder, it drove out all the air before it, which escaped at the orifice of a pipe K into the water of a smaller cistern L: the cock F being next opened, the steam from the boiler filled the cylinder as the piston rose again from the action of the counterpoise; as soon as it arrived at the top, the



cock F was closed and I opened, a jet of cold water from the cistern G rushed into the cylinder, condensing the steam, and thus forming a partial vacuum beneath the piston,* the pressure of the air on its upper surface forced it downwards, and caused the pump at the other end of the beam to raise an equivalent weight of water to a height equal to that through which the piston moved: the injected water and condensed steam-water flowed off into the cistern L through K, as the air had previously done. The cock I was now closed, and F opened, and the action was repeated, and when this engine was first introduced, it was the duty of an attendent to open and shut these cocks alternately; but subsequently lever handles to open and shut the cocks were acted on by pins or cams, carried by a rod suspended from the beam; and the engine became self-acting. This improvement was rudely made in the first instance by a boy named Potter, for the purpose of saving himself trouble; it was subsequently perfected by an engineer named Beighton in 1718.

Newcomen's engine was successively improved upon by Smeaton, Brindley, and other engineers, previous to Watt's time, and from its intrinsic merits it remained in general use under the appropriate name of the 'atmospheric engine' during the greater part of the last century, but was only used for pumping water: its existence was further prolonged by the important improvements we are about to describe, and possibly one or two may still be found in our remoter mining districts, neglected or in ruins, witnesses to the rapid march of our mechanical skill within the last fifty years.

It hence appears, that in Newcomen's engine, the steam was solely employed to produce a partial vacuum by its *condensation*, its elastic force at high temperatures not being made use of; and a great waste of heat, or fuel, was occasioned by this condensation taking place within the cylinder; for the consequent reduction in temperature caused a partial condensation of the next charge of steam, till the latent heat given out by this condensing steam had raised the temperature of the cylinder again to that of the boiler; more steam was therefore requisite than would otherwise have been necessary.

The first and most important of Watt's improvements on the engine consisted in effecting the condensation in a separate vessel, termed the *condenser*, which commu-

* This mode of effecting the condensation was considered an important improvement on that previously employed by Savery, which was by the external affusion of cold water over the steam-vessel; nevertheless, this latter principle has been partly re-introduced in the form of a condenser, patented by Mr. S. Hall, which is employed in many steam-vessels, and appears to be increasing in use.

nicated with the cylinder. This condenser being filled with steam from the boiler at the same time with the cylinder, the jet of cold water, admitted into the former only, effected the condensation of the whole volume of steam, both of that in the cylinder as well as of that in the condenser, in conformity with the well known principle in physics, that an action originated in any part of a homogeneous fluid is almost instantaneously communicated throughout its mass.

To effect still further the object of this separate condensation, Watt placed his condenser in a cistern, the temperature of which was kept constant by a fresh supply of cold water, brought from a well by a pump, to be presently mentioned; for otherwise, the heat given out by the condensing steam would, by heating the vessel and the water surrounding it, have prevented the rapid or almost instantaneous condensation necessary to the efficient action of the engine.

To comprehend the necessity for a rapid condensation, it must be remembered that the effective power of the engine depends on the pressure on the piston minus any resistance it encounters and on the space through which it moves. If the steam could be *instantly* converted into water, and so entirely removed,* a perfect vacuum would be formed beneath the piston, in which case, there being no resistance from this source to overcome, a maximum of power would be obtained: but if the condensation be slow, or only partial, since the piston will begin to move the instant there is any inequality in the pressures exerted on its opposite surfaces, its motion will be retarded, or the power diminished, by the resistance to compression offered by the uncondensed steam, and although that resistance would tend to diminish as the condensation proceeded, yet the space occupied by the steam diminishing in consequence of the descent of the piston in nearly the same proportion, the resistance would be nearly constant through the whole of that descent.

On the other hand, to maintain the temperature of the cylinder as high as possible, Watt, at first, cased it in wood to retard the radiation, and subsequently surrounded it by a second iron cylinder, admitting steam from the boiler between the two. This casing, or 'jacket,' as it is termed, is not used in most modern engines made since Watt's time; for reasons which will hereafter appear: a
radiation from the surface of the cylinder
guarded against as much as possible by k
face bright and smooth.

The second of Watt's improvements
engine consisted in closing the cylinder at
rod being made to pass through a cylindric
top, termed a *stuffing-box*, from the passag
steam-tight by a stuffing of tow saturat
which by its lubrication diminished the a
resulting from this arrangement. The obj
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employed to impel the piston downwards, i
atmospheric pressure: for this purpose the s
ted from the boiler above the piston at th
the condensation took place in the conde
passage being made double for the purpose,
munication with the condensor could be c
with the cylinder was opened, alternately.
had descended to the bottom of the cylind
poise at the pump-rod raised it again, as
engine; but to allow of this upward motion,
to remove the steam which was above the
was done by allowing it to pass under the
the condenser through a passage opene
instant for this purpose. Such is the gen
Mr. Watt's *single-acting* engine, which
*steam-engine*, and was no longer an *atmosp*

By a further improvement the counterpo
rod was done away with, which obviously h
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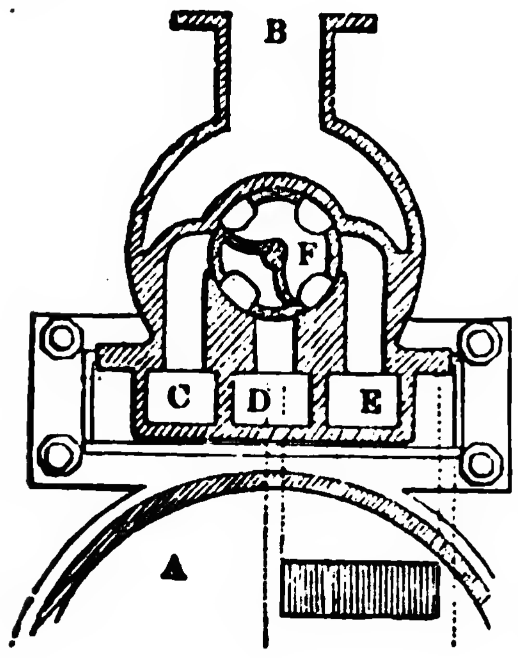
The upward stroke of the piston was n
admitting the steam *below* it, to act by its
had previously done *above* when causing
scend: thus the engine became *double-acti*
that essential general principle which it
maintained, although all the details of
have been improved upon by successive en

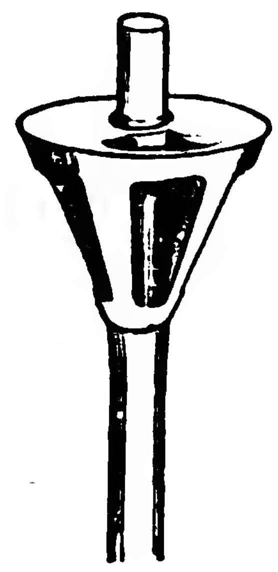
* One cubic inch of water occupies 1711 cubic inches of steam at 212°; consequently, the space occupied b condensation may be neglected in the computation.

The changes in the engine introduced by Watt created the necessity for two pumps, and commonly three, which are worked by rods attached to the beam: the first of these is the *hot-water* or *air pump*, intended to remove the air, condensed water, and steam from the condenser, in which they would otherwise accumulate, and finally stop the action; for this water cannot flow away into an open cistern, as it had done in Newcomen's engine, since by Watt's principle it is essential that the condenser should be as steam-tight and as perfectly closed as the cylinder, or else the steam could not exert a pressure greater than that of the atmosphere, as it is intended to do in order to increase the effective force of the engine. The second is a force-pump, required to return the water, drawn from the condenser by the first, back to the boiler, as will be hereafter explained; and the third, termed the *cold-water pump*, is that alluded to in a preceding paragraph as supplying the cold-water cistern which contains the condenser.

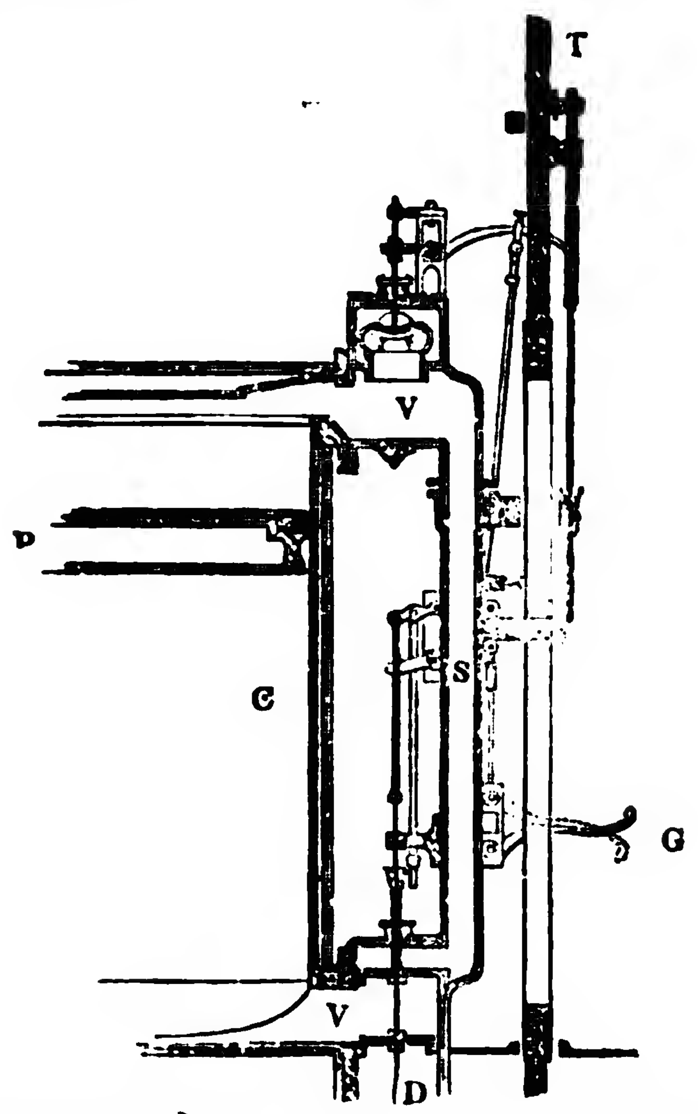
Having thus explained the general principle of the engine, some of the details of its construction must now be considered, and the piston [HYDRAULICS] may claim our first notice, both from its paramount importance and the practical difficulties to be overcome in its formation. In hydraulic machines, all vessels, pipes, valves, &c. must be made *water-tight:* in Bramah's pump, for example, the efficiency of the engine entirely depends on the accurate fitting of parts moving in contact, which must be perfectly water-tight, though subjected to a pressure of many hundred pounds on each square inch of surface, and the utmost perfection of skill in workmanship is requisite to ensure this: this difficulty is obviously considerably increased when steam or gases are the fluids to be dealt with. Now the piston of a steam-engine must be *steam-tight*, and yet move with a minimum of friction in the cylinder; and as this latter, from defective workmanship, can never be a perfectly true one, the cylindrical periphery of the piston must be so contrived as to be capable of adapting itself to every inequality in the surface against which it slides: this is effected in common pistons by their being made two inches or more less in diameter than the cylinder, leaving a projecting flange at the bottom, which, together with a top engines since the introduction of Watt's improvements. This can be accomplished by a *four-passage cock*, originally invented by Leupold in 1720, and since improved by Bramah and others. The principle of a four-way cock will be understood by the annexed figure of the plan of one employed by Messrs. Maudslay and Field in their small engines.




A is a portion of the cylinder; B, the steam-pipe; C, D, E, three passages, one communicating with the top, another with the bottom of the cylinder, and the third with the condenser; F is the four-passage cock, which by turning alternately to the right and left establishes a communication between one of the former with the latter passage. The lower figure represents the conical valve with its side apertures, and that at the top, by which the steam enters.



Watt employed flat conical valves for the purpose under consideration, which were raised or depressed by cranks acting on a guide-rod at right-angles to the plane of the valve, which therefore did not turn on a hinge like the common *clack-valve* of a pump; in some of his engines the valves were raised or depressed by toothed sectors acting on a rack in the guide-rod, so that the valve might rise from its seat without altering the parallelism of its plane. Two such valves were mounted in one box, one above the other, the guide-rod of the lowest passing through that of the upper.




The figure shows the valves of this construction, of the large engine recently erected by Messrs. Maudslay for the Chelsea water-works.

C, part of the cylinder; P, the piston; T, the 'plug-tree;' G, the gearing handles, which are struck by the tappets on the plug-tree, and thus open and close the valves V; S, the steam-passage to the upper and lower parts of the cylinder; D, the passage to the condenser.

In most engines of the present day however the *slide-valve*, as it is termed, has superseded the use of the others: a perfectly flat surface slides on another, terminating the orifices which are to be opened and shut; such is the general principle, but the forms and arrangements are too numerous to be mentioned. The figure subjoined shows a part of the cylinder of an engine with *box-slide valves*, now much used.

S, the orifice of the steam-pipe; the steam passes to the upper part of the cylinder at D, the lower passage E being shut off in the position of the valve shown and shaded in the figure; the slide is moved by the rod R, and it is shown in its second position in dotted lines, in which position it will be seen that the steam can then enter *beneath* the piston, while the passage P to the condenser is in turn in communication with the upper part of the cylinder by means of the tube T of the slide.

The characteristic and most valuable part of this principle is this, of making part of the slide act as a pipe to connect the two parts of the cylinder alternately with the condenser. The steam by pressing on the slide in the common form enormously increases the friction with the surface against which it acts, and also produces rapid wear of the parts; this defect is remedied in the box-slide and all others which possess this peculiarity. Another form of slide-valve is shown in the diagram, page 480.

Slide-valves were proposed by Murray, in 1799, but were abandoned, till improved workmanship allowed of their being more perfectly made; they have been successively improved in principle by Murdoch, Bramah, Millington, Maudslay, and Seward, the slides of the last named being now much used in marine engines.

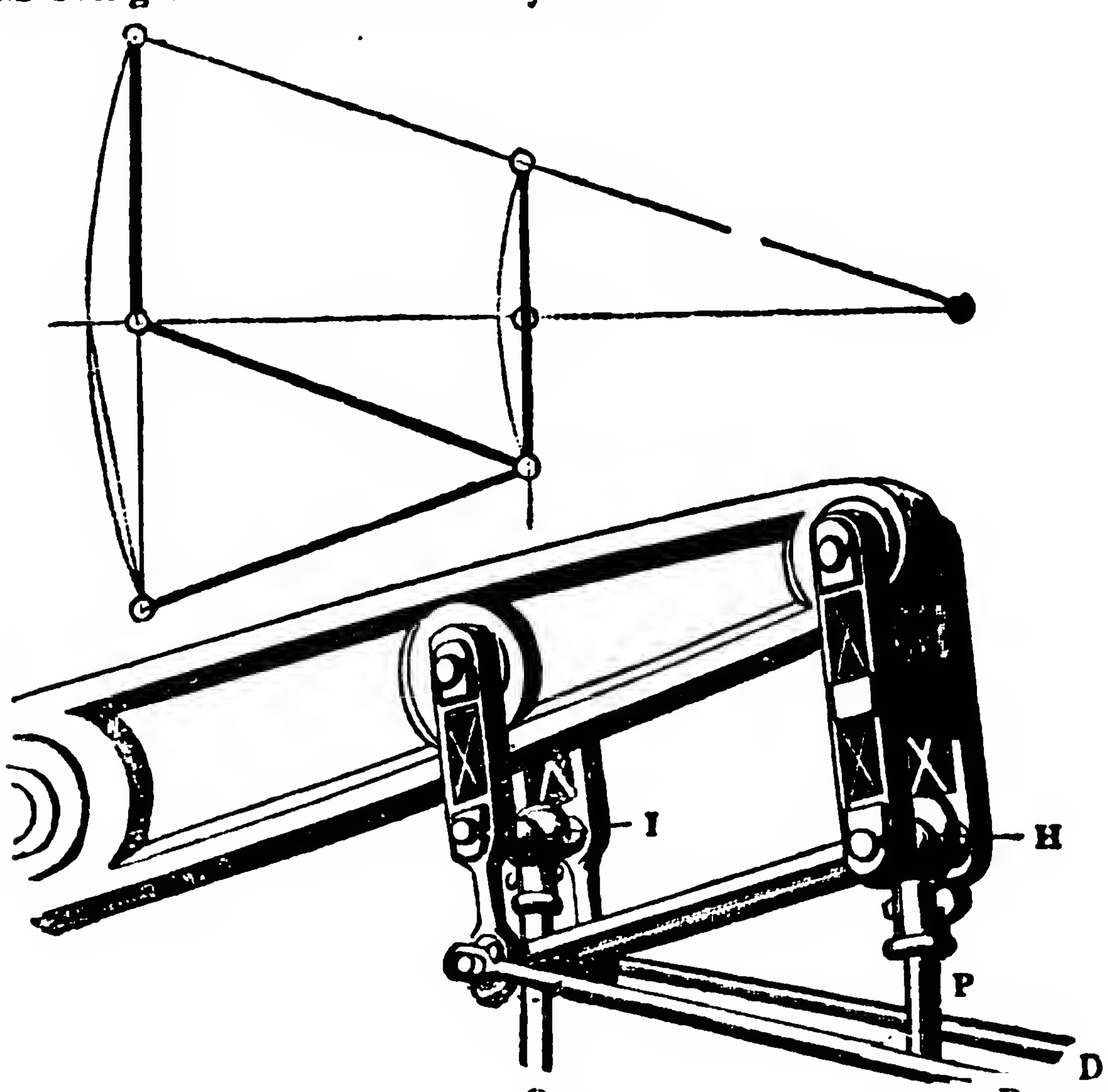
It has been mentioned that the alternate action of the valves in the atmospheric and Watt's engines was produced by pins, or *tappets*, adjusted on a rod called the *plug-tree*, suspended from the beam; as the plug-tree moved up and down with the beam, the tappets struck the ends of bent levers or cranks, which raised or depressed the valves in proper succession: some of these levers were so formed that the tappet by pressing against them might keep the valve closed during the greater part of the stroke* of the piston, and others required an intermediate shorter lever, or claw, to act on the valve-rod; so that the whole arrangement was inevitably complicated and cumbrous.† But when the slide-valve superseded Watt's double conical valves, and the steam passages could be opened and closed by the motion of one rod only, connected with the slide, this motion could be readily produced by what is termed an *excentric*, which for this purpose usually consists of a circular plate of metal, keyed *excentrically* on the shaft of the fly-wheel, and working within a ring attached to the end of a frame intended to move a crank directly connected with the slide-rod at its other extremity. As the shaft revolves, the excentric plate imparts an alternating motion to the frame, which, transmitted by the crank, alternately raises and depresses the slide-rod. The principle of the excentric is one of the most valuable of those mechanical contrivances by means of which a continuous circular can be converted into an alternating rectilinear motion.

* The term *stroke* is technically used by engineers to express the whole motion of the piston from the top to the bottom of the cylinder and back again.

† Messrs. Maudslay and Field have however retained the plug-tree and tappets and the conical flat valves in the large condensing engine erected by them for the Chelsea Water-Works at Pimlico in 1837; which replaced an original engine of Boulton and Watt, probably the last to be seen in the neighbourhood of London.

The 'beam,' so frequently alluded to, was obviously the readiest mode of connecting the alternating motion of the piston with the pump to be worked, in the atmospheric engine; and owing to the facilities it offers of working the plug-tree and the three pumps necessary in Watt's condensing engines, continued to form a part of the arrangement whether the engine were intended to pump a mine or to drive machinery. The beams of the first engines were made of two or more trees, bolted together to obtain the requisite rigidity, and further strengthened by a kind of truss, as is seen in the diagram of Newcomen's engine. But when the art of making heavy iron-castings was perfected, that metal was substituted for wood, to the manifest improvement of the engine in every respect. Watt also removed the cumbrous arched heads, which had been previously employed for the purpose of causing the piston-rod to move up and down in the same right line, though connected with the end of the beam, which necessarily described an arc of a circle, as turning on a fixed centre; this arrangement implied the use of a flexible chain, to suspend the piston, which might wind round, and unwind from, the arch, but a chain could not be used when the piston had to raise the beam, as it had to do in Watt's engine, instead of being raised by it, as in Newcomen's.

The object of these 'arched heads' is attained in modern engines by a system of simple rods or levers, so combined that one point may move in a straight line nearly. There are a variety of combinations by which this may be effected, but that termed the 'parallel motion,' invented by Mr. Watt for the purpose, is the only one which need be here noticed, as being that most commonly used.




The geometrical principle of this motion is shown in the diagram, as well as the whole arrangement when the piston is near the top of the cylinder. D D are rods fixed by one end to the frame supporting the beam, while the three other pair of levers being jointed together and to the beam, must obviously, in every position, form a parallelopipedon, whence the name is derived; P is the piston-rod attached to H; Q that of the hot-water pump connected with the parallel motion at I in the centre of that side.

When the engine is employed to drive machinery of any kind, a *fly-wheel* becomes a necessary adjunct to it. A fly-wheel is one in which the principal quantity of the matter is distributed in the periphery; when such a wheel revolves on an axis perpendicular to its plane, the greatest quantity of matter moving with a maximum velocity, the momentum of whole is a maximum, while its inertia, if it be large, causes it to control, or equalize, the motion of the machinery through which it receives its own. It is the momentum of such a wheel which constitutes the disposable force available for the multifarious purposes to which machinery can be applied; so that in the case of the steam-engine, although the elasticity of steam is the original source of power, the immediate one by which the work is executed is the momentum of the fly-wheel.

It is consequently necessary to adapt some contrivance to the end of the beam, which shall convert the alternating circular motion of the latter into a continuous one of the fly-wheel; this is effected by the *rod* and *crank*, a piece of mechanism of such frequent occurrence that it is unnecessary to describe it; the treadle of a lathe is a familiar instance of its application, and for a similar purpose, that of connecting the alternate motion of the turner's foot with the continuous one of the wheel of the lathe; the principle of the treadle, or rod and crank, is in fact the only one by which an alternating can be converted into a continuous circular motion, it must therefore be employed, notwithstanding the variation in the power transmitted by means of it, consequent on that of the angle formed by the rod and crank with each other. Thus, for example, when the rod and crank are in the same direction, which occurs twice at every rotation, no force whatever is transmitted by it, and the primary one is entirely suspended or held in equilibrium by the resistance of the fixed centres on which the crank and rod turn.

In the steam-engine the rod and crank are so adjusted that these two neutral positions occur when the piston is at one or the other end of the cylinder, and the valves are so arranged that both steam passages being closed, all communication between the engine and the boiler is cut off, otherwise the steam, which could not under these circumstances move the piston, would exert its force to the detriment of the machine; as soon however as the momentum of the fly-wheel has carried the crank past these positions, the motion reciprocally imparted through it to the piston and valves admits the entrance of the steam from the boiler into the cylinder again. It is one of the important details in the construction of the engine, that the piston should be in that point of its course when the steam exerts its maximum of effect on it, at the time when, the rod and crank being at right angles to each other, the maximum of force may be exerted to turn the fly-wheel.

Since the diameter of the circle described by the crank must be equal to the length of the stroke, or to the distance through which the piston moves, it might be thought advantageous to increase the length of the stroke as admitting of a longer crank; but there are limits to this length determined by a variety of circumstances, some of which will be hereafter explained.

When Watt substituted the elastic force of steam for the pressure of the atmosphere, he introduced a source of power which might be increased to an indefinite extent, provided it were found advantageous to employ it; and the question naturally suggests itself, what is the elastic force or pressure at which the maximum of useful effect can be produced with a minimum expenditure of fuel? Unfortunately no direct answer can be given; in mathematical language, the unknown quantity is a function of too many variables to be capable of determination, except by repeated experiments for every specific engine, this quantity varying with the principle of its construction, even to details. The results of such experiments seem to show that generally it is more advantageous to employ steam of a comparatively high elastic force; accordingly the pressure was increased, in engines constructed by Watt, from 4 to 8 or even 12 lbs. on the inch, the apprehension of danger from the explosion of boilers in which steam of high pressure was generated constituting the chief limit to a further extension of the practice. The nature of those improvements in the construction of boilers will be briefly explained hereafter, by which steam of 100 lbs. on the inch may be generated, if requisite, with nearly as much security as that of 4 lbs. in the earlier boilers; but at present, simply stating that such is the case, we proceed to explain some important changes which have been consequently made in the principles of the engine.

When the steam is first admitted into the cylinder, the total space filled by the steam is immediately augmented by that through which the piston moves; and if the capacity of the boiler were not several times greater than that of the cylinder, the consequence would be a gradual diminution of the pressure, supposing the total quantity to remain the same: but the moment the pressure in the boiler tends to diminish, an additional quantity of water passes into the state of vapour, of the same tension as that previously generated, provided the temperature be maintained; hence the pressure on the piston may be regarded as sensibly the same throughout the whole of its stroke, provided that pressure be somewhat greater than that of the atmosphere, and the communication with the boiler remain open. It must not however be supposed that the pressure on the piston is the same with that of the steam in the boiler; all that is here asserted is that the pressure on the former will be uniform.

But if the pressure be considerably greater than that of the atmosphere, the steam, even when separated from the water, while expanding in the enlarging space formed by the motion of the piston, will exert sufficient force to continue that motion, till at last the pressure diminishing inversely as the space increases, and directly as the temperature, according to Mariotte's and Gay-Lussac's laws, that pressure will finally be not in equilibrium with the resistance, and all motion will cease. This is the important principle of working engines, originally proposed by Watt, though not employed by him, but which now, from the improvements in boilers above alluded to, is becoming general under the name of that of *expansion*. In the common engine, if the pressure on the piston continue uniform during the stroke, as it would do if the communication with the boiler remained open, the piston would move with an accelerating velocity till it arrived at the end of the cylinder, when the motion in that direction being suddenly stopped, the momentum must be expended on some of the fixed points of the machine, to its manifest injury, and with the useless expenditure of so much power; accordingly the communication with the boiler is always cut off when the piston has arrived at a certain point, and with a momentum sufficient to carry it to the end of its stroke without any useless expenditure of force, while the steam behind it, which was originally of but a few pounds pressure above that of the atmosphere, thus limited in quantity, rapidly declines in force, and ceases to urge the piston on. But on the 'expansion principle,' when the steam possesses considerable elastic force, the communication with the boiler may be cut off much sooner, and the piston is urged forward by the expansive force of the steam, which, although decreasing as the space increases, is yet sufficient to carry the piston to the end of the stroke.

If it be asked how it is advantageous to use half the quantity of steam at twice the pressure, when it takes perhaps twice the quantity of fuel to raise the steam to the double pressure, the answer is, that it can be shown analytically that the total force exerted by steam acting expansively is greater than that which would be exerted by steam of a constant pressure, equal to the mean of those exerted, first, at the moment the steam-valve is closed, and, secondly, when the piston arrives at the end of its stroke; consequently, as less steam may be used to produce the required effect, a saving of fuel is the result, or in other words, the quantity of steam may be much less than half, at double the pressure, or the pressure much less than doubled, to produce the same effect.

As long as a continued force of any kind produces a continued motion with a constant velocity in any body, the force must be in equilibrium with the resistance it has to overcome; for if the force were greater than the resistance, it would produce an accelerating motion, which is contrary to the supposition; and if the resistance became greater than the force, the velocity would retard till the equilibrium were produced: as long therefore as a steam-engine is moving with a constant velocity, the *pressure on the piston* must be equal to the resistance to be overcome, consisting of the net work to be done, together with the friction of the various parts, the resistance of the uncondensed steam, of the air on the opposite side of the piston, and of other sources of resistance, which all concur to produce the gross resistance to be overcome. Putting P′ for the pressure of the steam on each unit of surface of the piston, and R for the resistance for the same unit, or for the quotient obtained by dividing the total resistance by the number of units of surface, we have

$$P' = R \qquad \text{(A)}$$

as the first equation of condition; but since the velocity of the motion must be taken into consideration, when the *power* or force of the engine is to be determined, we must consider the velocity with which this pressure is applied, or, in other words, the rate at which the steam is applied to the cylinder; and it is obvious that when the engine is moving with a constant velocity, the supply to the piston must be exactly that produced in the same time by the evaporation going on in the boiler. If therefore S expresses the volume of *water* evaporated in a unit of time and transmitted to the cylinder, and $m$ the ratio of the volume of *steam*, formed under the pressure P in the boiler, to the volume of *water* which produced it, $m$S would express the volume of steam generated in each unit of time under the pressure P: by passing into the cylinder this steam assumes the pressure P′, and, neglecting the further change produced by the variation in the temperature of steam in changing from pressure P to pressure P′, the volume of that quantity of steam would be inversely as the pressures by Mariotte's law; consequently the volume $m$S, when transferred to the cylinder, would become $m\,\mathrm{S}\frac{\mathrm{P}}{\mathrm{P}'}$; and putting $v$ for the velocity of the piston and $a$ for its area, $av$ will be the volume of steam expended in each unit of time; hence we get

$$av = m\,\mathrm{S}\frac{\mathrm{P}}{\mathrm{P}'} \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(B)}$$

eliminating P′ between equations (A) and (B), we obtain

$$v = \frac{m\,\mathrm{S}}{a} \cdot \frac{\mathrm{P}}{\mathrm{R}}$$

$$\mathrm{R} = \frac{m\mathrm{SP}}{av}$$

$$\mathrm{S} = \frac{av\mathrm{R}}{m\mathrm{P}}$$

for the *velocity, resistance*, and *evaporation*, when the other quantities are known: it must be observed however that the element neglected in these general deductions, namely, the change produced by the variation in temperature, has an important influence on the result, and must therefore now be taken into account.

$$\mu = \frac{1}{n + qp} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(C)}$$

is the general expression for the steam during its action in the engine, $\mu$ being the volume, and $p$ the pressure, and $n$ and $q$ constants, determined by experiments, for different kinds of engines.*

Let a certain volume of *water*, S, be converted into steam of the pressure $p$, and let M represent the volume of *steam* produced, then—

$$\mu = \frac{\mathrm{M}}{\mathrm{S}} = \frac{1}{n+qp'};$$

if M′ and $p'$ stand for the volume and pressure of steam from the same volume of water S, under other conditions, then—

$$\mu' = \frac{\mathrm{M}'}{\mathrm{S}} = \frac{1}{n+qp'};$$

and therefore the ratio of the volumes of steam produced under these different conditions from the same volume of water will be—

$$\frac{\mathrm{M}}{\mathrm{M}'} = \frac{\frac{n}{q} + p'}{\frac{n}{q} + p} \quad . \quad . \quad . \quad . \quad . \quad \text{(D)}$$

that is, the volumes will not be inversely as the pressures simply, according to Mariotte's law; but inversely as the pressures augmented by a constant.

* It can be shown that the density and relative volume of a vapour, whether or not in contact with the liquid, may be deduced, if its pressure and temperature are known; and that when in contact with the liquid the temperature varies directly with the pressure. In deducing formulæ for the steam-engine, it is necessary to be able to determine an expression for the relative volume of the steam in contact with the water, or the volume of the steam at the maximum of density and pressure at any proposed temperature. Now this cannot be done from the existing formulæ for analytical reasons, and it becomes necessary to adopt some empirical formula, for determining this relative volume of steam at its maximum of density, in terms of its pressure only; this formula must be tested by its conformity with experiment. The late M. Navier proposed for this purpose,

$$\mu = \frac{1000}{0{\cdot}09 + 0{\cdot}0000484\,p}$$

in which $\mu$ is the ratio of the volume of steam to an equal weight of water, and $p$ the pressure; but this formula, though true within certain limits of pressure, is not consistent with experiments at pressures lower than the atmospheric, and the following is propounded by M. de Pambour, as more correct and comprehensive:—

$$\mu = \frac{10000}{0{\cdot}4227 + 0{\cdot}00258\,p} \text{ for condensing engines;}$$

$$\mu = \frac{10000}{1{\cdot}421 + 0{\cdot}0023\,p} \text{ for non-condensing engines;}$$

$p$ being the pressure in pounds on the square foot. These formulæ in general terms therefore are expressed by

$$\mu = \frac{1}{n + qp} \text{ as in the text.}$$

From the above equation we get—

$$p = \frac{M'}{M}\left(\frac{n}{q} + p'\right) - \frac{n}{q} \quad . \quad . \quad . \quad . \quad (E)$$

Let $P$ = Pressure of the steam in the boiler.
$P'$ = Pressure of the steam in the cylinder; $P' < P$ *generally*.
$\pi$ = Pressure at any instant when acting *expansively* in the engine.
$l$ = length of the stroke.
$l'$ = the length of that part of stroke performed before the communication between the boiler and cylinder is cut off.
$\lambda$ = the length of that portion of the stroke performed when the pressure is become $\pi$.
$a$ = area of piston.
$c$ = *clearage*, or space in the cylinder at each end left between the piston and the ends of the cylinder, including the part of the steam-pipe between the slide-valve and the cylinder, which space is necessarily filled with steam at each stroke.

When the piston has performed $\lambda$ of its course under the expansive force of the steam, let $d.\lambda$ be the differential of this length, then the corresponding *force* or effect will be $\pi a d.\lambda$: and at the same instant the space $a\,(l' + c)$ occupied by the steam before the expansion will become $a\,(\lambda + c)$. Hence from (E)—

$$\pi = \left(\frac{n}{q} + P'\right)\frac{l' + c}{\lambda + c} - \frac{n}{q};$$

and $$\pi a d.\lambda = a\,(l' + c)\left(\frac{n}{q} + P'\right)\frac{d.\lambda}{\lambda + c} - \frac{n}{q}\,a d.\lambda.$$

Integrating between the limits $l'$ and $l$, we obtain

$$a\,(l' + c)\left(\frac{n}{q} + P'\right)\log\frac{l + c}{l' + c} - \frac{n}{q}\,a\,(l - l').$$

for the value of the total effect produced by *expansion* from the moment when the communication with the boiler is cut off, to the end of the stroke. By adding to this therefore the effect $P'al'$, produced previously, we get

$$a\,(l' + c)\left(\frac{n}{q} + P'\right)\left[\frac{l'}{l' + c} + \log\frac{l + c}{l' + c}\right] - \frac{n}{q}\,al = aRl \quad (F)$$

If in this expression, $l' = l$, which is equivalent to supposing the engine to be working without expansion, we get $P' = R$, as it ought to be.

Resuming the equation $\frac{S}{n + qP'}$, which expresses the volume of steam at the pressure $P'$ furnished by the boiler in the unit of time, and $a\,(l' + c)$ being the volume of this steam expended at each stroke; then if there are K strokes in that time, the expenditure of steam will be

$$Ka\,(l' + c);$$

and if $v$ be put for the velocity of the piston, we have $v = Kl$, or $K = \frac{v}{l}$; hence, by substitution, the expenditure will be

$$\frac{va\,(l' + c)}{l} = \frac{S}{n + qP'} \quad . \quad . \quad . \quad . \quad . \quad (G)$$

by equating the expenditure to the volume furnished by the boiler, which, as has been above stated, must be the condition when the motion is uniform. Eliminating $P'$ between (F) and (G), we get for the final general equation—

$$v = \frac{S}{a}\cdot\frac{1}{n + qR}\left[\frac{l}{l' + c} + \log\frac{l + c}{l' + c}\right] \quad . \quad . \quad . \quad (H)$$

The resistance expressed by R in this formula is the *total* pressure on each unit of surface of the opposite side of the piston, and is composed of three parts. First, of the *load*, or work to be moved or done, which we will denote by $r$. Secondly, of the resistance arising from the friction of the engine, which may be expressed by $f + \delta r$; $f$ being the friction when there is no load, and $\delta r$ the increment due to the additional friction for each unit of the load $r$. And, lastly, of the pressure on the opposite surface of the piston, which will be the atmospheric pressure in non-condensing engines, or that of the uncondensed steam and residue of air in condensing ones: this we shall call $p$. All these, $r$, $f + \delta r$ and $p$, refer only to each unit of surface of the piston, or

$$R = (1 + \delta)\,r + p + f,$$

by substituting this valve for R in (H), and by putting $k$ for

$$\left[\frac{l'}{l' + c} + \log\frac{l + c}{l' + c}\right],$$

we obtain

$$v = \frac{S}{a}\cdot\frac{k}{n + q\,[(1 + \delta)\,r + p + f]} \quad . \quad . \quad (K)$$

Now the quantity $\frac{S}{n + qR}$, it will be seen (C) is the total space occupied by the steam (in contact with the water) under the pressure R: hence to deduce the velocity $v$, the volume of steam corresponding to the volume of water S, supposed to be converted into steam under a pressure equal to R, must be calculated; and this volume being divided by $a$, the area of the piston must be multiplied by $k$.

The equation thus deduced shows the relation between all the quantities, known or sought, that enter into the mechanical theory of the engine in its most general form: it should be observed however that to preserve homogeneity, the dimensions $a$, $l$, $l'$, should be expressed in the same unit as the volume S of the water evaporated; and the pressures P, $r$, and $p$ referred to the same unit as S.

When this formula is used for computation, it must be understood that the quantity S expresses the *effective* evaporation; that is, the volume of water which really passes to the cylinder in the form of steam, and which acts on the piston, and does not allow for any loss by leakage or from any peculiarity in the structure of the engine.

If the engine is a condensing one, acting expansively, $l'$ must be made equal the length at which the steam is cut off; if expansion is not employed, $l'$ must be put equal to $l$, or to the whole length of the stroke, in which case the quantity $k$ becomes $\frac{l}{l + c}$, and the expression for the velocity becomes

$$v = \frac{S}{a}\cdot\frac{l}{n + qR}\cdot\frac{1}{l + c}.$$

The part $p$ of the quantity R must be made equal the pressure of the uncondensed steam, &c. If the engine be a non-condensing one, then $p$ will be equal the atmospheric pressure.

Since from (K) we obtain

$$ar = \frac{Sk}{(1 + \delta)qv} - \frac{a}{1 + \delta}\left(\frac{n}{q} + p + f\right) \quad . \quad . \quad . \quad (L)$$

it might be supposed that when $v = 0$, the resistance would be infinite, a paradox which would appear to vitiate the correctness of the formula. But it must be borne in mind that when $v = 0$, $S = 0$; for S is the quantity of steam which passes through the cylinder in each unit of time: and since no quantity of steam, however small, can pass without moving the piston, as long as S has any real value, $v$ will have one too: when therefore $v = 0$, $S = 0$ also; and then

$$ar = \frac{0}{0}, \text{ and not } = \infty;$$

that is, the formula becomes indeterminate, but not the less direct, as will appear by considering the other quantities it involves, and the consequences of putting $v = 0$.

By supposing the velocity zero, it is, in the first place, evident that no steam can pass to the cylinder, as has been stated; consequently there can be no expansion, that is, $l = l'$. Again the velocity being zero, the piston at rest becomes equivalent to the fixed sides of the boiler, and the pressure it sustains is equal to that in the boiler.

The working of an engine may be considered under three conditions: first, when it is working with a given pressure of steam, and with any, whatever load or velocity. Secondly, when it is working with a given pressure, and with that load or velocity compatible with the production of a maximum of useful or net force with that pressure: this may be termed the *relative maximum of useful effect*. And thirdly, when the pressure having been determined to furnish the force most consonant with the action of steam in any specific engine, the load is regulated so as to be that most advantageous for that pressure: this last constitutes the *absolute maximum of useful effect* for that machine.

The three fundamental problems for solution in the calculation of steam-engines consist in determining the velocity, the load, and the rate of evaporation in the boiler, since the useful effect, or net available power, is a function of these three quantities; and this net available power may be expressed in six different ways:—

First, by the number of pounds raised to a unit of height in a unit of time.

Secondly, by what is termed the 'horse-power' of the engine.

Thirdly, by the weight raised by the consumption of 1 lb. of fuel.

Fourthly, by the weight raised by the evaporation of a cubic foot of water.

Fifthly, by the number of pounds of fuel, or of cubic feet of water, for each horse-power.

Sixthly, by the number of horses-power which is furnished by each pound of fuel, or by each foot of water.

For the various formulæ by which all these problems may be numerically solved for different kinds of engines, and for the investigations by which those formulæ are deduced, we must refer to more comprehensive works; contenting ourselves here with deducing the general equations for the other unknown quantities of evaporation, useful effect, and horse-power, as we have done for velocity.

From (K) we obtain

$$S = av\,\frac{n+q\,[(1+\delta)r+p+f]}{k} \quad . \quad . \quad . \quad (M)$$

as the expression for the evaporation of which an engine must be capable to overcome a given resistance $r$, with a proposed velocity $v$, S being the quantity of water which is to be converted into steam and transmitted to the cylinder in each unit of time.

The useful or net force of the engine generated in the same unit of time is obviously $arv$; since $v$, the velocity, is in fact the space moved through by the piston in that time; by multiplying therefore both sides of (L) by $v$ we obtain

$$\text{Useful force} = arv = \frac{Sk}{(1+\delta)q} - \frac{av}{1+\delta}\left[\frac{n}{q}+p+f\right] . \; .(N_1)$$

or by multiplying both sides of (K) by $ar$, we obtain an expression for the same quantity in terms of the load

$$\text{Useful force} = arv = \frac{Srk}{n+q\,[(1+\delta)\,r+p+f]} \quad . \quad . \quad (N_2)$$

It will be noticed that for any proposed engine this force does not depend on the pressure of the steam in the boiler, P not entering into these expressions; but on the evaporation S effected in the boiler in each unit of time.

What is termed a 'horse-power' is estimated as 33,000 lbs. raised one foot in a minute: by dividing therefore the equations last obtained by 33,000, we get

$$\text{U. F. in horse-power} = \frac{\text{Useful Force}}{33000}.$$

and if during the unit of time N lbs. of coals are used in the furnace,

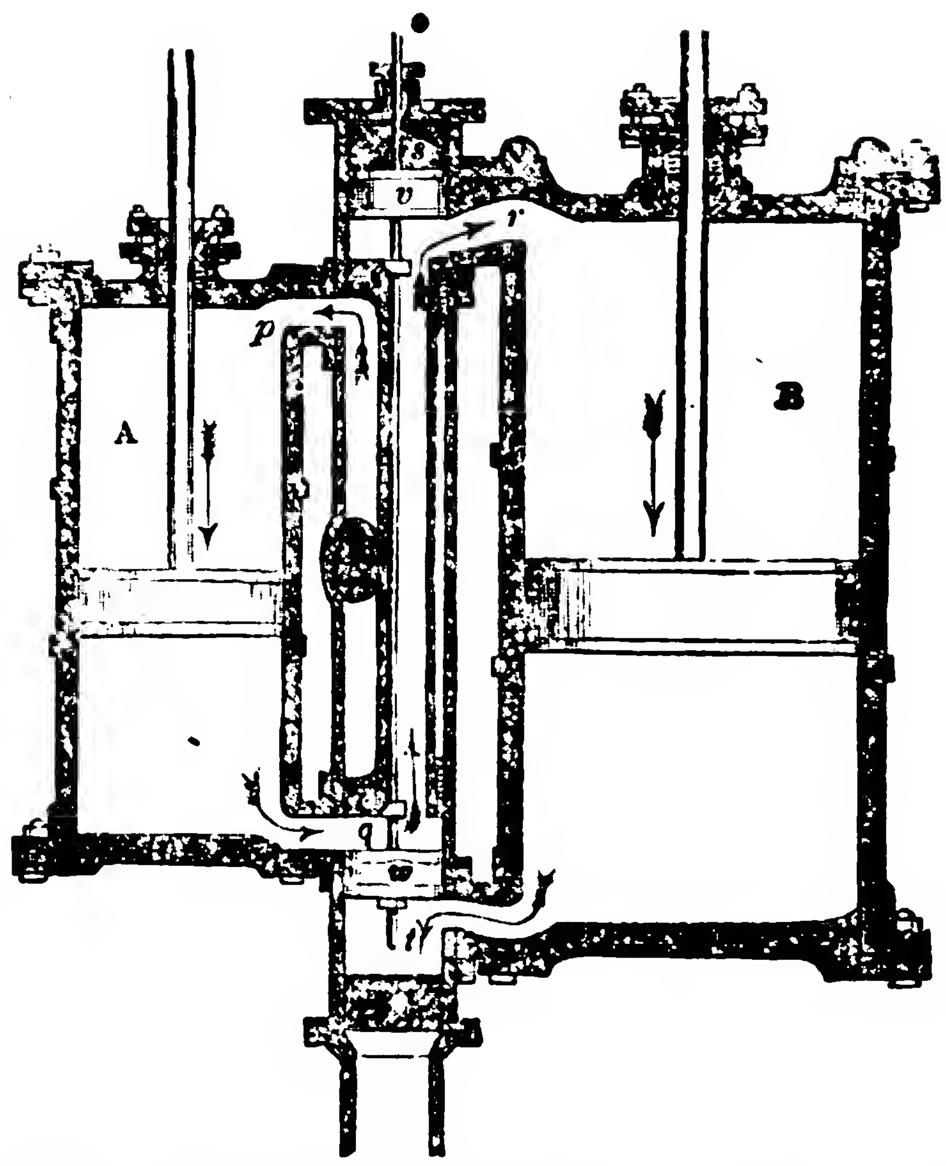
$$\text{U. F. from 1 lb. of fuel} = \frac{\text{Useful Force}}{\text{N}}$$

We must now return to our general description of the engine and of its modifications.

In 1781 an engineer named Hornblower proposed using the expansive principle by means of a double cylinder, but was prevented from carrying out his plan by the comprehensive and jealously guarded patents of Watt and his partners. In 1804 however Woolf brought this principle of the double-cylinder engine into use. The annexed figure will explain the mode of its action with an improved slide-valve.

The steam enters through the passage $p$ *above* the piston in the smaller cylinder A, at a considerable pressure: while the piston is descending under its influence, the steam from beneath passes through the tube $r$ to *above* the piston in the large cylinder B, which is impelled downwards by its expansion, the steam which was previously under this piston having passed to the condenser by the passage $t$. When the stroke is completed, the slide is moved downwards by its rod $o$. The small plugs or pistons $v$ and $w$ pass below the openings $r$ and $t$, and the slide below the orifices $p$ and $q$, and the action is reversed.

But though possessing considerable advantages, the dou-




ble-cylinder engine has not become common, probably owing to the complication of its structure, and the increased effects of radiation from so large a surface, more than compensating its merits; and the expansive principle, equally applicable to a single cylinder, is now principally employed in engines of the common construction.

If by the use of steam under conditions by which, though not in themselves economical, we are enabled to reduce so materially the cost price of the engine that the increased cost of fuel is more than balanced by the interest on capital, or if this more costly power were necessary to render the engine available for purposes which could not otherwise be attained, it is clear it would be had recourse to. It is such considerations which finally led to the adoption of the *non-condensing engine*, first suggested by Leupold, then patented but not used by Watt, and efficiently carried ont by Trevithick and Vivian in 1804; their object being to produce a locomotive engine to draw waggons on a tram-road. In the article RAILWAY the reader will find a comprehensive account of a locomotive engine as connected with the subject of railways; we shall here confine ourselves therefore to a few observations on this form of engine in connection with others which would have been foreign to the subject there considered.

To reduce the compass and weight of the engine sufficiently to render it portable, the cumbrous apparatus of the condenser, and its attendant pumps and cisterns, had to be discarded; and since the principle of condensation was consequently renounced, it was necessary to raise the steam to a pressure sufficient to overcome that of the atmosphere on the opposite side of the piston. To allow the steam to act alternately on both sides of the piston, that which had just acted on one side to drive the piston was expelled into the open air through an orifice, corresponding to that which would have connected the cylinder with the condenser in an engine of the usual construction; but unless this orifice were as large as the diameter of the cylinder, which obviously it never can be nor nearly, the steam, retarded in its escape by the contraction of the passage, must diminish, by its resistance to compression, the effective force of that which is acting to impel the piston.

Such is the simple principle, and such the greatest defect, of the non-condensing engine; but the saving in original cost and the paramount advantage of portability more than compensate for this defect; so that the use of this kind of engine has become general, not only for the purposes of locomotion, but for a variety of others where the engine is stationary, and probably in many instances where its advantages are imaginary.*

Since the pumps of the condensing engine are dis-

* The non-condensing engine is frequently termed the *high-pressure engine*, from the comparatively great elastic force of the steam employed in it; while in contradistinction the condensing engine for the same reason is termed the *low-pressure* one: vague and indefinite denominations, which ought to be abandoned, since high and low are relative. Many condensing-engines are worked with steam Watt would never have contemplated using; and Trevithick' engine was a low-pressure one compared with many now in use.

pensed with in the non-condensing one, the beam may be so likewise; the piston-rod is made to move in a straight line, by having a cross-piece attached at its top, which slides between *guides* fixed on each side of the cylinder, the rod which works the crank of the fly-wheel being attached to the end of this cross-piece. A still further simplification is effected by connecting the piston-rod directly with the crank on the shaft of the fly-wheel, the cylinder being mounted so as to oscillate as the wheel revolves on the steam passage, and thus alternately to open and close the communication between the top and bottom of the cylinder. Such engines are termed *vibratory*, and are successfully used where space must be economised, as with marine engines, but the weight of the cylinder thus moved is so much to be deducted from the power of the engine, and further causes a rapid wear of the centres on which it turns, which consequently cannot be long preserved steam-tight, and require frequent renewal.

Steam-engines are properly classed, according to the principle on which the physical properties of the steam are employed in them, into—

1. *Condensing Engines.*

1. Atmospheric engines, acting by Condensation only.
2. Double-acting engines . . . . . Pressure and condensation.
3. Double-acting engines . . . . Pressure, expansion, and condensation.

2. *Non-condensing Engines.*

1. Engines worked by . . . . . . Pressure only.
2. Engines worked by . . . . . . Pressure and expansion.

The form of the engine, the arrangement and construction of its parts, its power, &c., depend entirely on the purpose to which it is to be applied, and may be indefinitely diversified, but those most in use may be artificially classed thus—

1. *Condensing engines*, with beams and parallel motions.
   1. Without a fly-wheel, for pumping in mines, &c.
   2. ———— Marine engines.
   3. With a fly-wheel, for working machinery.
2. *Non-condensing engines*, without a beam.
   1. Stationary, with a fly-wheel for working machinery.
   2. ———— Rotatory engines.
   3. Locomotive engines, without a fly-wheel.

Marine engines, or those used for propelling vessels, are in this country* generally condensing engines, their situation admitting the abundant use of cold water. The principal peculiarity in the arrangement of the marine engine is the position of the beam, which, for the purpose of economising room, is placed lower than the cylinder, and is double, there being one on each side; a rod from one end of each of these is connected with a cross-piece at the top of the piston-rod, the rectilinear motion of which is produced either by guides, or by a crank-arrangement, analogous in its action to the parallel motion. The other ends of the double beam are connected by a cross-piece, carrying in its centre the 'rod' to work the crank on the shaft of the paddles. In all vessels of any magnitude, there are two engines complete, so arranged that while the rod and crank of one are in their neutral position, those of the other are in that of greatest effect. Two engines are necessary to equalize and continue the motion of the wheels; for in the marine engine, the paddles, instead of performing the part of fly-wheels to continue and control the motion of the piston, require the whole force of the engines to maintain their own, owing to the resistance they have to overcome. There is also this further advantage derived from two engines, that if one should be injured, the vessel may be still propelled by the other, and not be entirely dependent on her sails, as she would otherwise be.

It has been mentioned that there is a limit to the proportion between the diameter and length of the cylinder; the advantage that would accrue in gain of power by a long stroke being diminished by the greater radiation of heat from the larger surface diminishing the force of the steam in the cylinder; here therefore, as in every other calculation connected with the steam-engine, it is hardly possible to arrive at any formula or rule that can be invariably used. If the surface of the cylinder were to be made a minimum, with a maximum of capacity, we could readily determine that the length should be twice the diameter;* but we find that this proportion is not adhered to by the best makers; it varies from 3 : 1 to 2 : 1; but in the marine engine it is usually shorter; in some instances the proportion is 1 : 1·25.

The diameter of the cylinder of a marine engine is usually greater, in proportion to its length, than in others, in order to obtain, by an increased surface of piston, that power which is unattainable by a long stroke, owing to the limited space which can be appropriated to the engine. Formerly, the apprehension of danger, where so many lives were at stake, prevented the use of steam of more than 4 to 6 lbs. on the inch in marine engines, and the expansion principle consequently could not be had recourse to. At present, the economy of using this principle has outweighed the apprehension in the minds of the owners of vessels, while the public, contented with the information that the engine is a condensing one, seldom inquire further, and conceive that the steam is at a low pressure in all marine engines, although, where the expansion principle is used, which it now extensively is, the pressure in the boiler is at about 20 lbs. on the inch above the pressure of the atmosphere.†

Engineers have always been induced, by the obvious advantage of a continuous over an alternating motion, to aim at contriving a steam-engine in which the steam should act directly to produce such a motion. It does indeed appear at first sight that, where the object of the engine is to produce a continuous circular motion of a fly-wheel, or of wheels of some kind, it would be desirable that the steam should be applied directly to impel the wheel, instead of having its force transmitted through a series of levers, necessarily increasing the friction and the cost of the engine. Watt accordingly patented more than one of such rotatory engines, and many others since have from time to time brought forward arrangements for the purpose, but none have come into permanent and general use. The fact is, that, as can be easily shown, the employment of steam in this way is productive of a greater waste of power, with a greater increase of friction, than can be compensated by any real advantages. In all rotatory steam-engines hitherto proposed, the principle has been to admit the steam to act on a fan or fans revolving round an axis of the cylinder, and, by ingenious excentric movements, the surface of these fans is made to increase as the steam diminishes in elastic force from the enlargement of the space it occupies. Many such engines have been used for a time, but commonly after a few years' trial they have been abandoned, and the reciprocating principle substituted, thus proving that experience confirmed the deductions from theory.

In all mechanical combinations the object to be effected necessitates a certain characteristic form of the machine, which it retains, whatever improvements may have been successively introduced either in its principle or in the details of its construction. We can recognise in a modern Sussex plough the general form of that used by the subjects of the Pharaohs to till the banks of the Nile; and Newcomen would acknowledge a marine engine made by Maudslay and Field as a descendant of his atmospheric one: but he would for some time be at a loss to tell the object of a locomotive engine of Stephenson's, if he could see it at rest only; and the connection between it and its tender would be beyond his comprehension. The reason of this is that a locomotive engine is a perfectly new one, having no other analogy to an ordinary engine except that steam is the source of power in both; but all locomotive engines will ever possess a family likeness.

The principal causes of this novelty of form are, that

* It is stated by Mr. Stevenson that the American steamers which navigate the Mississippi are always non-condensing engines.

* Let $l$ = length, $x$ = the diameter, $c$ = the capacity of the cylinder: since the concave surface is only gradually brought into contact with the steam, by the motion of the piston, its effects on the temperature may be considered as about half what it would be if the whole surface were at once exposed. Then the whole surface, including the two ends, being

$$\pi x l + 2\frac{\pi x^2}{4} \text{ and } c = \frac{\pi l x^2}{4},$$

we have for the surface affecting the temperature of the steam

$$\frac{\pi x l + \pi x^2}{2} = \frac{2c}{x} + \frac{\pi x^2}{2}$$

therefore

$$\pi x dx - \frac{2c dx}{x^2} = 0$$

and by substituting the value of $c$, and reducing $2x = l$.

† On the Mississippi the boat-engines are worked with steam of from 100 lbs. to 130 lbs. on the inch; but the latter enormous pressure is rarely exceeded, 'except,' as an American commander said, 'on *extraordinary occasions*.'

great velocity being the object, the boiler must constitute the greatest part of the bulk, in order to supply a sufficient quantity of steam to meet the demands of two pistons making 200 strokes per minute, and even then it requires a *tender* to accompany it to carry a supply of fuel and water to keep up the quantity. The locomotion is produced by a pair of ***driving-wheels*** made to revolve by the engine by means of cranks on their axle, receiving motion almost directly from the piston rods; the adhesion which takes place between these wheels and the edge-bars or rails, causes the carriage to move on, just as the paddle-wheels of a steam-boat propel the vessel by the resistance of the water to the float-boards. The driving-wheels of a locomotive engine do not, any more than the paddle-wheels of a steam-boat, act as fly-wheels to regulate the velocity of the engine; this is effected in the former by the inertia of the whole mass; the great velocity consequently ensures the steady action of the engine. In the steam-boat this great velocity of the paddles is unattainable, and consequently two powerful engines are requisite to maintain even a moderate velocity; but air being the medium in which the driving-wheels of a locomotive engine act, almost any velocity can be imparted to them, and for obvious mechanical reasons is best attained by steam acting with a force almost amounting to impact on small pistons through a short stroke, two alternately acting cylinders being necessary, as in the steam-boat, to equalize the action of the cranks.

The two cylinders are most conveniently placed under the boiler in nearly a horizontal position; intermediate cranks preserve the rectilinear motion of the piston-rods, and connect them with the cranks on the axle; while excentric frames on this axle actuate the simple slide-valves required in a non-condensing engine. The steam which is driven out of the cylinder at each stroke, instead of escaping directly into the open air, passes into the funnel of the furnace, and thus increases the draught; but as the action of the engine cannot be understood independently of the boiler, it becomes necessary to turn our attention to that subject, without a general description of which, any account of the steam-engine would be incomplete.

Since some of the principal objects to be kept in view in the construction of boilers are incompatible with each other, one or more must be dispensed with in order to secure the rest. The specific purpose for which the engine is constructed must determine the general principle of the boiler; thus, rapid generation of steam, security, compactness, and lightness must be aimed at in boilers for marine or locomotive engines, even at the cost of a comparative waste of fuel; while for those intended for pumping or driving machinery, economy of fuel must be the paramount object, the weight, form, and space occupied by the boiler being secondary considerations. And whenever steam of a high elastic force is to be used, that form of boiler should be adopted which will most nearly equalize the strain on it. The following requisites are therefore to be understood as being those which it would be desirable to combine, though, united, they are unattainable in practice.

First, The boiler should have the greatest capacity with the least surface, to save material, diminish the weight, and increase the strength: hence a spherical form would be best in this respect, but it is incompatible with an economical application of the heat to a great extent of surface, which is essential to the rapid generation of steam.

Secondly, The form should be as simple as possible, both as reducing the expense of construction and most readily admitting of repair. Boilers are made of iron or copper plates riveted together at their edges, and if one of these is cracked, or has been burnt, that plate can be taken out and another put in without pulling the whole to pieces, which must be done when the boiler is of a complex form; added to which, all angles are sources of weakness, owing to the inequality of the strain on the adjoining surfaces, and the injury done to the metal by bending it to form the angle.

The form of boiler used for Savery's, Blakey's, Newcomen's, and other engines of the seventeenth and eighteenth centuries, up to the time of Watt, was that of an inverted frustum of a cone, with a spherical top, and its bottom slightly concave; this boiler was set in brick-work like a common copper, the flame playing round the whole of the lower part. The steam-pipe was connected in the usual way to a flange of a collar in the spherical head. Watt adopted a long rectangular form, with a semi-cylindrical top; the ends were flat and upright, the sides slightly curved inwards, as was also the bottom. From this form it is termed the *waggon-head* boiler; it is set in a rectangular mass of masonry, the cylindrical head alone projecting above the level of the brickwork; the fire-place was underneath one end of the boiler, and extended backwards for one-third of its length; the flue, after proceeding to the further end, returned along one side, across the end, over the furnace, and along the other side, into the chimney shaft, the boiler itself every where forming one side of the flue, and consequently having the flame and heated air directly in contact with it at the bottom and sides. In some cases, when the boiler was very large, a cylindrical iron flue was formed through the boiler longitudinally, opening at each end into and forming a continuation of the brick one, thus increasing the surface to be acted on by the heat.

The next and important modification in form was that of making the boiler entirely cylindrical with hemispherical ends, which is probably the best to combine as many requisites as possible. With this form the furnace is often placed in a second cylinder within the boiler, and forming the first part of the flue; thus the fuel being entirely surrounded by the water, little or no heat is lost by radiation; but there are serious objections to this practice on the score of accidents, as well as the deficiency in draught, owing to the confined space in which the combustion takes place.

When an engine is of such a size as to require more steam than one boiler of the ordinary magnitude can supply, it has two or more, set side by side, communicating with a common steam-pipe. Since the extent of surface exposed to the pressure of the steam, and therefore the liability to bursting, increases in a greater ratio than the capacity, there is obviously a limit to size, which can never safely be surpassed, while the security is proportionally increased by diminishing that capacity; hence the necessity for using two or more small boilers instead of one large one; and the principle, carried to its limit, constitutes that of the *tubular boiler*, in which the steam is generated in a series of independent metal-pipes of small diameter, all communicating with a common steam-chamber or reservoir, itself small, and strong enough to resist great pressures.

These tubular boilers however have not come into general use, not only from their complexity, and consequent liability to derangement, but because there does not exist any demand for steam of such high pressure as they are intended to generate.

Since, in accordance with the general hydrostatic law, every unit of surface of the boiler has to sustain the same pressure, if a small portion of that surface can be opened by the pressure of the steam, when it has attained that which the boiler was only intended to withstand, by the escape of a quantity of the vapour at this orifice, the elasticity of the remainder is again reduced below the limit This is the object of the *safety-valve*, which is such an aperture, kept closed by a valve retained in its seat by a weight calculated to yield to, or be raised by, the pressure the moment the steam exceeds its proper elastic force.

The safety-valve was first contrived by Papin, and used in his digester and boilers, and has ever since constituted an essential appendage to every boiler. In its simplest form it is an obtuse conical valve, kept in its seat, which is at the end of a short collar, standing up from the surface of the boiler, by a weight acting at the end of a lever, resting on the spindle of the valve, and having its fulcrum or hinge at the other extremity. The effective weight by which the valve is kept down may be varied by shifting the position of the weight on the arm of the lever; and as this alteration might be unintentionally made by carelessness or accident, the valve should be inclosed in a box under lock and key, to prevent its being tampered with. A chain attached to the valve, and accessible to the engineer, should be provided, to enable him to raise the valve, to ascertain that it is in efficient order, and has not become fixed in its socket. But the best mode of applying the weight is directly on the valve, so that it cannot be increased, as long as it is inclosed, by any accidental alteration in its position. In locomotive engines the weight would be liable to derangement by the motion, and a spiral spring is employed to keep down the valve.

The safety-valve is perfectly effective as long as it is free to rise in its seat, and is loaded with a constant weight, which ought never to be more than half the pressure the boiler is just capable of withstanding. The rapid diminution in the number of accidents from explosions, notwith standing the increased employment of steam, sufficiently proves that they are nine times out of ten caused by gross negligence or culpable recklessness; but to obviate as much as possible the recurrence of explosions, every boiler should have at least two safety-valves, both secured from access, and yet both capable of being raised by hand from time to time; one should be loaded with a less weight than the other, that by the escape of the steam from it the engineer may be warned to reduce the quantity of steam generated, by 'damping' his draught; and the other safety-valve should be only loaded with a weight equivalent to one-third the pressure which, by computation founded on actual experiments, would burst the boiler, if made with metal of a given thickness; for however carefully the boiler may have been made, it is impossible to ensure equal strength of it in every part.

A plan was originally suggested by Trevithick for insuring safety from a boiler by inserting in it a plug of metal, which, melting at the temperature attained by the steam when its tension became dangerous, might open an exit for it. This plan is, we believe, adopted in France, but besides that it is repugnant to our ideas of mechanical fitness, it is liable to many objections; none of the pure metals melt at a temperature sufficiently low to be available, and all the fusible alloys soften long before they melt, and vary in these respects with minute differences in the proportion of their ingredients, so that the plug would be driven out before the proper time.

The boiler, besides the danger of bursting from over-pressure of the steam within it, is also liable to injury by the external pressure of the air, if the steam within be condensed, as it must be on cooling, when the fire is let out, thus causing a comparative vacuum in the boiler. To guard against this there should be a safety-valve to act in the direction opposite to the usual one, which, yielding to the pressure of the atmosphere, would allow of the entrance of the air, when this pressure exceeded that exerted by the steam to keep the valve closed.

Another source of accident, which should be guarded against most sedulously, is the formation in the boiler of a deposit of the earths, &c. chemically united with the water or held suspended in it, and which are deposited from all water when long kept boiling in any vessel, as is illustrated and proved by the furring of old tea-kettles. This deposit is intensely hard, and adheres so closely to the metal, that it requires a chisel and hammer to detach it when accumulated to any thickness. Being a bad conductor of heat, it prevents the rapid generation of steam, and by not allowing the water to be in contact with the metal, so as to carry off the heat imparted to the latter, the metal gets red-hot and is burnt, or, in chemical language, becomes oxidized by long exposure to a high temperature. If, under these circumstances, a fissure should be produced in the silicious crust, the water, suddenly admitted to contact with the red-hot iron, is converted instantaneously into steam of such high pressure as to risk the bursting of the boiler.

It is one of the advantages held out as an inducement to their adoption by the inventors of tubular boilers, that owing to the inequality of the temperature of the liquid at different distances from the source of heat, a circulation is continually going on, which mechanically prevents the formation of a deposit, while in large open boilers no such cause can operate to any extent. In these the remedy appears to be the frequent cleaning out of the boiler, to prevent the accumulation of the deposit, and the admission of the water, which supplies the waste to the part not over the furnace, which should be separated from the rest by a partition extending upwards nearly to the level of the water; the fresh water is thus allowed to deposit its sediment in the part where it can be least productive of the evils alluded to, and whence it may be removed collectively from time to time.

Mr. S. Hall, the patentee of the new form of condenser mentioned above (note p. 474), has contrived a plan for supplying the boilers of marine engines, which are most obnoxious to furring from the quantity of salts contained in sea-water, with distilled water. This ingenious apparatus consists of a closed vessel or still placed within the boiler, and supplied with cold sea-water from the waste pipe of the condensing cistern, by means of appropriate connections with self-acting cocks. The upper part of this still is connected with the condensers, the vacuum consequently formed above the water in the still produces rapid evaporation, the vapour passes into the condenser, whence it is returned, as pure water to the boiler by the hot-water pump. We do not know whether the advantages of this plan compensate for its expense.

To indicate the actual pressure at any time of the steam within the boiler, this is furnished with a *gauge*, consisting of a bent tube, open at both ends, one orifice A opening into the boiler. This tube contains mercury, which will obviously be at the same level in both branches when the steam in the boiler is of the same pressure as the atmosphere, but will rise in the longer leg as the pressure of the steam increases, and will thus by its altitude indicate that pressure. If the longer leg be of a certain length, the mercury would flow over, or be blown out altogether; if the steam were suddenly to increase in its elastic force, the gauge would in this case act as a safety-valve. The loss of the mercury may be guarded against, under these circumstances, by a cistern placed round the orifice of the gauge to receive it, as shown in the figure.

A water-gauge is often used instead of a mercurial one, to save the expense of this metal; but then the tube must be long enough to allow a sufficient column of water to balance the pressure of the steam; and by making the tube of sufficient diameter, this water-gauge then constitutes an efficient safety-valve. As these gauges cannot, for obvious reasons, be made of glass, to allow of the height of the fluid within them being directly observed, this height is indicated by a light wooden rod projecting beyond the end of the gauge, which floats on and therefore rises and falls with the mercury or water.

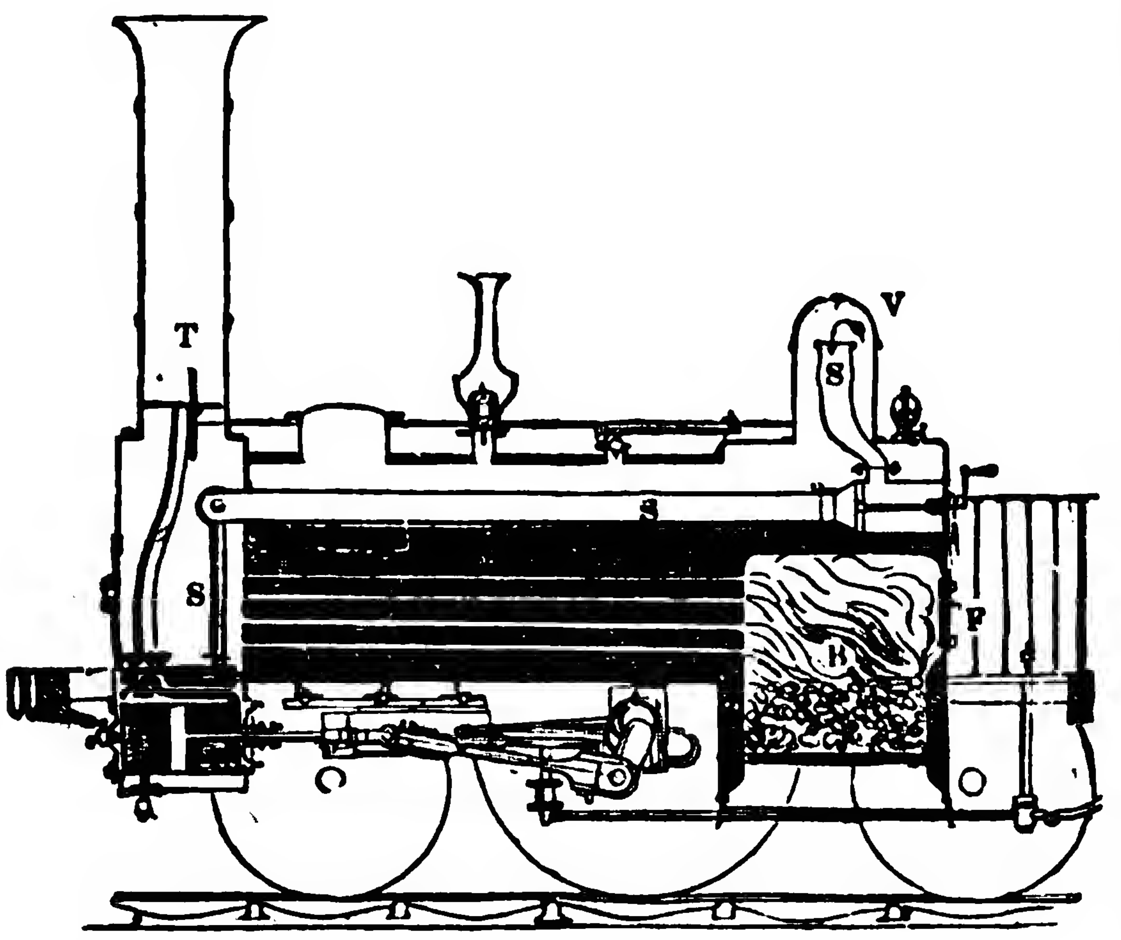
In locomotive-engines, where the use of a mercurial and still more of a water gauge is impracticable, the same end is attained by a thermometer, on the well-known principle that the temperature of steam is always in a constant relation to its pressure. [Steam.]

If there be not water in contact with that part of the boiler exposed externally to the direct action of the flame and hot air in the furnace and flues, the iron will become red-hot, and so suddenly increase the pressure of the steam in contact with it, that an explosion would probably ensue; and if not, the iron in that part would be more oxidized or burnt. To prevent this it is necessary that there should be always water in the boiler above the level of the highest part of the flues; and to enable the engineer to ascertain whether this is the case, there are in all boilers two pipes with cocks, one of which dips down into the water, while the other reaches only to within a few inches of its surface when at the right height in the boiler; the consequence of this arrangement is, that if the cock of the shorter pipe be opened steam will issue from it, and water from the other when that is opened in its turn; but if steam escapes from both cocks, the engineer is warned that there is not sufficient water in the boiler, and therefore directs his attention to remedy the deficiency.

The boiler is always supplied with water by the action of the engine; the hot water, pumped out of the condenser, is raised into a cistern placed at a sufficient height above the boiler, by the force-pump mentioned in the general description of Watt's engine; from this cistern a pipe passes through the top of the boiler, and reaches nearly to the bottom, where it is bent at right angles; the upper orifice in the cistern is closed by a valve connected by a spindle-rod with one end of a simple lever, from the end of the other arm of which a wire is suspended, supporting a stone float in the boiler, the valve being weighted just to counterbalance the specific gravity of the float; as the water subsides in the boiler in consequence of its evaporation, the float falls and raises the valve, allowing sufficient water to descend into the boiler till the float rising again causes the valve to close; the weight of the column of water in the pipe prevents the steam from escaping in that direction during the action of the valves; hence the necessity for the feeding-cistern being raised sufficiently above the boiler. The bend at the bottom of the feeding-pipe is intended to cause the water, when issuing near to the bottom of the boiler, to wash away the sediment which would otherwise collect there.

About five or six years ago, a novel and ingenious plan for generating steam for engines was proposed by Mr. T. Howard: it consisted in injecting small quantities of water at regular intervals on a surface of iron raised to a temperature of about 450°, by being in contact with mercury heated over a furnace. By this arrangement the space occupied by a boiler of the usual construction was saved. A vessel was fitted with one of Mr. Howard's engines, and made a voyage from Falmouth to Lisbon, and apparently with a saving of fuel. Nevertheless this principle has not been brought into use: it was stated at the time that enough of the vapour of the mercury escaped to be prejudicial to the health of the engineers; but we believe the true cause of its want of success was that it was intended to remedy an evil of no great magnitude; or, in short, that the usual principles are not easily to be improved on, if they are properly applied.

The locomotive engine, as has been stated, requires a boiler of a form and principle totally different from those of an ordinary one.




The boiler A is a cylinder made of wrought-iron plates, riveted together in the usual way, but is covered with a wooden casing, to prevent as far as possible the great waste of heat which would radiate from a metal surface moving through the air with such velocity. At one end of the boiler is the furnace B, consisting of a double case, the outer one of iron with a semi-cylindrical head, but quite open at bottom; within this is an inner square case of sheet copper, riveted all round the bottom edge to the outer one, but leaving on its three sides a space of three inches between them, which is filled with water, and indeed forms a continuation of the boiler. The bottom of this inner case is the grating on which the fuel is laid. F is the feeding door in front, opening of course through both cases, which are therefore riveted together, so as to be steam-tight all round. A series of upwards of 100 brass tubes of small diameter pass from the back of the furnace to the further end of the boiler, where they open into the chimney. These tubes, which are entirely immersed in the water, constitute the flue, and thus increase considerably the heated surface in contact with the water, and therefore promote the rapid generation of steam. The introduction of these tubes forms an epoch in the construction of boilers, and was the suggestion of Mr. R. Stephenson in 1829. [RAILWAY.]

The cylinders of the engine, of which one can only be seen in the section, are fixed at the bottom of the chimney. The steam passes to the slide-valve by the pipe S, S, while the waste steam escapes up the funnel at T. The cylindrical vessel with the spherical head V is called the *separator*, the steam-pipe terminating in it at S. The object of this arrangement is to prevent the water, which is agitated by the motion, from passing through the steam-pipe to the cylinder, where it would be highly detrimental; the main steam-pipe divides into two branches in the chimney, one passing to each cylinder.

The boiler is supplied with water from the tender by two force-pumps worked by the engine, and has a gauge, try-pipes, safety-valves, &c., in common with other engines, though all peculiar in their construction.

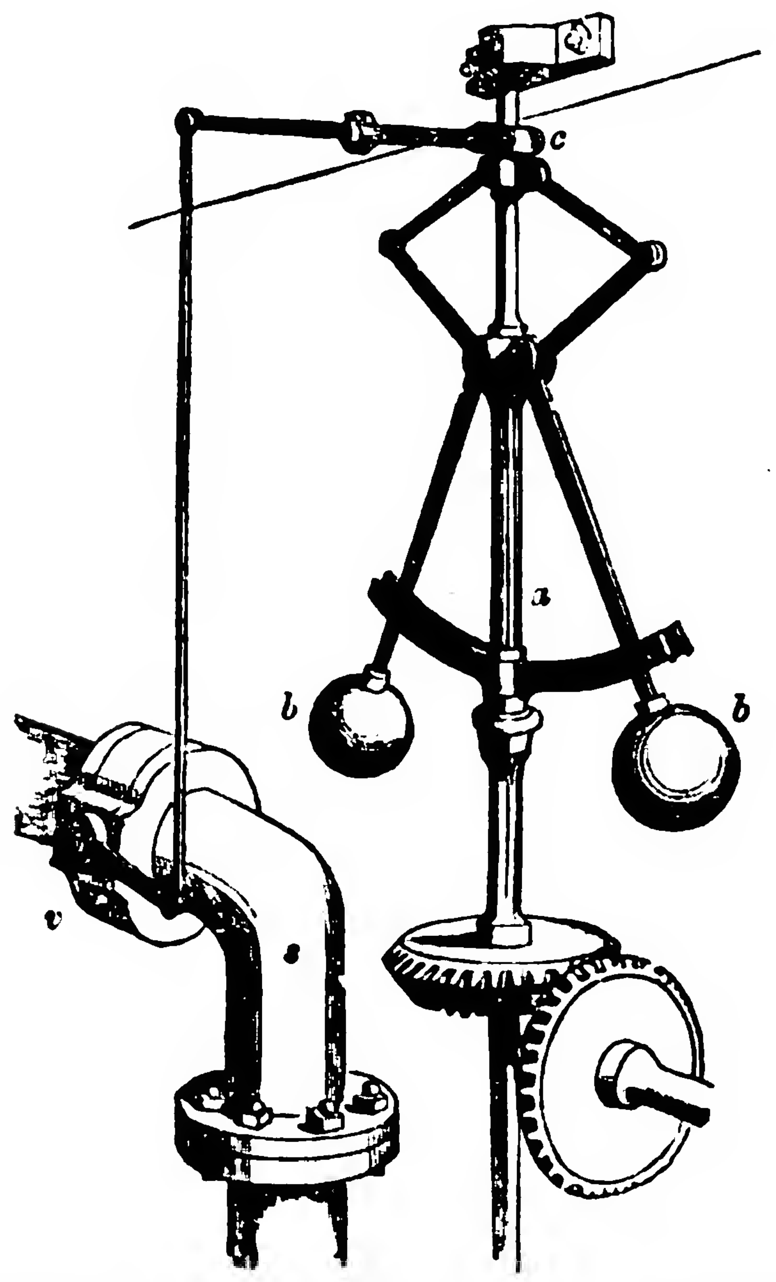
This brief account of the boiler and of its various arrangements will hardly be considered complete without some notice of the explosions to which it is liable; and that these may arise from several causes is sufficiently indicated by the various precautionary adjuncts above described, which are intended to obviate their occurrence. We have already mentioned that the number of accidents is rapidly diminishing relatively to the extended use of steam, as an indication that negligence is the commonest cause of them. It is indeed obvious that, provided a boiler be originally well constructed, of a good form, and furnished with double safety-valves adequate in size and kept in efficient action, with a gauge by which the actual pressure at any time on the boiler may be ascertained by simple inspection, an accident never can occur except by the burning out of the boiler, which will always announce itself previous to any explosion by certain indications. If it be objected that unremitting attention is more than can be expected of an engineer actively engaged, perhaps sixteen hours out of the twenty-four, we can only reply that the moral causes of these accidents are not under consideration, though there are obvious remedies for these; our object is only to remove any apprehensions from the extended use of steam in the minds of the timid, by showing that there are no physical causes of danger that may not easily be provided against. If the proprietors of engines or the commanders of steam-vessels are selfish enough to prefer their immediate interest to the safety of those they employ, or the passengers who have trusted them, by raising steam of 100 lbs. in a boiler only intended to generate steam of 50 lbs., or by employing defective boilers, public opinion can alone provide the remedy by the manifestation of public indignation.

The bursting of boilers present very different phenomena, being sometimes a simple rent in the metal, allowing the harmless escape of steam and water; and at others accompanied by an explosion in its violence equal to that produced by gunpowder;* it has hence been conjectured that on these occasions some explosive gases are formed in the boiler; but this does not appear probable, nor is reconcileable with any known physical laws, while the elastic force of steam is capable of indefinite increase, and is quite adequate to produce any mechanical effect whatever. It is always difficult to get any satisfactory evidence as to the facts of an explosion of a boiler; the terror of the moment prevents the survivors from accurately recalling the phenomena immediately antecedent, while those who from their proximity would be best capable of affording this evidence are either killed or are too interested in exculpating themselves to be impartial witnesses. With regard to the formation of explosive gaseous compounds in the boiler, it is generally admitted that hydrogen gas is the only ingredient of such that can be formed; and that is obtained by the decomposition of the steam when in contact with the red-hot iron; but pure hydrogen is not explosive; and to render it so it must be mixed with oxygen or atmospheric air. It has been suggested that the latter may be introduced along with the water by a defect in the feeding-pump; but the proportions of the air and of the hydrogen must be definite to produce an explosion; and it is difficult to suppose that in such a situation either should continue to accumulate till the quantity is exactly that necessary to produce an explosion. In short this explanation of the subject is beset with difficulties which have not yet been removed, though the attention of scientific men both in Europe and America has been frequently directed to it.

Whenever the steam-engine is employed to execute any work which is variable in its quantity or intensity, there must be some means of adjusting the force of the engine to this varying resistance it has to overcome: if the engine

* When the boilers of the American steam-boat Moselle exploded on April 25, 1837, at Cincinnati, by which accident 150 persons were killed, and abou 100 severely wounded, several portions of the boiler were thrown to distances of from 300 to 400 feet; one of which, weighing 336 lbs., was thrown 480 feet into the garret of a back shop in a yard, having broken through the roof and driven out the gable end; while another portion, weighing 236 lbs., 'went obliquely up the river eight hundred feet, and passing over the houses landed on the side walk.' The height to which some of these pieces were carried may be inferred from the great angles at which they descended, of from 45° to 60°.

were suddenly relieved of half that resistance, as, for example, would be the case if half the machinery it was driving were suddenly stopped or thrown out of gear, the engine, if impelled by the same quantity of steam, would immediately move with a rapidly accelerating velocity, till that velocity were doubled, which would be prejudicial to the engine itself and to the rest of the machinery it was working, as well as be a useless expenditure of force or fuel. The object of that beautiful piece of mechanism termed the *governor*, is to enable the engine to regulate the supply of steam admitted to the cylinder, or in other words to adapt the force it has to transmit to the resistance it has to overcome.




The governor, the form and principle of which will be better understood from the figure than from any description, is made to revolve on its vertical axis *a*, by a band passing round a pulley and round one on the axle of the fly-wheel, or else by bevilled wheels, as shown in the figure; so that its velocity of rotation varies with that of the fly-wheel. If this velocity increase, the heavy balls *b b* diverge by the increased centrifugal force, and cause the collar *c* to slide up the axis; this by means of the intermediate cranks partially closes the valve at *v*, in the steam-pipe *s*, termed the *throttle-valve*, and consequently diminishes the quantity of steam passing to the cylinder: if, on the contrary, the velocity of the fly-wheel is diminished by an increase in the resistance; the balls of the governor collapse, and the throttle-valve is opened so as to admit more steam to the cylinder to augment the force in proportion to the increased resistance.

The effect on the governor is equivalent to varying the diameter of a second fly-wheel, the circumference of which is represented by the balls *b b*, consequently the governor itself, independently of its action on the throttle-valve, has a tendency to effect the adjustment required; since a portion of the surplus force of the engine, on the first supposition, is absorbed in overcoming the increased inertia of the governor; while, on the second supposition, that inertia, being diminished, relieves the engine of a portion of resistance. This accounts for the prompt action of the governor in effecting the adjustment, which it does without those fluctuations in the velocity of the piston which would be prejudicial to the effect of the machinery actuated by this prime-mover.

In the marine engine no governor is requisite; the resistance being so great compared to the force, that the velocity can never be excessive, and all the power the engine is capable of exerting is required to turn the paddle-wheels; added to which the resistance is nearly uniform, only varying with the draught of the vessel or the state of the weather, but never diminishing below that originally calculated on and provided for by the power of the engines; an increase of the resistance accordingly produces a diminution in the velocity of the vessel, but the engine can never work so fast as to be injured by its own velocity.

The governor is equally unnecessary to the locomotive engine, since the attendant must constantly have the engine under his control, and be watching its action; he can therefore regulate the throttle-valve by hand-gear placed within his reach; and in this case also, as with the marine engine, the resistance is nearly constant, consisting chiefly in the weight of the engine and the train of carriages to be moved, a weight not liable to any sudden change during the transit, while the momentum of the whole mass acts as a fly-wheel or regulator to equalise the motion of the pistons.

We have not entered into any investigations of the formulæ for determining the dimensions of an engine and of its boiler, the pressure at which it must be worked, the velocity of the piston, &c., in order to produce any proposed available or net force; or into the account of the experiments by which the amount of friction, the effects of the uncondensed steam, the quantity of caloric obtained from different kinds of fuel, &c., all of which must be taken into account in these investigations, and have been approximatively determined. In the preceding article the formulæ expressing the physical and mechanical properties of steam will be found, and for the others the following works among others may be consulted:—Tredgold, T., *On the Steam-Engine*, recent edition, by Woolhouse, 2 vols. 4to., London; Farey, J., *On the Steam-Engine*, 4to., London; Stewart's *History of the Steam-Engine*, 8vo., London; Lardner, Dr., *The Steam-Engine*, 8vo., London, 1840; De Pambour, F. M. E., Chev., *Théorie de la Machine à Vapour*, 8vo., Paris; Galloway, *On the Steam-Engine*; *Reports in Parliament on Railways, Explosions of Boilers, &c.*; *Mechanic's Magazine.*

The most valuable sources of information on the action of steam-engines, their consumption of fuel, and effect produced, are the Reports and Tables published from time to time by the Cornish engineers of the working of the engines in their various mines.

STEAM-CARRIAGE. The application of the steam-engine to the purpose of locomotion upon railways having been noticed elsewhere [RAILWAY, vol. xix., pp. 247, 259], it only remains to treat of such locomotive machines, impelled by steam-power, as have been contrived for use upon common roads.

It may perhaps appear, at first sight, that there can be no very material difference between machines adapted to purposes so nearly similar; yet there are several circumstances which render very different arrangements necessary in the two cases. The railway engine runs upon very hard and smooth surfaces, and has only slight and very gradual changes of level to surmount. Its precise track is determined by flanges upon its wheels, and that track never deviates suddenly from a straight line; so that no internal steering apparatus is necessary. The road upon which it travels is capable of bearing almost unlimited weight, and affords facilities for the disposal of the load to be conveyed in a long train of carriages; so that the construction of the engine itself is not necessarily affected by any arrangements for the accommodation of passengers or for the stowing of luggage. Hence the railway locomotive is usually nothing but a steam-engine upon wheels, without even any provision for carrying its own supply of fuel and water: this being conveyed in an accompanying carriage, or *tender*, behind which the vehicles containing the load are linked together; and the whole of the propelling machinery frequently weighs from ten to twenty tons, independent of the load conveyed—a weight unsuitable for rapid motion upon an ordinary road. In a steam-carriage for use upon a common road, on the contrary, provision must be made for passing over rough, soft, and constantly varying surfaces, and for surmounting acclivities of considerable steepness. The machine must be provided with a steering apparatus, by which it may be guided with ease and certainty along the sinuosities of a common road or street, among other vehicles, and round sharp corners. The weight must be kept within the smallest possible limits, as well for the sake of the road as to preserve an economical proportion with the load to be conveyed, which must never exceed what may be carried either upon the machine itself or upon one supplementary vehicle; the use of a long train of carriages being inadmissable. Hence also arises the necessity of so arranging the machinery as to occupy but little space, and to interfere as little as possible with the accommodation of passengers and goods.

These circumstances call for the exercise of much contrivance, and the combination of qualities apparently contradictory and irreconcilable. In order to keep the machinery small, and to ensure its rapid action, the steam must be worked at a very high pressure, and must be formed with great rapidity, thereby rendering a very strong boiler and powerful furnace necessary. But this strength and efficiency cannot be obtained by increasing the thickness of the metal, and the size of the boiler and furnace, because that would add to the weight and bulk. The object must be accomplished by a minute subdivision of the water, so that a very large extent of surface may be exposed to the action of the fire, and by urging the fire with a very strong blast, which, however contrived, absorbs a considerable part of the power of the engine. The construction of the boiler must also be *safe*, so that in the event of any part giving way—a contingency which it is impossible entirely to avoid—the explosion may take place *internally*, and may not endanger the passengers by causing the dispersion of water and steam. When these, the principal difficulties, are overcome, much ingenuity is called for in the arrangement of the engine, and in the means of communicating the power to the wheels. In order to accomplish the latter point effectively, an intimate, and, in one direction at least, a *rigid* connection must be formed with the axle; while it is essential to the durability of the machine that the whole apparatus shall be suspended upon springs, and thus protected from the concussions to which the wheels and axles are continually subject. The machinery should be so contrived as to act with varying power and velocity, to meet the frequent changes in the amount of resistance arising from the varying and imperfect surface of the road, or from its different degrees of steepness or inclination; and it should be perfectly manageable, so that the conductor can vary the speed, or stop suddenly, even when descending a hill. In addition to these requisites, the apparatus must be simple and easy of access, so as to be of moderate cost and easily kept in repair; its appearance should be such as to disarm prejudice; and it must neither emit smoke nor occasion any offensive noise or smell. It is not pretended that all these conditions have been perfectly attained by any steam-carriage projector; but sufficient has been accomplished to afford good reason for the belief that none of them are impracticable. The difficulties which have hitherto prevented the profitable introduction of steam locomotion on turnpike-roads are not chiefly of a mechanical kind, but arise in a great measure from unfavourable circumstances affecting the individuals by whom it has been attempted, and probably in part from the very injudicious manner in which its adoption has been advocated—the most absurdly exaggerated statements having been often made as to the profits to be derived from it, and the advantages to be realised by the substitution of mechanical, or, to use Gordon's favourite term, *elemental* for animal power in general travelling. The extensive adoption of railways, which afford facilities for more rapid conveyance than can ever be profitably or safely effected upon turnpike-roads, has also greatly tended to retard the use of steam-carriages on common roads; but this cause will probably operate less unfavourably than it has hitherto done, since experience has proved that the splendid results of modern railway travelling can only be attained at a cost which will long prevent the extension of such roads into districts of small traffic. Common-road steam-carriages have been, by many of their advocates, treated as *rivals* to railway conveyance, and have suffered by comparison with it; but there is good reason to believe, that when they come to be regarded as auxiliaries or feeders to the great lines of railway, which may be supported by, and aid in the development of, traffic too limited to require the more perfect means of conveyance, they will be much more favourably regarded by the public.

Hitherto, as far as locomotion is concerned, the substitution of steam for animal power has only been effected to any considerable extent upon railroads; and, wherever a large traffic is to be conducted, there can be no question as to their superiority over every other means of rapid conveyance. There are however many districts in which the amount of traffic is insufficient to justify the expenditure of from twenty to forty thousand pounds per mile for the sake of a saving, however great, in the labour of draught; and if, for the sake of accommodating such districts, railways were to be laid down with steeper inclinations than usual, much of their advantage would be lost. Paradoxical as it may appear, steep inclinations are of less consequence upon less perfect road; it being less difficult to construct a common-road steam-carriage with power to ascend ordinary hills, than to adapt a railway locomotive to similar changes of level. This point is explained in the following manner by Mr. Gurney, in his 'Observations on Steam-Carriages on Turnpike-Roads.' It should be premised that while the relative amounts of resistance upon a railway and a common road, as here given, are hypothetical, and are probably erroneous (a much smaller proportion of power being sufficient to move a load upon a tolerably good turnpike-road), the *principle* upon which the calculation is made may be applied to any other ascertained degrees of resistance. Gurney submits that—

'1st. The amount of extra power necessary to draw a certain weight up a hill is given by the inclination, and is the same whether it be on a railroad or common road, whether it be carried on a horse's back, or dragged on wheels or on a sledge. This increment is occasioned by *gravitation* alone.

'2nd. The force of traction necessary to propel a ton weight upon a level railroad is about 8 lbs., that is, $\frac{1}{280}$th, or, to be within limits in practice, say $\frac{1}{240}$th part of the whole weight. The average force required to draw a ton weight on a common road is $\frac{1}{12}$th of the whole weight. The former is therefore to the latter as 1 to 20.

'3rd. To go up a hill rising one foot in twelve, viz. three inches in a yard (which is about the steepest now on our public roads), an additional force of traction is required, equal, in all cases, to $\frac{1}{12}$th of the weight, to overcome the increased opposition arising from gravitation. Thus then, to go up a common road of the above elevation, the power of traction is simply *doubled*, and no more, while on a railway it is increased to $\frac{1}{12}+\frac{1}{240}=\frac{21}{240}$, or *twenty-one times greater* than it was on the level.'

'It is evident from this,' he further observes, 'that if a steam-carriage have only double the power wanted on a level common road, it can ascend any hill that we have. If it have treble, it can ascend this hill, and has one-third to spare, and so on. But to ascend the same elevation on a railway, the engine must exert a power no less than twenty-one times that which it required on a level; and, to have one-third to spare, as the other, for contingencies, it had need to have upwards of thirty times the force that is necessary for propelling it over the level; the very weight needful for this (to say nothing about a load) renders it practically impossible.'

The earliest steam-carriage of the construction of which the writer has met with any account, was that of John Theophilus Cugnot, a native of Lorraine, who, about the year 1763, exhibited a model of one to the Comte de Saxe. He subsequently removed to Paris, and obtained the patronage of the Duc de Choiseul. Here he constructed, in 1769, at the public expense, a large steam-carriage, which was tried in 1770, and moved with such force as to overturn a portion of wall which was opposed to its progress; a circumstance which led to the supposition that the new power was not sufficiently controllable for practical purposes. Stuart, from whose 'Historical and Descriptive Anecdotes of Steam-Engines,' this account is derived, states that the project was abandoned, and that the experimental machine was deposited in the museum of the Arsenal, and is now in the *Conservatoire des Arts et Metiers*. Some years before these experiments were made, the late Dr. Robison, while a student in the university of Glasgow, had conceived the possibility of propelling wheel-carriages by the agency of steam, and had suggested the idea to his friend Watt, who commenced a model of a contrivance for the purpose. The scheme was abandoned, partly on account of the difficulties which presented themselves, and partly because both Robison and Watt had other avocations requiring their attention. The year 1759 is often stated as the date of this suggestion; but it appears to have been made rather earlier, as Robison left college about the end of 1758, and went to sea. Subsequently, in his patent of 1784, Watt described a plan for a steam-carriage, which however he never carried into effect. He proposed that the boiler should consist of wooden staves hooped together with iron like a cask, and having the iron furnace within it, surrounded with water. The reciprocating action of the piston was to be converted into a rotatory motion by the contrivance known as the sun-and-planet wheel; and the rotation was to be communicated to the turning wheels by toothed gear, with a provision for varying the relative velocities of the piston and the wheels, according to the varying resistance of the road. To get rid of the cumbersome condensing apparatus, it was proposed to allow the steam to escape into the air after propelling the piston. It is well known that Watt entertained a prejudice against the use of high-pressure steam, and that circumstance may partially account for his not having prosecuted this design. Mr. Murdoch, a Cornish engineer, to whom Trevithick is said to have been a pupil, and who subsequently became connected with Boulton and Watt, was perhaps the first who actually constructed a steam-carriage in this country. His machine, which is by some writers styled a *model*, was exhibited at Redruth about 1782 or 1792. These different dates are given by different authorities, and we have no means of ascertaining which is the most correct statement. Mr. William Symington, who was also connected with some of the earliest experiments on steam navigation, constructed a model of a steam-carriage, which was exhibited in Edinburgh about 1786. A representation of this machine, communicated by the son of its inventor, was published in No. 480 of the 'Mechanics' Magazine.' In this the whole of the machinery is placed at the back of the carriage, and the rectilinear motion of the piston-rod is communicated to the axle by a rack and pinion; a ratchet being used to prevent the wheels from turning backwards with the return of the piston. The bad state of the roads, and the difficulty which would have been experienced, at that time, in procuring supplies of water and fuel, are mentioned as the principal causes of the abandonment of the experiment by Symington. In North America the use of steam-carriages was early advocated by the ingenious Oliver Evans, who applied, in 1786, to the legislature of Pennsylvania for an exclusive right to the use of steam-waggons, and certain other inventions, in that state. His ideas respecting steam-locomotion appeared so strange that he was considered insane; and though in the following year his petition was granted as far as regarded his improvements in flour-mills, no notice was taken of the steam-waggons. A similar application in Maryland was more favourably received; the required privilege being granted for a term of fourteen years, on the ground that it could injure no one, and might lead to the production of something useful. Evans however could not obtain such encouragement and assistance as would enable him to build a steam-carriage; and therefore he turned his attention more to the application of his improvements in the steam-engine to mill-machinery. In a curious autobiographical notice of his inventions, which has been published in No. 372 of the 'Mechanics' Magazine,' and in several other English works, Evans states that, in 1804, he demonstrated the practicability of his steam carriage project by applying temporary wheels to a machine which he constructed for the purpose of cleansing docks, and connecting these with the steam-engine which was intended to work the apparatus for raising mud into lighters. With this cumbersome and necessarily imperfect steam-carriage, he succeeded in obtaining a satisfactory though slow motion. Stuart's account of Evans's scheme (*Anecdotes of Steam-Engines*, p. 391) intimates that he sent drawings and descriptions of his machinery to England. The views of this projector were far in advance of his age, for he expressed his belief that the time would come when carriages propelled by steam would be in general use, as well for the transport of passengers as goods, travelling at the rate of fifteen miles an hour, or three hundred miles a day, upon good turnpike-roads.

The next invention which claims notice is that patented in 1802 by Messrs. Trevithick and Vivian, and shortly afterwards brought into operation with greater success than had attended any earlier experiment Disregarding the prejudices which had previously deterred English engineers from the use of high-pressure steam, these gentlemen contrived a steam-engine far superior to any previously known in lightness and portability. The propulsion of wheel-carriages was one of the objects proposed by the patentees. Their carriage, as described in their specification, was to be mounted upon four wheels; the principal weight resting upon the hind wheels, which were of large diameter, while the fore wheels, which were used for guiding the carriage were small, and nearer together than the others. The boiler and the steam-cylinder were placed at the back of the hind axle; the cylinder being horizontal. The piston-rod imparted motion to a sliding cross-piece, the ends of which moved in horizontal guides, and from which a connecting rod, returning towards the piston, communicated the power to a cranked axle. By the ingenious device of dividing the piston-rod into a forked form, to allow the connecting rod and crank to play through it, the apparatus was rendered very compact. On each end of the crank-axle was a toothed-wheel, working into another fixed upon the nave of the hind wheel of the carriage; and on one end of this axle was fixed a fly-wheel, to obviate any inconvenience arising from the use of a single cylinder. The toothed-wheels on the crank-axle were not fixed immoveably to it, but were so arranged that, by means of a lever under the command of the steersman, either or both of them might be disconnected from it, so as to allow the wheels to stand still, or to roll backwards, without stopping or reversing the engine. Thus the greatest facility was afforded for turning the carriage, since one wheel might be propelled by the engine while the other remained stationary. A provision was also made to allow the wheels to alter their relative velocities sufficiently to meet the ordinary sinuosities of the road, without throwing either side of the propelling apparatus out of gear. It was proposed to alter the velocity and power of the carriage when necessary, by the use of cogged-wheels of various sizes. This mode of communicating motion to the wheels is convenient, as it allows them to revolve freely upon the axle, the ends of which may be bent, as in common carriages, if preferred A lever, or brake, pressing against the periphery of the fly-wheel, was used for retarding the motion of the machinery, when running down-hill or stopping suddenly; and a lever-handle connected with the fore-wheels afforded the means of directing the vehicle. The details of this invention evince much ingenuity, and fully entitle its contrivers to the credit of having produced the first really efficient locomotive carriage of which any minute description is known. Engravings of the apparatus, with a full explanation from the specification of the patent, may be found in Hebert's 'Engineer's and Mechanic's Encyclopædia,' vol. ii., pp. 387-8. Shortly after the date of this patent, a carriage was constructed, which was exhibited in London with sufficient success to prove the practicability of the invention; although, owing to the generally defective state of the roads at that time, its inventors soon gave up their experiments on common-road locomotion, and adapted their machinery to use upon a railway. [RAILWAY, vol. xix., p. 248.] It is a remarkable coincidence that one of the principal places in which Trevithick's steam-carriage was exhibited in London nearly forty years since, should have been near the site of the great railway station at Euston Square.

For about twenty years after the experiments of Trevithick, the only locomotive steam-engines of any note were those constructed for use upon railroads. [RAILWAY.] When the improved state of the common turnpike-roads rendered steam-locomotion more practicable upon them, steam-carriage projectors arose in rapid succession. One of the first of these was Julius Griffith, who obtained a patent in 1821 for the mechanism of a steam-carriage, some parts of which were communicated to him by a foreigner residing abroad. He had a carriage built by Messrs. Bramah, with two steam-cylinders and pistons, impelling the hind-wheels by the intervention of small cogged wheels, so arranged as to be always in gear, notwithstanding the jolting and vibration of the carriage. To preserve the boiler and machinery from injury, they were suspended from the frame-work by chains and helical springs. Imperfect as this device for the elastic suspension of the machinery appears to have been, it deserves to be mentioned as one of the earliest attempts to overcome what has always proved a very serious difficulty. Trevithick's locomotive was, we believe, without springs, as far as the machinery was concerned. Griffith's boiler was tubular, and will be noticed hereafter. Its action proved defective; and, probably on this account, the experiments were given up.

Several of the inventions which follow next in chronological order were based upon the erroneous assumption that a carriage could not be propelled with certainty, especially in ascending a hill, by the action of any internal mechanism merely turning the wheels—an assumption which also led to contrivances in railway engines, noticed elsewhere. A singular plan for obviating this difficulty, and rendering the irregular surface of the road of little consequence, was patented in 1822 by David Gordon. He proposed to use a small locomotive engine, resembling those employed by Trevithick upon a railway, but having its wheels surrounded by cogs or projecting teeth. This engine was to be placed within a large rolling drum, about nine feet in diameter and five feet wide, the inside of which should be fitted with circular rack-rails, fitting the wheels of the steam-engine. Thus the motion of the engine would cause the drum to roll forward, on the same principle that the endless race of the squirrel in a cylindrical cage occasions it to revolve; and the rolling of the drum was to move a carriage connected with it. It does not appear that this invention has ever been applied in the form described; but heavy goods have been conveyed across a swamp in America by a similar apparatus, the goods being placed within a drum formed of sheets of iron. In 1824 the same gentleman patented a highly ingenious machine of very different character, to overcome the supposed difficulty. It was to be propelled by means of six legs, disposed under the body of the carriage, the weight of which was supported upon wheels. The propellers, or legs, were set in motion by six long cranks, which were turned by means of two steam-engines vibrating on gudgeons, so as to avoid the necessity of using connecting-rods; the ends of the piston-rods being connected immediately with two small cranks upon the same axle as those by which the propellers were moved. Experience has proved that all such contrivances are quite unnecessary in ordinary cases; but this does not detract from the merit of Gordon's contrivance, in which the most admirable provisions are made for adapting the propellers to the undulating surface of the road, and rendering their action at once effective and harmless. The details of the propelling machinery are represented in Alexander Gordon's 'Treatise upon Elemental Locomotion.' There have been several more recent schemes for the same purpose, but they do not require further notice.

Among the numerous competitors for public favour in this department of enterprise, Mr. Goldsworthy Gurney, formerly lecturer on chemistry at the Surrey Institution, stood for some years the most prominent. The time at which he commenced his experiments was much in his favour, curiosity being then highly excited; and the circumstance of his having obtained much more pecuniary support than any other steam-carriage projector, doubtless tended in a great degree to the reputation which he obtained. Of others who have invented and built steam-carriages between 1824 and the present time, the names of Burstall and Hill, of Leith, W. H. James, of Birmingham, Walter Hancock, Summers and Ogle, Messrs. Heaton, of Birmingham, Dr. Church, of the same place, Dance and Field, Squire and Macerone, Scott Russell, of Greenock, Hills, of Deptford, and Sir James Anderson, are the most prominent, although many others have appeared upon the field. Several of these inventors have produced carriages capable of maintaining an average speed of from ten to twelve miles per hour for considerable distances, and a much more rapid rate of motion for a short time; and some have succeeded in performing extensive journeys with their steam-carriages. Experimental journeys, especially when of considerable length, are attended by many inconveniences, arising from the want of means for supplying fuel and water at the stopping stations, and several other circumstances which would not interfere with their success if steam-carriages were regularly established; but, notwithstanding all these difficulties, the experiments have fully proved the possibility of constructing steam-carriages of sufficient power to ascend all ordinary hills, and to surmount any difficulty likely to be met with upon a tolerably good turnpike-road.

A complete history of steam-carriages from 1825 to the present time would require very considerable space. Gurney, after experimenting for several years, at great expense, and with the assistance of several ingenious artisans, and having repeatedly altered the arrangement of his boiler and machinery, succeeded in so far proving the practicability of his scheme, that Sir Charles Dance was induced to put his carriages to the test by establishing a regular steam-conveyance between Gloucester and Cheltenham, a distance of about nine miles. The steam-carriage commenced plying on the 21st of February, 1831, and continued running four times a day for four months, with tolerable regularity; the time of each trip averaging about fifty-five minutes. At the end of this time part of the road was covered with loose stones to such a depth as to render it almost impassable, even to horse-coaches; this was done, according to Sir Charles Dance, at the instigation of parties who were interested in opposing the new conveyance. The steam-carriage passed through the stones twice, with some difficulty, but the hind axle, which was cranked to receive the impulse of the pistons, and appears to have been strained by the unusual exertion of power, broke on the third journey, before arriving at the place where the stones were laid. The proprietor of the carriage, in a letter to Mr. Gurney, stated that the stones were laid eighteen inches deep, and that the road did not need any repair, but was in excellent order before they were put on. He further stated that he had intended to have the injury repaired, and the wheels strengthened, and so to have gone on in spite of this opposition; but that, in the course of the following week, he was informed that several turnpike acts had just been passed, and that others were in progress, which imposed prohibitory tolls upon carriages propelled by mechanical power; an act for the Cheltenham Trust being one of the number. He therefore relinquished the experiment, feeling any further contest to be useless, until the unreasonable tolls should be discontinued. 'In some cases,' Gurney states, 'the tolls imposed amounted to 2*l.* at every gate, at others to 2*l.* 8*s.*, and in some to 3*l.* 8*s.*' To meet this new difficulty, Gurney immediately petitioned parliament, and thus led to the appointment of a select committee of the House of Commons to inquire into and report upon the tolls which ought to be imposed upon coaches and other vehicles propelled by steam or gas upon turnpike-roads; the rate of toll actually levied under any acts of parliament then in force; 'to inquire generally into the (then) present state and future prospects of land-carriage by means of wheeled vehicles propelled by steam or gas upon common roads; and to report upon the probable utility which the public may derive therefrom.' The report of this committee, made in October, 1831, was very favourable. They represented steam-carriages as deserving of legislative protection, and reported that they considered the practicability of substituting inanimate for animal power in draught on common roads to have been fully established. The report adverts to the prospective advantages claimed for steam locomotion in economy and safety; observing that while the cheapness of the conveyance would probably be for some time a secondary consideration, a saving of expense, as well as an increase of speed, as compared with horse-conveyance, might be ultimately expected. The evidence adduced was such as to disprove the supposition that steam-carriages would necessarily frighten horses, or cause annoyance either from noise or from the emission of smoke or steam. With regard to the toll question, it did not appear that there was any sufficient reason for the heavy imposts complained of, either on the ground that steam-carriages would carry many more passengers than other vehicles, or that they would prove injurious to the roads. The weight of the steam-carriages then in use is stated to vary from fifty-three to eighty cwt.; but some have been since used of rather greater weight. Still, with cylindrical wheels of suitable width, such carriages would be far less injurious than the pounding of horses' feet, and the grinding of the narrow conical wheels in common use. The committee concluded their Report by observing that sufficient evidence had been adduced to convince them—

'1. That carriages can be propelled by steam on common roads at an average rate of ten miles per hour.

'2. That at this rate they have conveyed upwards of fourteen passengers.

'3. That their weight, including engine, fuel, water, and attendants, may be under three tons.

'4. That they can ascend and descend hills of considerable inclination with facility and safety.

'5. That they are perfectly safe for passengers.

'6. That they are not (or need not be, if properly constructed) nuisances to the public.

'7. That they will become a speedier and cheaper mode of conveyance than carriages drawn by horses.

'8. That as they admit of greater breadth of tire than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses.

'9. That rates of toll have been imposed on steam-carriages which would prohibit their being used on several lines of road, were such charges permitted to remain unaltered.'

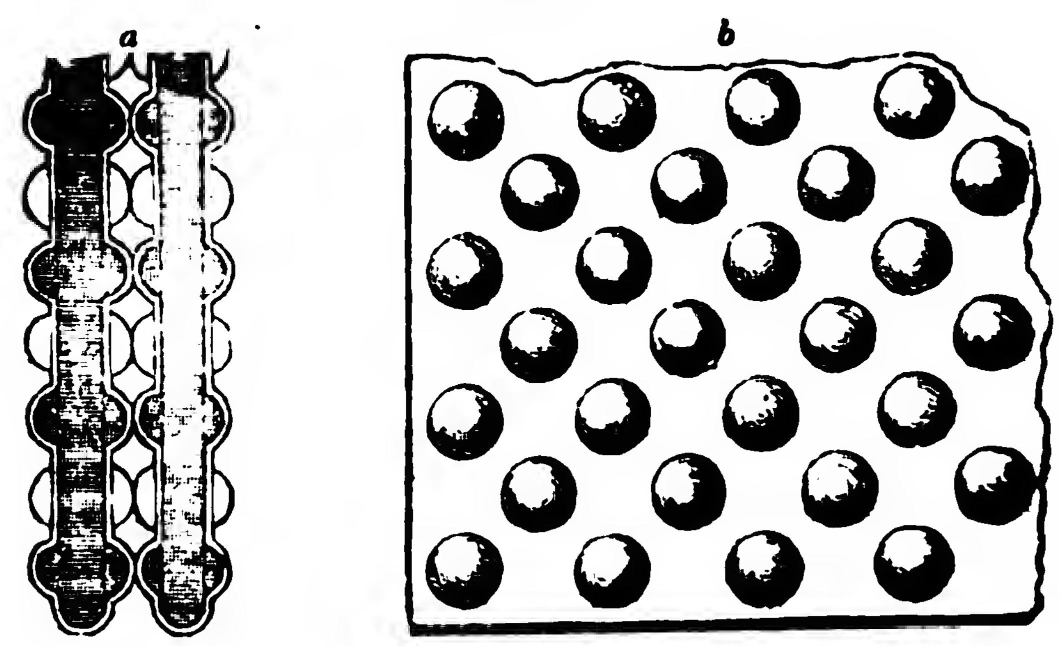
No legislative encouragement arose out of the proceedings of the committee of 1831, nor have the subsequent occasions on which the subject of steam-carriages has been brought before parliament been productive of any measures calculated to promote their general adoption. In 1834 and 1835 the subject was investigated by committees appointed to report upon Gurney's claims to an extension of his patent right, or to a pecuniary compensation for the loss which he was alleged to have sustained through the legislative discouragement of steam-carriages, and it was stated that he had expended more than 36,000*l.* in his experiments, of which about 20,000*l.* was advanced by parties who had hoped to derive profit from working his engines. This inquiry led to the introduction, in 1836, of a bill for relieving steam-carriages from exorbitant tolls; but the bill, after passing through the House of Commons, was thrown out by the Lords. Still, as the prohibitory tolls complained of do not apply to every road, it cannot be supposed that the general introduction of steam-carriages has been materially retarded by them. So soon as the economy as well as the practicability of running steam-carriages on common roads shall be satisfactorily established, it is likely that all minor difficulties will disappear. The advocates of this kind of locomotion will have far more difficulty in removing the suspicion which has been excited by the numerous exaggerated and deceptive statements which have been made on the subject—statements which have in many cases, from their palpable incorrectness, cast ridicule upon a project which, if carried into effect in a judicious manner, might prove highly beneficial. The performances of Gurney's carriages especially have been the subject of such gross misrepresentation, that it is extremely difficult to elicit the truth from the contradictory statements of his partisans and his rivals. The performances on the Cheltenham and Gloucester road, for instance, might be supposed, from the statements of Mr. Gurney and some other writers, to be those of one carriage; in which case they would appear very satisfactory. In Gurney's pamphlet, above referred to, the work is described as that of 'a carriage,' and a tabular 'Account of the Journeys made by *the carriage* between Cheltenham and Gloucester' is given; so that the reader is left to assume that nearly four hundred trips were made by one machine. The case appears very different when we are informed by Colonel Macerone, in his 'Few Facts concerning Elementary Locomotion,' that Sir Charles Dance had *three carriages*, all constructed and painted alike; and 'that it required the utmost exertions of an engineer (Mr. Stone), at a salary of 1*l.* per day, and four men, at 3*l.* per week, to keep one of the three coaches in moving order.' That this account is in the main correct may be presumed from the circumstance that it has never been, as far as the writer is aware, publicly contradicted; and also from the fact that in a letter from Sir Charles Dance to Mr. Gurney, printed at the end of the second edition of his pamphlet, the carriages are spoken of in the plural number.

The performances of Mr. Hancock's steam-carriages appear more satisfactory, all things considered, than any other, though the modesty of the inventor has deterred him from publishing such favourable statements as have appeared in many other cases. This gentleman commenced operations about the same time as Gurney; and, after a series of experiments, which have been detailed in an interesting 'Narrative,' published in 1838, he succeeded, early in 1831, in setting to work a very promising carriage, which he called The Infant.

In February of that year, a few weeks before the starting of the steam-carriage between Gloucester and Cheltenham, Mr. Hancock commenced running The Infant regularly for hire between Stratford and London; not with any expectation of profit, but with the hope of dissipating prejudice. This was, it is stated, the first steam-carriage that ever plied for hire upon a public road; and its inventor succeeded in bringing it into operation single-handed. He has since built more steam-carriages than any other individual; and has repeatedly run one or more as public conveyances about London for several weeks together, with such success as to leave very little reason to doubt the profitable introduction of such vehicles in lieu of the common omnibuses if they were taken up by parties with sufficient capital to try the experiment upon an extended scale. With the exception of the carriages of Mr. Russell, which ran for some time between Glasgow and Paisley, no other steam-propelled vehicles than those above mentioned have, as far as the writer is aware, been actually run for the regular conveyance of passengers; although that of Messrs. Squire and Macerone, and several others, have performed many journeys about the metropolis.

It may appear strange that, in the face of so many tolerably successful experiments, common road locomotion should have made so little *practical* progress, that it may even now be said, in the words of an able paper in the 'Foreign Quarterly Review' for October, 1832, that 'every attempt yet made to render steam-carriages the means of economical and regular inland communication has totally and absolutely failed.' The paper alluded to, which has been attributed to Mr. John Scott Russell, is, in most points, as applicable to this branch of science in its present state, as it was at the date of its publication. The reviewer observes that 'not in the nature of the thing to be done, but in the mode of setting about it, is the cause of failure to be discovered;' and it would perhaps be scarcely going too far to say with him, that it is possible 'to detect in each invention omissions and elements of self-destruction necessarily involving total failure; and these not in mere details, but in the great principles of structure and arrangement.' Many of the defects alluded to arise from the circumstance that steam-carriage builders have usually worked independently of each other; each having to find out, by tedious experience, difficulties which have impeded the success of his predecessors. The effect of the patent laws has also occasioned, in all probability, many imperfections. The man who has invented an excellent boiler may not have the practical knowledge necessary for the construction of an efficient well-proportioned engine; or, if he be able to contrive that, he may not be competent to build a good carriage. The necessary perfection in boilers, in the mechanism of the steam-engine, the convenient disposition of the component parts of the machine, and the construction of a carriage suitable for the conveyance of a heavy load at a rapid speed, are not likely to be attained by any individual; yet it has mostly happened that the contriver of something ingenious in one department has, in order to test his invention, been compelled to apply himself to all the rest. It is needless to suppose, with Gordon, that the imperfect machines thus produced exhibit 'the partial efforts of men who underrate the defects and magnify the merits of their own invention, and are disinclined to adopt any improvement, however good, which did not originate with them selves.' (*Observations on Railway Monopolies*, &c.) It is very true, as the same writer observes, that 'there has been no hearty and combined co-operation in the various endeavours to bring forward this object,' but this circumstance may be more liberally accounted for by the necessity which exists for avoiding any encroachment upon the patent rights of those who have previously turned their attention to the subject. Another circumstance which often presents a serious difficulty is the great expense of experiments; the inventor being sometimes compelled, by the deficiency of his pecuniary resources, to try his inventions at great disadvantage, or to abandon them when on the eve of perfection. Several attempts have been made to meet some of the difficulties alluded to by the formation of societies or companies for the introduction of steam-carriages; but such have, from various causes, hitherto failed. There is indeed at the present time (January, 1842) a 'Steam-Carriage and Waggon Company,' who have recently advertised for proposals for the supply of steam-carriages; but it is doubtful whether the required improvements will be effected until means are provided for combining the results of past experience and the practical knowledge of several individuals to produce a more perfect machine. A careful analysis of the numerous inventions which have been tried or suggested, might facilitate such a measure; and were the subject taken up in a judicious way by a company with ample pecuniary resourses, totally unconnected with any steam-carriage projector, but willing to compensate any inventor for such parts of his apparatus as might be adopted, it is not unreasonable to believe that a steam-carriage, far superior to any hitherto constructed might be the result. Great attention should be paid to the proportions and other characteristics of the machine considered as a *carriage*, in order to make a favourable impression upon the public. Many of the steam-carriages which have hitherto appeared have been so deficient in these qualities as to excite, rather than to allay, that prejudice which it will be difficult to overcome, even when every precaution is attended to. The same qualities which will tend to the comfortable motion and pleasing appearance of the carriage,—its lightness and elasplied to the engines in a pure *dry* state. The boiler and furnace are enclosed in an iron case, from which the gaseous products of combustion escape into the chimney *f*. The use of tubes filled with water instead of solid fire-bars, economises the heat, and tends to prevent the formation of clinkers, because the metal, being in contact with water, cannot become over-heated. The chief defect of Gurney's boiler appears to have been that the water was too minutely divided, the steam being unable to escape freely from the tubes. The steam-chambers, or *separators*, being of comparatively large diameter, were necessarily thick and heavy. The boiler patented by Sir Charles Dance and Mr. Field, in 1833, was a modification of Gurney's. An ingenious boiler was constructed by Mr. James, of Birmingham, consisting of a cylinder formed of a number of annular tubes. The tubes were of small diameter, and each of them was bent into a ring. A number of such tubular rings, packed together side by side, constituted the boiler, in the interior of which the fire was placed. The boiler of Colonel Macerone and Mr. Squire consisted of eighty-one vertical tubes, between which the flames were made to play; the tubes in the inner part of the boiler being shortened at their lower ends to afford room for the fire. Hollow or tubular fire-bars, containing water, were also used to prevent the formation of clinkers. Messrs. Summers and Ogle used vertical tubes or cylinders about four inches diameter, in the centre of each of which was another tube of about one inch diameter. The water occupied the space between the two tubes, and was therefore exposed in thin cylindrical sheets to the action of the fire, which played round the outside of the large tubes and up the inside of the smaller ones, each of which constituted a small flue. The steam-carriages of Mr. Scott Russell, which present several points worthy of notice, had boilers similar in principle to those used in railway engines. Instead however of the requisite strength being obtained by the thickness of the metal, it was provided for by the use of about thirteen hundred connecting rods or wires, about a quarter of an inch in diameter, so fixed as to tie the opposing portions of the boiler together. These also communicate heat very rapidly to the water, for which purpose alone some inventors have proposed to use plates or wires distributed throughout the boiler. Hancock's boiler is simple, efficient, safe, and easily repaired. In its original form it consisted of a series of flat-sided chambers of thin metal, arranged vertically at a small distance from each other, and held apart by vertical fillets. These chambers were enclosed in a strong outer case, in the lower part of which the fire was situated; and the flame and hot air rose up in the spaces between the chambers. The inventor has since improved this boiler by using plates embossed with hemispherical projections for forming the sides of the chambers; the projections being so arranged that the prominent parts of one chamber press against those of the adjoining one, as shown in *Fig.* 2, when the boiler is put together. In the annexed cut *a* represents, in section, parts

*Fig.* 2.




of two chambers of this improved construction; the water being indicated by horizontal lines. The bosses, or projections, are, as shown by the portion of a plate represented at *b*, placed in alternate rows, by which arrangement the flames are compelled to take a tortuous course in passing between the chambers, and to impinge repeatedly upon their sides. By this admirable contrivance the chambers are held sufficiently apart without the useless weight of the fillets formerly inserted for that purpose. Mr. Hancock has used other forms of projection on the sides of his chambers, and has tried them of a corrugated or grooved form; the projections, as in the former case, resting against each other, and the grooves or hollows forming passages for flame.

A boiler with chambers of the latter kind was also used in Redmund's steam-carriage. In a chamber-boiler on Hancock's plan the steam can escape from the water more readily than it can when confined in small tubes; yet the subdivision of the water is sufficiently perfect for safety. The chambers, being held tightly together by bolts passing through the whole boiler, support each other; but as they are much thinner than the outer case of the boiler, no harm is likely to arise if one of them should burst. Such a boiler has burst while the carriage was running, without either the engineer or the passengers being conscious of the occurrence, which was only discovered by the gradual stoppage of the machine. Mr. Hancock has also contrived a very useful apparatus by which the grate, or floor of bars upon which the fuel rests, may, when foul with clinkers, be easily removed, and a clean grate slid into its place. By this means the inconvenience of clearing the grate with a rake is avoided. The foul grate is laid aside to cool; and as it shrinks in cooling, the clinkers become detached. Sir James Anderson's steam-carriage boiler consists of a number of vertical chambers, differently arranged from Hancock's, and strengthened with iron framing to prevent bursting. The flames are made to take a serpentine course up and down between the chambers. Boilers have been tried consisting of several concentric cylinders, concentric cones, &c., the water being disposed in thin sheets or layers; and many other schemes, which it is needless to particularise, have been suggested.

The means adopted for producing a strong draft in the fire are of two kinds. The method commonly adopted in railway-engines, of throwing the waste steam into the chimney to produce a blast, would be inadmissible upon a common road, because of its noise. Gurney, in one of his carriages, turned the waste steam into a chest or case, acting like the air-chamber of a fire-engine, from which it issued into the chimney in a uniform stream; thereby avoiding the panting noise produced by the separate puffs of steam. The plan has the disadvantage of impeding the exit of the steam, after it has propelled the piston, and therefore diminishing the available power of the engine. The other kind of blast—that produced by blowing air into the fire with fanners—was also used by Gurney in some of his earlier carriages; and a similar apparatus has been adopted by Hancock, Macerone, and several others. Hancock destroys his waste steam by throwing it into the fire. The fan-blast, by requiring part of the power of the engine to work the fanners or blowers, diminishes its useful effect, though in a different way to the steam-blast.

Many different arrangements have been adopted for communicating the power of the pistons to the wheels of the carriage. One of the simplest methods, used by Gurney, Macerone, and some others, is to place the cylinders horizontally under the body, and to communicate the impulses of the pistons, by connecting-rods, to cranks upon the axle of the hind wheels. This plan, which resembles the common arrangement in railway engines, is attended by the disadvantage that the engines cannot be mounted fairly upon springs. The fore part of the frame-work, to which the engines are secured, may be so supported; but the hind part must either be without springs, or must have their action exceedingly limited. Hence the cranks and those parts of the machinery immediately connected with the axle are exposed to very injurious concussions. The axle itself also, having to bear the weight of the carriage as well as the impulses of the pistons, is very liable to be strained and broken. Hancock has a very effectual contrivance for avoiding these defects. He employs two vertical cylinders, working a crank-axle which is steadily mounted in the body of the carriage, so that the whole is suspended upon springs. The hind axle of the carriage is straight, and receives motion from the crank-axle by means of endless chains, working over grooved pulleys or sheaves, so formed that the chains cannot slip; and the chains are always kept at the proper state of tension by means of *radius-bars*, which extend from one axle to the other, and keep them constantly at the same distance apart, notwithstanding the vertical play of the springs. This beautiful arrangement has been imitated by some other steam-carriage builders. Another mode of communicating the motion of a separate crank-axle to that upon which the running wheels are fixed is by toothed wheels, as in Trevithick's steam-carriage. In Russell's steam-carriages this method was adopted; a peculiarly formed spring, with other contrivances, being used to prevent the distance between the axles from varying. The singular project patented in 1825 by J. and S. Seaward, for avoiding the difficulty attending the use of springs, closely resembles, in principle, the arrangement of Hancock. In this plan a propelling wheel or roller at one end of the carriage, attached to it by a swinging frame pivoted to the body, which acts like the radius-bars of Hancock, is turned by means of an endless chain which passes round a crank-axle in the body of the carriage, which was to be mounted upon springs. The want of sufficient weight upon the propelling-roller would probably have rendered the plan, in this form, useless; but it is referred to as giving an early intimation of what, in an improved form, appears to be the best mode yet adopted of communicating power to the wheels of a steam-carriage. Mr. James and Dr. Church each proposed the use of a separate axle to each hind wheel; the plan of the former being to apply two cylinders, of very small diameter, and worked with steam of unusually high pressure, to the axle of each wheel; so that each wheel might move with any required velocity, independent of the other, to facilitate the turning of the carriage. Mr. James further proposed that the oblique position assumed by the fore axle when the carriage moves in a curved direction should so influence an apparatus connected with the valves through which steam is supplied to the engines, as to regulate its access to the cylinders on each side of the carriage, according to the respective velocities with which the wheels were required to revolve. Trunnion engines, which are applied to the cranks without the intervention of jointed connecting-rods, have been used by several steam-carriage projectors; and some have suggested the use of three or even four cylinders and pistons, acting upon as many cranks on one axle. Mr. Russell, on the contrary, in the 'Foreign Quarterly Review,' recommended the use of one cylinder, because of the difficulty of making two act perfectly together. In his steam-carriages he has used two; but the difficulty is avoided by making them work separate shafts.

The contrivances for locking the wheels to the axle need not differ materially from those used for similar purposes in other machinery. It has been found sufficient, in ordinary cases, to have one wheel so connected with the axle, the other being left free to revolve with varying velocity according to the sinuosities of the road; but in ascending a steep hill, or passing over soft and uneven ground, the adhesion of both of the hind wheels is required. The clutching or locking apparatus should therefore be capable of easy application. In one of the steam-carriages invented by Messrs. Burstall and Hill, of Leith, a provision was made for communicating the power of the engines to the fore as well as the hind wheels, by means of mitre wheels and shafts, a universal joint being inserted in the apparatus to allow the fore wheels to lock in turning, and the wheels being so connected with the axle that they might vary their velocities to the extent necessary for ordinary curves without any of them being thrown out of gear.

In the means of adapting the power of the vehicle to the varying resistance of an undulating road, most steam-carriages hitherto built have been very deficient. This object may be effected to some extent by varying the pressure of the steam; but, if carried too far, this method is dangerous. The use of wheels of different sizes,—small wheels for a slow speed with great power, and large wheels for quick running, when the roads are in a good state,—is an expedient too inconvenient for general adoption. Whenever the running-wheels are placed upon the crank-axle, one of the above methods must be resorted to; but when a separate crank-axle is used, the relative velocities of the pistons and the running-wheels may be varied by means of different sets of spur-gear; or, when Hancock's mode of connection is adopted, by changing the relative sizes of the pulleys over which the coupling-chain works. This facility is one of the great recommendations of a distinct crank-axle; as some contrivance for varying the power, which may be brought into action on a journey without delay, is almost indispensable in any steam-carriage intended for use upon a hilly road, or one on which the resistance, from the progress of repairs, or any other cause, varies greatly in different parts.

The operation of steering is usually performed by a hand-wheel in the fore part of the carriage, giving motion, by means of a rack and pinion, or a chain and pulley, to the fore-axle. Gurney, and one or two others, used a small wheel or pair of wheels rolling on the ground in advance of the carriage, to assist in turning; but no such contrivance has been considered necessary by recent steam-carriage builders. The labour of steering is much diminished by the use of a friction-band and drum, contrived by Mr. Hancock, which, when brought into action by the pressure of the steersman's foot upon a pedal, retains the steering-apparatus in a direct position. Thus the guide may remove his hands from the tiller-wheel whenever the carriage is running in a straight course; the friction of the band and drum being sufficient to overcome any tendency to swerve occasioned by the irregular surface of the road; while, by relaxing the pressure of his foot, the apparatus becomes easy to move in any direction. In the contrivance invented by Mr. James, and subsequently adopted, with some modification, by Messrs. Heaton, the vertical spindle by which motion is communicated to the axle is not turned immediately by a tiller-wheel fixed upon it, but by means of bevil-gear turned by two winch-handles, one for each hand of the steersman. This apparatus may be so arranged as to increase the power of the steersman over the fore-carriage to any required degree, by varying the diameters of the bevil-wheels. Mr. Redmund, in a carriage built in 1832 or 1833, effected the operation of steering by means of reins acting upon levers which moved the fore-wheels. To facilitate the movements of the carriage, each wheel was fixed upon a distinct axle, according to the plan patented in 1816 by Mr. Ackerman, to avoid the inconvenience of the common system of locking the wheels in turning. This mode of constructing the fore-axles has the advantage of giving increased safety in turning; the fore-wheels being enabled to assume any required angle with the body without running under it. In one of James's steam-carriages, a lamp was fixed a little in advance of the steersman's seat, supported upon and turning with the fore-carriage, so as both to light the road at night and to indicate the direction in which the carriage was running. Mr. Russell used an arrow in a similar way.

All locomotive carriages should be provided with efficient brakes, by which their motion may be arrested when necessary. These, in common-road steam-carriages, usually consist of metallic bands, capable of being pressed against either the nave or the periphery of one or both of the hind-wheels. The latter plan appears to be the most effective. It might be a good precaution to have this apparatus in duplicate, as several accidents have occurred in descending hills, from the derangement or insufficiency of the brakes.

In the general arrangement of the machinery, as well as in the contrivance of its component parts, much ingenuity and judgment are required. Some locomotionists arrange their machinery and accommodation for passengers in the same carriage; but others prefer conveying the load, or the greater part of it, in a supplementary carriage, drawn by that containing the engine, which then becomes a mere drag. The latter plan requires the most power, owing to the friction of the increased number of wheels and axles; but it would probably be preferred by the passengers, from the circumstance that they are thereby further removed from danger in the event of an explosion. It also affords facilities for changing the engine in the course of a long journey, or in case of any derangement of the machinery, without disturbing the passsengers any more than they are disturbed by changing the horses of an ordinary stage-coach; and the passenger-carriage may be fitted with provisions for attaching horses to take it forward whenever an accident occurs to the drag. Further than this, when the engines and carriages are separate, the capital invested in the one need not be unproductive while the other is undergoing repair. This was the arrangement adopted in the carriages used by Sir Charles Dance. Hancock has built some engines for use as drags, but he, in common with several others, prefers placing the whole weight upon one carriage. In one of the steam-coaches designed by Burstall and Hill, a model of which was exhibited in Edinburgh and London nearly fifteen years ago, the engines were placed in the hind boot of the vehicle, which resembled a common stage-coach in form; but the boiler and furnace were supported by an additional pair of wheels, connected by a jointed framework with the back of the coach. The connection between the boiler-carriage and the coach was such as to allow the machine to turn with facility; the steam-pipes being provided with peculiar joints to enable them to accommodate themselves to the motion. This plan has the advantage of removing the boiler from the passengers without so great an increase of weight and friction as the use of a distinct carriage involves, and would also afford great facilities for removing a defective or furred boiler, and substituting a fresh one, without difficulty or delay; but possibly it might, by reducing the weight on the driving-wheels, so diminish their adhesion as to prove inconvenient. In the carriages of Mr. Russell, which were much handsomer in appearance than those of most steam-coach builders, the boiler and engines were supported by the hind axle of the carriage (with the intervention of springs), but the supply of fuel and water was contained in a supplementary vehicle, or tender, supported upon two wheels, and having seats for some outside passengers. This tender it was proposed to change at the stations, so as to avoid needless delay. In many steam-carriages water-tanks are formed under the passengers' seats; and when these do not afford sufficient room, another tank may be placed underneath the body. To facilitate the operation of taking in a supply of water, Mr. Gordon, in his 'Journal of Elemental Locomotion,' suggested the use of a moveable tank, suspended beneath the framework of the carriage, and capable of being detached and wheeled away on a small truck pushed underneath to receive it, while the carriage stopped at a station; a full tank being then brought on the truck, and attached in the place of the empty one. The same gentleman recommends that the boiler be so placed and connected with the engines, that it may be easily removed, and another of the same or a different construction put in its place. This precaution will be especially important so long as steam locomotion remains in an experimental state.

It is advisable to place the cylinders and working parts in a position readily accessible while the carriage is running, so that any derangement may be immediately perceived and rectified by the engineer. Mr. Hancock provides for this by placing the engines in a small chamber, in which the engineer is stationed, between that part of the carriage which is devoted to passengers, and the boiler, which occupies the extreme rear of the vehicle, and is fed with fuel by a stoker who rides outside at the back, and acts also as brakesman. The draft being produced by blowers, the fire-place must always be close; it is therefore fed by a hopper with double doors, and eye-holes, glazed with talc, are made to enable the stoker to see the state of the fire. A very promising drag, built by Mr. James of Birmingham, but abandoned, it is stated, for want of more ample pecuniary resources, had the whole of the machinery, with the boiler and supply of water and fuel, enclosed in a compact carriage somewhat resembling a small omnibus, the roof of which was little more than six feet from the ground. The engineer was placed on a seat at the back, and had access to the engines through openings in the roof. In the machines of Gurney and several others, the engines, being placed under the body, are inaccessible when in motion, and are exposed to dirt and currents of cold air. It is important to attend to the length and direction of the pipe for conveying steam from the boiler to the cylinders; since a great length of pipe or angular turns in its course diminish the power of the steam. This point has been singularly disregarded in some cases. In one of Gurney's carriages, for instance, the steam-pipe from the upper part of the boiler, which was at the back of the carriage, was turned down to pass underneath the body, thence up again through the fore-boot, in which the fanners for blowing air into the furnace were placed, to the steersman's seat, where the throttle-valve was situated; it then turned suddenly downwards, and passed through the boot to the cylinders. With such an arrangement, it is not surprising to find Gurney himself stating that, although the average pressure of steam in his boiler was about 70lbs. to the inch, he thought the pressure on the piston was not more than 20lbs. The throttle-valve must always be under the immediate control of the steersman; but this may be effected without the absurdity of conducting the steam-pipe to his feet. Gurney contrived an apparatus, by which, if the steersman were thrown off his seat, or were absent from it from any other cause, the throttle-valve should close of itself by the action of a spring; so that, on level ground, the carriage could not possibly run away without a guide. That some such provision is desirable may be inferred from the fact that several instances have occurred of railway engines being set in motion in the absence of their drivers. As the safety of the boiler depends much upon the perfect action of the pumps by which it is supplied with water, they should be particularly attended to. Several accidents have been occasioned by their becoming choked with mud, bits of straw, &c. suspended in the water.

Finding it difficult to procure wheels of sufficient strength for his steam-carriages, Mr. Hancock contrived his patent wedge-wheels, which are described under WHEEL.

Many plans have been proposed for the propulsion of locomotive carriages by means of gas or compressed air in lieu of steam; but nothing has been accomplished of sufficient importance to claim detailed notice. Hitherto none of the gas-engines tried have proved as economical as those worked by steam. The other project is attended by very serious practical difficulties; and were these overcome, its advantages are questionable, since it merely affords a means of storing up and gradually expending the power exerted in condensing the air, and does not either produce or economise power. Whatever advantage is realised must be in the convenient application of the power of the stationary machinery used to compress the air; the amount of such power being diminished by the friction of the apparatus.

More detailed information on the subject of this article may be obtained from Gordon's 'Treatise upon Elemental Locomotion;' the article 'Railway,' in Hebert's 'Engineer's and Mechanic's Encyclopædia,' which contains a chronological account of the principal inventions in steam-locomotion, mixed up with those relating to railways; Hancock's 'Narrative;' the pamphlets of Gurney, Macerone, &c.; and the 'Mechanics' Magazine,' and other scientific periodicals. Many facts may also be gleaned from the evidence given before the select committee of the House of Commons on Steam-Carriages, in 1831, and the select committees appointed in 1834 and 1835, to investigate Mr. Gurney's claims. The subject has likewise been brought before parliament in connection with the prospects of turnpike trusts; but the statements made by the promoters of common-road locomotion have in too many cases been so deceptive and exaggerated, as to provoke ridicule rather than to induce a calm investigation of the prospects of this important branch of practical science. When a speed of twenty or thirty miles an hour is talked of as attainable upon a turnpike-road, it is not surprising that steam-carriage projectors should be deemed wild enthusiasts; since anything like that velocity, even if attainable at a moderate expense, must be attended with most fearful danger upon a road liable to the intrusion of miscellaneous vehicles, animals, and foot-passengers. More moderate pretensions, coupled with due regard to the appearance and comfort, as well as the efficiency of steam-carriages, and satisfactory proof of their economy, will do far more for the cause of common-road locomotion than the extravagant statements which have appeared so frequently within the last fifteen years.

STEAM-VESSEL, a vessel moved by the power of a steam-engine acting upon paddle-wheels or other mechanism for propelling it through the water. In narrating the principal facts relating to the history of the application of the steam-engine to the propelling of vessels, and describing a few of the more prominent peculiarities of the mechanism by which it is effected, it may be convenient to treat first of the experiments and suggestions made on the subject prior to the practical introduction of steam-vessels as a regular means of conveyance; in the second place, to give very briefly the principal circumstances of their subsequent history, and some statistical information respecting the progress and present state of steam-navigation in Great Britain and its dependencies; and, thirdly, to consider the principal features of the structure of steam-vessels, and of the mechanical contrivances by which steam navigation is usually effected.

*History of the Invention of Steam Navigation.*—Closely connected with the application of the steam-engine to the purpose of propelling vessels, is the use of revolving paddles or similar contrivances in lieu of oars. Although no such means of propulsion have ever been extensively adopted except in connection with steam-power, they have been repeatedly tried, and more frequently recommended, in connection with other prime-movers, for rendering the progress of a vessel in some degree independent of wind and tide. It has been asserted that boats with paddle-wheels turned by oxen within the vessel were known to the antient Egyptians, and that they are represented in some Egyptian tombs; but the writer is not acquainted with any such representation, and it is possible that some mistake may have given rise to the statement. Be this as it may, wheel-boats impelled either by oxen, horses, or men, were known to the Romans. The rare and curious work of Valturius, 'De Re Militari,' which was published in 1472, contains representations of two wheel-boats, one of which has one pair of wheels, and the other five pair. The wheels consist of four paddles each, and are turned by cranks in their axles; and in the second boat the five cranks are connected together by a rope, so that their motion may be simultaneous. Such boats are alluded to by some other early writers on military subjects, as advantageous for the conveyance of troops. That wheel-boats have long been known to the Chinese may be presumed from the 'Mémoires' of the Jesuit Missionaries at Peking. In the eighth volume of that work, which was published at Paris in 1782, appeared an engraving and description of a vessel of war, which is called 'Barque à Roues,' and has two paddle-wheels on a side, turned by men (pl. xx., *fig.* 94). The writer remarks (p. 343) that this might give rise to some useful invention for moving vessels during calms; observing that if they could be thus propelled for only one league, it might suffice to remove them from a bad position. Many writers have recommended the use of paddle-wheels or revolving oars for this purpose, both before and after the commencement of experiments on steam navigation. Some projectors have proposed to work such wheels by a capstan, a treadwheel, or cranks turned by hand; and others have suggested their being set in motion by revolving sails, so that the vessel might be propelled by the wind even when moving in a direction contrary to it. Prince Rupert tried a wheel-boat propelled by horses upon the Thames; and so far succeeded as to leave the king's barge, which was manned by sixteen rowers, far behind. Such a vessel was also tried at Chatham in 1682. Captain Thomas Savery, who is better known for his share in the invention of the steam-engine, exerted himself much to introduce a similar apparatus, to be worked by a capstan; and, failing to obtain patronage from government, he published an account of his scheme in 1698, in a work entitled 'Navigation Improved, or the Art of rowing Ships of all rates in calms with a more easy, swift, and steady motion than oars can.' Revolving paddles were tried about the same time in France by M. Duquet, and have since been repeatedly experimented upon, but without realising any important advantage, except when moved by a steam-engine. These experiments are nevertheless interesting from their bearing upon steam navigation.

In order to notice the inventions connected more immediately with steam navigation in chronological order, allusion must be first made to the curious claim which has been brought forward on behalf of Blasco de Garay, a sea captain, who is stated to have exhibited in Spain, in 1543, an engine by which ships and vessels of the largest size could be propelled, even in a calm, without the aid of oars or sails. [BARCELONA, vol. iii., p. 438.] The documents relating to this claim, which, if correct, gives Spain the priority by a long period in experiments on steam navigation, were discovered in the royal archives at Simancas, and were published in 1826, by Thomas Gonzales, director of the archives. It appears that Blasco de Garay proposed his invention to the emperor Charles V., who ordered a public experiment to be made in the port of Barcelona, before commissioners appointed for the purpose. The experiment was made on the 17th of June, 1543, the vessel used being a ship of two hundred tons burden, which had just discharged a cargo of corn at Barcelona. Garay wished to keep his mechanism secret; but it was perceived to consist partly of a large cauldron or vessel of boiling water, and of two moveable wheels, one on each side of the ship. The reports made to the emperor and to his son (Philip II.) were favourable to the engine, particularly, it is said, on account of the promptitude and facility with which the vessel was turned. Ravago, the treasurer, who was one of the commissioners appointed to examine the invention, appears to have been unfriendly to it. He reported that the vessel would go two leagues in three hours; that the machine was too complex and expensive; and that there was danger of bursting the cauldron. The other commissioners, more favourably inclined, stated that it made a league an hour at least. After the trial, Garay removed the machinery from the vessel, deposited the wood-work in the arsenal at Barcelona, and retained the rest himself. It is stated that the invention was approved, and would have been encouraged further by the emperor, had not an expedition in which he was engaged interfered with it. Garay was however rewarded by promotion, and received a sum of two hundred thousand maravedis, besides having his expenses defrayed from the public treasury. The authenticity of this curious narrative has been called in question; and, supposing it to be strictly correct, it bears only conjectural evidence of the use of steam. Considering the low state of the mechanic arts in the sixteenth century, which precludes the supposition that any machinery requiring much accuracy in the execution could have been employed, it has been suggested that probably the moving-power was obtained by an apparatus resembling the primitive steam-engine of Hero. However this may be, the invention was kept secret, and led to no practical result.

Stuart, in his 'Anecdotes of Steam-Engines,' endeavours to establish something like a claim to the invention of steam navigation by the Marquis of Worcester. By taking the sixty-eighth proposition of his 'Century of Inventions' (which was written in 1655, though not published until 1663), in connection with the ninety-eighth and hundredth propositions, as suggested by a writer in the 'Glasgow Mechanics' Magazine,' vol. ii., p. 339, it would appear that he designed to describe, though obscurely, a steam-engine with a piston and lever. Stuart prints a short account of Worcester's invention, which is, he states, still extant in manuscript, and which appears to corroborate this idea. This paper describes what may, without any great stretch of fancy, be supposed to be a machine for effecting navigation by means of a steam-engine; although some of the circumstances mentioned are difficult to account for on that supposition. Stuart also quotes a pamphlet published in 1651, entitled 'Invention of Engines of Motion lately brought to perfection,' which, though published anonymously, describes an engine of such great and universally-applicable power, that Stuart seems to incline to the opinion that the Marquis of Worcester must have been the writer. The author alludes to a little engine, or great model, which he had 'already erected' at Lambeth; and, among many other purposes to which his invention might be applied, states that it may be used 'to draw or hale ships, boates, &c. up rivers against the streame; to draw carts, wagons, &c. as fast without cattel; to draw the plough without cattel, to the same despatch if need be,' &c.

The project to be next alluded to is that of Papin, who proposed an apparatus somewhat like that subsequently patented in England by Jonathan Hulls. Those who have endeavoured to establish a claim to the invention of steam navigation on behalf of France have pleaded Papin's suggestion in favour of their views; but none, so far as we know, have asserted that he put his scheme to the test of experiment. In 1730, in his 'Specimina Ichnographica,' Dr. John Allen propounded a plan for propelling vessels by forcing a stream of water or air out of a tunnel or pipe at the stern of the vessel, which was to be urged forward by the reaction. This scheme has been repeatedly brought forward, with various modifications. Dr. Allen tried it with a boat of considerable size, the pumping being effected by men; but he conceived that the steam-engine might be employed for the purpose. While the possibility of moving a vessel by this means has been proved, none of the experiments tried have indicated any advantage.

On December 21, 1736, a patent was granted to Jonathan Hulls for a machine which may be designated a steam tug-boat; of which a full description was published in the following year, in a sensible pamphlet entitled 'A Description and Draught of a new-invented Machine for carrying Vessels or Ships out of or into any Harbour, Port, or River, against Wind and Tide, or in a Calm.' Hulls proposed to place an atmospheric steam-engine in the tug-boat, and to communicate its power by means of ropes to the axis of a kind of paddle-wheel mounted in a frame-work projecting from the stern of the vessel. A contrivance is added for continuing the motion of the paddles by the descent of a counterbalance-weight, in the intervals between the strokes of the piston. To guard against the injury of the fans or paddles by the violence of the waves, Hulls proposed to lay pieces of timber so as to swim on each side of them. The objections likely to be brought against the scheme are anticipated and answered by the writer, who expresses his opinion that it would be found better to place the machine in a separate vessel than in the ship itself, because the machinery would be cumbersome in the ship, and, if in a separate vessel, it might lie at any port to be ready for use, &c. It was suggested that up inland rivers, where the bottom could possibly be reached, the fans (or paddles) might be taken out, and cranks placed at the hinder axis, on which the paddles were usually fixed, to strike a shaft to the bottom of the river, and so to drive the vessel forward. It is not known whether Hulls ever did anything more to bring his project into use than the publication of the work referred to.

In 1759 a scheme for the improvement of navigation was published at Geneva, by a Swiss pastor, named Genevois, who proposed, in imitation of the web-feet of aquatic birds, to use a kind of jointed oar or propeller, which should be expanded while actually propelling the boat, but should fold together, so as to pass through the water with very little resistance, while being moved forward in order to make a fresh stroke. These propellers he intended to work by the reaction of springs; using a kind of cannon with a piston to compress the springs. The project of Genevois is the more entitled to notice in this place owing to another proposal which he made, namely, to bend his springs by a steam-engine on Newcomen's principle. So eager was Genevois to pursue his plan, that he visited London in 1760 to lay it before the commissioners of the British navy, and translated and published some extracts from his book, under the title of 'Inquiries tending to the Improvement of Navigation.' In this pamphlet he states that he was informed by a member of the Navy Board, that a Scotchman had, about thirty years previously, attempted to move a ship by means of gunpowder, but in a very different way from that proposed by himself; the Scotchman's plan being to urge the vessel forward by the reaction produced by firing one or more cannon from the hinder part of the ship. By this plan, it is said, thirty barrels of gunpowder were found necessary to propel the vessel ten miles in twenty-four hours.

The next circumstances which claim notice in the history of the invention of steam navigation afford the principal reasons for attributing, as some of their writers have done, the origin of the art to the French. In 1774 the Comte d'Auxiron, a French nobleman of scientific attainments, constructed a steam-boat, and tried it on the Seine, near Paris. It appears that the engine had not sufficient power to move the wheels efficiently, an error into which many of the early experimenters fell; and consequently the result was unsatisfactory, and the persons who had united to enable the Comte to construct the machine abandoned the project. In the next year, 1775, the eldest of the ingenious brothers Perier, who had assisted in d'Auxiron's experiment, resumed the attempt, and placed a very imperfect engine, of about one-horse power, in a boat on the Seine, connecting the engine with two paddle-wheels. He, also, laboured under the disadvantage of having too little engine-power, and therefore failed to obtain any satisfactory result; his boat moving but slowly against the current of the Seine. Fortified by the favourable opinion of the Marquis Ducrest, who perceived the cause of his disappointment, 'Perier did not,' observes Stuart, 'altogether abandon the subject; and in succeeding years he made a few attempts with other propelling mechanism instead of paddle-wheels, which he thought were defective substitutes for oars, and which, in his view, occasioned his failure.' He did not however accomplish anything important; nor did his attempts, according to the author just quoted, excite much attention in France, or any at all in England. In an Historical Notice on Steam-Engines, by M. Arago, in the French 'Annuaire' for 1837, it is stated, probably from inadvertence, that M. Perier was the *first* to actually construct a steam-vessel. From this paper we learn that trials were made on a larger scale in 1778, at Baume-les-Dames, by the Marquis de Jouffroy, who subsequently, in 1781 or 1782, tried a boat of considerable dimensions upon the Saône, at Lyon. Several English authorities give the dimensions of this boat as a hundred and forty feet long and fifteen feet broad; but Arago says it was forty-six metres long and four and a half broad. Colden's Life of Fulton, in an extract from the 'Journal des Débats' for March 28, 1816, states the dimensions to have been a hundred and thirty feet long and fourteen broad. The vessel had a single paddle-wheel on each side, and the machinery appears to have been constructed with some skill, although it was not sufficiently strong. The experiments of the Marquis were eventually stopped by the political disturbances of the country. After a long exile, he returned to his country about 1796, and found that M. des Blancs, a watchmaker of Trevoux, had obtained a patent for a steam-vessel, which, it has been supposed, was constructed chiefly on the information which he could collect respecting that of the Marquis. Jouffroy appealed to the government, but nothing important resulted from his doing so, or from the experiments of M. des Blancs, which, like those of Jouffroy, were made on the Saône. While M. des Blancs was engaged in his steam-boat project, Fulton, who was then in France, was also experimenting upon the same subject. It appears, indeed, that both tried the scheme of propelling by means of paddles or float-boards attached to an endless chain stretched over two wheels projecting from each side of the vessel. Fulton abandoned this plan, and adopted paddle-wheels in its stead; but during his experiments, M. des Blancs complained of his operations as an infringement upon his patent right, and remonstrated with Fulton upon the subject. Fulton, according to his biographer Colden, answered him by explaining the difference between the wheels which he was then using, and the chains, or *chaplets*, of the Frenchman, and informing him of the unfavourable result of his own experiments with a similar apparatus. Colden states that he concluded by offering M. des Blancs a share in the advantages of his discovery, if he would bear a proportion of the expense; but that no notice was taken of the offer.

The narrative must now return a few years, in order to notice the attempts making in North America to solve the problem of propelling vessels by mechanical power. Without noticing mere vague suggestions of its possibility, of which some have been mentioned of earlier date, we find that two individuals named Fitch and Rumsey were early in the field as experimentalists. Stuart goes into their claims very minutely; but it may be briefly stated that as early as 1783 Fitch had succeeded in moving a boat on the Delaware by means of paddles (not paddle-wheels) set in motion by a steam-engine; and that in 1785 he presented a model and description of his apparatus to Congress. He was supported for some time by an association of wealthy persons, and was so sanguine as to the success of his project, as to send drawings and descriptions of his machinery to Messrs. Boulton and Watt, in order that they might procure an English patent for it. Nothing was accomplished by Fitch and his friends in England, and but little in America. It is worthy of notice that Fitch expressed his belief that the time would come when steam-power would be employed for crossing the Atlantic. Rumsey, the rival of Fitch, had exhibited a model of a contrivance for moving a boat to General Washington as early as 1784; but Fitch alleged that it was merely an apparatus for enabling a boat to stem the current of rapid rivers, by means of wheels, cranks, and poles; and that it had been tried some years before by another person on the Schuylkill, and had failed. In 1787 Rumsey made some short voyages on the Potomac, with a boat about fifty feet long, propelled by the re-action of a stream of water drawn in at the bow and forced out at the stern by means of a pump worked by a steam-engine. This boat moved, it is said, at the rate of three or four miles an hour, when loaded with three tons, in addition to the weight of her engine, which was about one-third of a ton. The boiler held only five gallons of water, and the whole machinery did not occupy more space than four barrels of flour. The fuel consumed was from four to six bushels of coals in twelve hours. Rumsey afterwards proposed applying the power of a steam-engine to long poles, which were to force the boat forward by reaching the bed of the river, when it had to move against a rapid current. Rumsey, as well as Fitch, was backed by a company; and their respective friends did not confine their rivalry to America, for the adherents of Rumsey addressed themselves to Boulton and Watt in opposition to the statements of Fitch. After all their conflicting pretensions, however, neither succeeded in the practical establishment of steam navigation. Rumsey came to England after the failure of his projects in America, and commenced a steam-boat on the same principle as that he had used on the Potomac, which will be recognised as like the much older plan of Dr. Allen. He died before the completion of this vessel; but it was finished by the persons associated with him, and was brought to trial in February, 1793. This steam-boat performed several times on the Thames, against wind and tide, and attained a speed of four miles an hour. This method of propelling a boat was subsequently tried by Mr. William Linaker, master-shipwright in Portsmouth dockyard, who obtained a patent for it in 1808. His experiments had, as appears by his papers, been commenced as early as 1793. Stuart states that a similar apparatus was tried on the Thames after Linaker's death, the engine used being on the principle of that invented by Savery.

While Fitch and Rumsey were making their experiments in America, other experiments were in progress in Scotland, which tended, more than any previous trials, to the useful application of steam to the purpose of propelling vessels. Of the highly interesting experiments made in 1788 and 1789, under the auspices of Patrick Miller, Esq., of Dalswinton, in Dumfriesshire, many accounts are extant, differing indeed very slightly from each other, yet tending, by the colouring given to minor details, to attribute different degrees of honour to the three individuals by whom they were carried out. It is not likely that this question will ever be thoroughly set at rest; for the degree in which each contributed to the success of the experiments will ever be estimated differently, according to the peculiar mode of judgment adopted by the inquirer. Without desiring to throw any slight upon those who differ from him, rather in his deductions than in the facts upon which they are based, our narrative will be condensed from that of Mr. Russell, who has evidently taken much pains to produce a satisfactory account of the whole course of proceedings.

After stating that it has been very usual to attribute the invention of steam navigation to Miller, and that two competitors have contested his claim, Mr. Russell observes, 'We shall soon see that to no one of the three can the palm be awarded. The creation of the steam-ship appears to have been an achievement too gigantic for any single man. It was produced by one of those happy combinations in which individuals are but tools working out each his part in a great system, of the whole of which no single one may have comprehended all the workings.' The persons who have contested the title of inventors of steam navigation, or rather, they for whom the title has been contested by others, are Patrick Miller, James Taylor, and William Symington; and, after a long and patient examination of their respective claims, and of the papers, published and unpublished, of the parties who advocate the cause of each, as well as of the personal testimony of such individuals as could throw light on the case, our author gives it as his conclusion that the art of steam navigation was the joint invention of the three. It will be seen from the history given above, that if the mere suggestion of applying a steam-engine to the propulsion of a vessel, or even the actual construction of a steam-boat, be considered sufficient to entitle a person to the name of inventor of steam navigation, that name belongs to some earlier projector, and not to any of the three individuals just mentioned; and if, on the other hand, the honour be due to those who produced the first successful steam-boat, it cannot be applied with propriety to any individual, seeing that the superiority of the boats of Miller, Taylor, and Symington was attributable to a happy union of talent and enterprise.

Mr. Miller of Dalswinton was a gentleman who gave much attention to mechanical pursuits, and freely expended his property in the promotion of schemes which he considered to be for the public good. He had been engaged in attempts for the improvement of naval architecture, proposing to build ships of much greater length than usual, in proportion to their breadth, and, in order to enable such narrow vessels to bear sail, to unite two or even three boats or hulls, side by side, so as to form a double or triple boat. He had also experimented upon the application of paddle-wheels, turned by a power within the vessel, instead of, or rather as auxiliary to, the force of the wind. Russell observes, that he does not find that Miller anywhere claimed absolute property in the invention of paddle-wheels, which, as has been already stated, had been often tried. Having thus prepared a form of vessel suitable for the purpose of steam navigation, and provided it with an apparatus for propelling it through the water, it only remained to apply the steam-engine itself. This, it appears, was done subsequently, in consequence of the suggestion of Mr. Taylor, who, in 1785, went to reside in Mr. Miller's family as tutor to his younger sons, and, in 1786 and 1787, frequently assisted in his experiments with paddle-wheel boats. In one of these, in the latter year, one of Miller's double boats, sixty feet long, propelled by two wheels, each of which was turned by two men, was matched against a Custom-house boat, which was reckoned a fast sailer; and on this occasion the want of a sufficient moving-power to turn the wheels was sensibly felt. Both Miller and Taylor perceived this; but when the latter suggested the steam-engine, Mr. Miller, for a time, questioned its applicability. In 1787 he published an account of his experiments, in which he observed, after describing his paddle-wheels, 'I have also reason to believe that the power of the steam-engine may be applied to work the wheels, so as to give them a quicker motion, and consequently to increase that of the ship. In the course of this summer I intend to make the experiment; and the result, if favourable, shall be communicated to the public.' This project formed the subject of much conversation at Dalswinton in the summer of 1787, and was mentioned by Taylor to his intimate friend Symington, who was then engaged as a mining-engineer at the Wanlockhead lead-mines, but had devoted much attention to the improvement of the steam-engine, and had recently constructed a model of a steam-carriage [STEAM-CARRIAGE, p. 487], in which he had provided simple means for converting the reciprocating motion of the pistons into a rotatory motion. Thus, while Miller had been preparing a proper vessel and propelling apparatus, and Taylor had been recommending the agent required to work it, Symington had been effecting those modifications in the structure of the engine which were necessary to adapt it to the purpose required. There is some reason, indeed, to believe that he had conceived the possibility of this particular application of the steam-engine; for, in a letter to Taylor, dated August 20, 1787, apparently in answer to one just received from him, Symington says, 'I must make some remarks upon your summer's inventions, which, if once made to perform what their author gives them out for, will undoubtedly be one of the greatest wonders hitherto presented to the world, besides its being of considerable emolument to the projector. Great success to you, *although overturning my schemes*.' In December of the same year the Dalswinton experimenters were in Edinburgh, where they met Symington, and, at the house of his patron, Gilbert Meason, Esq., saw his steam-carriage model. The result of this meeting was, that Symington, in conjunction with Miller and Taylor, constructed a small engine in the following summer; the castings being, by a curious coincidence, executed by a founder of the name of Watt. In October, 1788, this engine was placed in a small double pleasure-boat belonging to Mr. Miller, and was tried upon Dalswinton lake. The engine was placed on one side, the boiler on the other, and the paddle-wheel in the middle. With all the disadvantages of a first experiment, and with cylinders of only four inches diameter, the boat moved with a velocity of five miles an hour. After repeated satisfactory trials, the engine was removed from the boat, and kept for many years as a trophy in the library at Mr. Miller's.

Had the experiments of Miller and his fellow-labourers stopped here, it might have been conceived that their success was in some degree attributable to accidental circumstances. The result of a second experiment, in the following year, is sufficient to dispel any such idea. In 1789 an engine of about twelve-horse power (or twelve times the power of the first) was made by the same parties at the Carron works. This was mounted in the large double boat which had formerly run against the Custom-house boat at Leith. Except in size, this machine resembled the former model. The engine was commenced in June, and near the end of the year the boat was tried on the Forth and Clyde canal. Some difficulty was at first experienced from the weakness of the fastenings by which the float-boards or paddles were secured to the arms of the paddle-wheels; several of them being broken off by the severe strain to which the power of the engine subjected them. When this matter was set right, the boat performed very successfully, and attained a speed of nearly seven miles an hour, 'being,' observes Mr. Russell, 'about as great a velocity as it has been found possible to obtain by steam-boats on canals, even at the present day.' The vessel having been built for a different purpose, and being much too slight for permanent use as a steam-boat, or for taking out to sea, was, soon after the trial, dismantled. Mr. Miller, having thoroughly proved the practicability of the plan, and having expended a large fortune in his enlightened pursuits for the public benefit, relinquished the experiment, leaving its great results to be worked out by others. That he should have done so need excite no surprise, when the difficulties attending the introduction of any great improvement are considered. Taylor was still less likely to take any effective steps for carrying out the grand design; and Symington was not in a situation to do so immediately, although he was subsequently engaged in further experiments to that end.

Satisfactory as was the result of these experiments, they did not immediately lead to the introduction of steam navigation, and several other unsuccessful schemes were tried in this country and in North America before it was effected. One of these, that of Rumsey the American, on the Thames, has been already mentioned. About this time Dr. Cartwright contrived a steam-barge, and explained it to Fulton. Some authorities state that it was shown to Fulton in 1793, when he was studying painting under West; but others date it a few years later, stating that he was introduced to Dr. Cartwright during his journey to Paris in 1796. However this might be, it is evident that Fulton's attention was directed to the subject about this time. Colden, his biographer, states that he made drawings of an apparatus for steam-navigation in 1793, and soon afterwards submitted them to Lord Stanhope. In 1795 Earl Stanhope himself made experiments with a steam-vessel propelled by duck-feet paddles placed under the quarters, like those formerly recommended by Genevois. Notwithstanding the ingenious folding of the paddles, in order to diminish the resistance of the back-stroke, the apparatus required so much power that, with a powerful engine, he could not obtain a speed greater than three miles an hour.

In 1801 Symington commenced a satisfactory series of experiments on steam navigation, under the auspices of Thomas, Lord Dundas. The object immediately aimed at was the introduction of tug-boats instead of horses for drawing boats upon canals. After several minor trials, one of the boats built on this occasion by Symington drew, on the Forth and Clyde canal, in 1802, two loaded vessels, each of seventy tons burden. On this occasion, it travelled with its load a distance of nineteen miles and a half in six hours, although there was so strong a wind ahead that no other vessels in the canal could move to windward on that day. The tug-boat was a rather short vessel, with a single paddle-wheel in the stern, impelled by an horizontal cylinder of twenty-two inches diameter and four feet stroke, working, by means of a connecting-rod, a crank on the axle of the wheel. The rudder was double, on account of the situation of the paddle-wheel, and it was moved by means of a tiller-wheel in the fore-part of the vessel. In this case, though the object aimed at was fully attained, as far as the successful performance of the vessel could go, the project was abandoned, in consequence of an idea that the undulation of the water occasioned by the paddle-wheel would prove injurious to the banks of the canal. The speed attained by this steam-boat, when unimpeded by having any others to draw after it, was about six miles an hour.

While the experiments of Symington, under the patronage of Lord Dundas, did not lead to the immediate adoption of steam-vessels for commercial purposes, they probably tended, in no unimportant degree, to their subsequent profitable establishment in America and in Great Britain; for among the numerous individuals who inspected his vessel with interest were Fulton and Bell. It has been shown that projects for steam navigation had been early tried in North America. After Fitch and Rumsey, the chancellor Livingstone attempted to build a steam-boat on the Hudson, and in 1797 he applied to the legislature of the State of New York for an exclusive privilege to navigate boats by a steam-engine. Though his project excited much ridicule, the privilege was granted in 1798, on condition that he should, within twelve months, produce a steam-vessel which should attain a mean rate of at least four miles an hour. This he failed to accomplish, although assisted, it is said, by an Englishman named Nesbit, and by Brunel (now Sir Mark Isambard), and consequently his grant or patent became void. Shortly afterwards, being at Paris as minister from the United States, Livingstone conversed with Fulton on the subject of steam-boats, and intimated his intention of resuming the experiments on his return to America. Fulton then commenced, under his auspices, the experiments which have already been alluded to as exciting the jealousy of M. des Blancs. After several preliminary measures, Fulton and Livingstone completed a boat of considerable size on the Seine near Paris, early in 1803; but, being too weak to bear the weight of her machinery, she broke through the middle, in a gale of wind during the night, and went to the bottom. To this discouraging accident Mr. Russell attributes one of the excellencies of American steam-boats,—the strong and light framing by which, though slender, they are enabled to bear the weight and strain of their large and powerful engines. To remedy this evil, Fulton had to reconstruct his vessel almost entirely, after her shattered hull was raised; and in August of the same year he had her in trying order. This vessel was sixty-six feet long and eight feet wide. The speed attained was much less than had been hoped for; but the result of the experiment was such as to induce the projectors to order an engine of Boulton and Watt, with a view to further trial in America. As the boat into which it was fitted was the first regularly established steam-packet, it will be noticed in the second part of our history; but before closing this narrative, allusion must be made to the proceedings of Fulton between the time of these French experiments and his successful enterprise on his return to America. During this time he visited England [FULTON, ROBERT, vol. xi., p. 13.]; and while here he introduced himself to Symington, from whom he asked for particular information respecting what he had done in steam navigation. According to Symington's account, Fulton told him frankly that he intended shortly to return to America, and to establish steam-boats on the rivers of that country, where he thought they might be adopted with great advantage. Symington further stated that Fulton expressed an opinion that the proposed establishment of steam-vessels on the other side of the Atlantic could not fail to be advantageous to him, and earnestly requested to see his boat in action. This account certainly indicates at least a want of generosity on the part of Fulton towards a man whose perseverance and talent had accomplished far more than he had done himself; as, after obtaining all the information he could from Symington, who performed a satisfactory voyage solely on his account, he took no subsequent notice of him. Symington states that during the voyage Fulton requested and obtained permission to make notes respecting the steam-boat; and proceeds to say, in a narrative which he himself wrote, 'In consequence he pulled out a memorandum-book, and after putting several pointed questions respecting the general construction and effect of the machine, which I answered in a most explicit manner, he jotted down particularly everything then described, with his own remarks upon the boat, while moving with him on board along the canal; but he seems to have been altogether forgetful of this, as, notwithstanding his fair promises, I never heard anything more of him till reading in a newspaper an account of his death.' The conduct of Fulton does not appear in a more favourable light from the circumstance that, in making proposals to Boulton and Watt for the construction at Soho of a steam-engine for the vessel which he contemplated building in America, he gave a feigned name. His disguise was soon detected, but the engine was nevertheless proceeded with. Before returning to America, his colleague, Livingstone, wrote thither, and secured to themselves the monopoly of steam navigation in the state of New York, setting forth their claim to the *invention* of steam-boats.

This brief sketch of what may be termed the preliminary history of steam navigation would be incomplete without referring to the experiments of John Stevens, of Hoboken, near New York, who was connected with some of the earliest attempts of Livingstone to introduce steam navigation in North America. Stuart describes a small boat, twenty-five feet long and five feet wide, impelled by a steam-engine with a cylinder of four inches and a half diameter and nine inches stroke, which he tried about New York in 1804. The boiler, which was only two feet long, fifteen inches wide, and twelve inches high, consisted of eighty-one tubes of an inch diameter. This little steam-boat had a velocity of about four miles an hour, or, for short distances, of seven or eight miles an hour. The subsequent vessels of Stevens and his son will be hereafter noticed. About the same time (1804) Oliver Evans, another early American improver of the steam-engine, constructed his 'Orukter Amphibolos,' or machine for removing mud from docks, with a steam-engine to work the buckets. It was a heavy flat-bottomed boat, thirty feet long and twelve feet broad. Evans constructed this machine at a distance of a mile and a half from the river Schuylkill, and exhibited his long-cherished project of steam locomotion on land by mounting it upon wheels, and connecting them with the engine. [STEAM-CARRIAGE, p. 487.] After doing this to his satisfaction, he fitted a paddle-wheel to the stern of the machine, and launched it on the river as a steam-boat.

It is not pretended that the above account embraces every project brought forward, or even every public experiment made respecting navigation by steam; but enough has been related to show that its possibility had long been contemplated, and that many persons had expended much time and money upon the scheme before a single steam-vessel was regularly used for the purposes of commerce. Upon the subsequent history of steam navigation it is needless to treat at length; but, before entering upon it, it may be well to state that besides the claims to the invention which have been put forth on behalf of Spain, France, England, Scotland, and North America, one has been made also for an Italian, named Serapino Serrati, in a work published at Florence in 1796, in which it is stated that Watt was the inventor of steam-engines in England in 1787, but that Serrati was 'the first not only to conceive the design of a steam-boat, but also to place one upon the river Arno, which runs through Florence.' Russell observes that he had no means of testing the truth of this statement, but that, like the narrative of Garay's performances, it may be either true or untrue, without affecting the history of steam navigation; since it is evident that our present system of steam navigation has been in no way derived from either of them.

*History of the Practical Application of Steam Navigation.*—In order to the successful introduction of any great improvement, much more is required than mere proof of its possibility. It must be shown to be also profitable, and in some degree necessary; and, when everything has been done which it is in the power of the inventor to accomplish, it must be taken up by parties able and willing to meet and triumph over incredulity and prejudice. There are some cases in which the author of a valuable invention succeeds in obtaining liberal patronage by his own unaided exertions; but the instances are more numerous in which an enterprising speculator, who has had little to do with the labour of invention, is the first to reap benefit from a project that has perhaps occupied years of anxious and unrequited labour. It seldom happens indeed that the persons who can conceive and construct a new machine possess also the qualities necessary for rendering it commercially successful. Hence it is not difficult to account for the fact that while the machinery of Symington, which had accomplished more than any other steam-boat apparatus, remained for years disregarded in his own country, Fulton, with less merit as an inventor, but with more ample pecuniary resources, and with energy to face the numerous obstacles to the scheme, succeeded in establishing steam navigation on the rivers of America, and in thereby acquiring a larger share of honour than is due to him. Without denying that his perseverance did essential service to the cause, or even depriving him, as some would do, of all merit as an inventor, it is notorious that he sought for and obtained minute information respecting the early experiments of Miller, Taylor, and Symington, as well as the later experiments of Symington under Lord Dundas; and that, until he had personally inspected the steam tug-boat on the Forth and Clyde canal, he did not accomplish anything which will bear comparison with what the Scotch experimenters effected.

Fulton returned to America towards the latter end of 1806, and immediately commenced building a steam-boat for use upon the Hudson. This vessel was built at New York, and was launched in the spring of 1807. The engines were mounted and ready for trial by August in that year, engineers from Soho assisting in the work, and when the vessel started, its success became immediately evident. Colden, in describing the first trip, says, 'The minds of the most incredulous were changed in a few minutes—before the boat had made the progress of a quarter of a mile the greatest unbeliever must have been converted. The man who, while he looked on the expensive machine, thanked his stars that he had more wisdom than to waste his money on such idle schemes, changed the expression of his features as the boat moved from the wharf and gained her speed; his complacent smile gradually stiffened into an expression of wonder; the jeers of the ignorant, who had neither sense nor feeling enough to repress their contemptuous ridicule and rude jokes, were silenced for the moment by a vulgar astonishment, which deprived them of the power of utterance, till the triumph of genius extorted from the incredulous multitude which crowded the shores shouts and acclamations of congratulations and applause.' Soon afterwards this vessel, which was named, from Livingstone's residence, the Clermont, made her first voyage from New York to Albany, a distance of about a hundred and forty-five miles, though it has frequently been stated to be a hundred and fifty or a hundred and sixty miles; which distance it accomplished at the rate of about five miles an hour. On the first journey however the boat did not run through at once, but stopped at Clermont for some time. The whole voyage was performed without any accident. So novel an object as a steam-boat very naturally called forth the astonishment of persons who, like many of the inhabitants of the shores of the Hudson, had never even heard of a steam-engine. Colden states that the vessel was described by some who saw her indistinctly in the night, as 'a monster moving on the water, defying the winds and tide, and breathing flames and smoke.' 'She had,' he proceeds to say, 'the most terrific appearance from other vessels which were navigating the river when she was making her passage. The first steam-boats, as others yet do, used dry pine-wood for fuel, which sends forth a column of ignited vapour, many feet above the flue, and whenever the fire is stirred a galaxy of sparks fly off, which in the night have an airy, brilliant, and beautiful appearance. This uncommon light first attracted the attention of the crews of other vessels. Notwithstanding the wind and tide were adverse to its approach, they saw with astonishment that it was rapidly coming towards them; and when it came so near that the noise of the machinery and the paddles were heard, the crews in some instances shrunk beneath their decks from the terrific sight; and others left their vessels to go on shore; while others again prostrated themselves, and besought Providence to protect them from the approach of the horrible monster which was marching on the tides, and lighting its path by the fires which it vomited.'

Satisfactory as was the performance of the Clermont, she did not, owing to the want of proper proportion in the wheels, attain so great a speed as Fulton had anticipated. The dimensions of the boat, which was of a hundred and sixty tons burden, were one hundred and thirty-three feet long, eighteen feet wide, and seven feet deep. Her cylinder was two feet in diameter, and four feet stroke; and the paddle-wheels were fifteen feet in diameter, with paddles four feet long, dipping two feet into the water. These dimensions probably refer to the improved paddle-wheels used subsequent to the first trial, those originally used being too large, so that they dipped too deep into the water. The wheels were of cast iron, and had no support beyond the sides of the vessel, and consequently some trouble was occasioned by their frequent breakage in the earlier experiments. The vessel made several trips as a passage-boat between New York and Albany in the year in which she was launched; and, after being repaired and strengthened during the winter, she was again brought into action in 1808, with complete success. In common with many other public benefactors, Fulton had to bear with much ungenerous opposition and rivalry. It is stated that the jealousy of some parties interested in the sailing-vessels displayed itself in the wilful damage of the Clermont, by other vessels running foul of her. In spite of all opposition, the Clermont, and the steam-vessels subsequently built by her proprietors, immediately obtained considerable patronage, and the profitable establishment of steam navigation on the rivers of America was fairly accomplished. Until his death in 1815, Fulton continued to be actively engaged in building steam-vessels, and at that time he had just completed a large steam-frigate or floating battery, supported by two hulls, with a canal fifteen feet wide between them, in which the paddle-wheel worked. So highly were his services then appreciated, that, besides other testimonies of respect, the members of both houses of the legislature wore mourning on occasion of his death.

Fulton had scarcely launched the Clermont before a rival appeared. Stevens of Hoboken had a steam-vessel ready for trial in a few weeks after the triumph of Fulton; but, as the monopoly of steam navigation in the state of New York was secured to Livingstone and Fulton, he could not employ it upon the Hudson, and therefore took it round by sea to the Delaware, thus becoming the first (unless the case of Garay be an exception) to venture to sea with a steam-vessel. To R. L. Stevens, his son, American steam navigation is deeply indebted. He has, according to Russell, improved the form of the American vessels, by substituting a very long proportion, with a fine entrance and a fine run, for the full round bows and sterns of Fulton, whose boats were, he says, mere boxes sharpened a little at both ends, which drove before them so large a heap of water as to limit their speed to about nine miles an hour. The improvements of Stevens enabled him to rise to a velocity of thirteen miles an hour. He also adopted a different form of engine from that of Fulton; using cylinders of very long stroke, with upright guides, instead of the old parallel motion, to ensure the accurate motion of the piston, and placing the working beam above the deck, instead of altering the usual arrangement of the machinery in order to keep it below the deck, as done in Fulton's engines and in those commonly used in British steam-vessels.

The practical application of steam navigation in Scotland, though attributable to the experiments of Miller, Taylor, and Symington, at least as distinctly as were the operations of Fulton upon the rivers of North America, did not take place till a few years later, and was in some degree suggested by them. Henry Bell, of Helensburgh, on the Clyde, the individual by whom steam-vessels were first used in Britain for commercial purposes, had been well acquainted with the experiments at Dalswinton and on the Forth and Clyde canal; but he did not take any step for carrying into effect the important scheme of which they proved the practicability, until the proceedings of Fulton, combined with peculiar circumstances in his own case, urged him to do so. Of the connection that existed between Fulton and Bell we have never met with any satisfactory account. In a letter published in 1816, in the 'Caledonian Mercury,' Mr. Bell himself states that Fulton had occasion to write *to him* respecting some machinery in Scotland, and, in doing so, requested him to make inquiries respecting Miller's boats, and, if they had succeeded, to send him a full drawing and description of the apparatus. Bell accordingly had a conversation with Mr. Miller on the subject, and sent Fulton the information he required. The date of this transaction is not stated, but it is affirmed that about two years afterwards Fulton wrote to Bell, informing him that he had constructed a steam-boat from the drawings he had sent, which was likely to answer the end, but required some improvement. These letters of Fulton, which would throw light upon the history of steam navigation, were left, according to Bell's account, in the hands of Mr. Miller. He proceeds to say, 'This letter led me to think of the absurdity of writing my opinion to other countries, and not putting it in practice myself in my own country; and, from these considerations, I was roused to set on foot a steam-boat, for which I made a number of different models before I was satisfied. When I was convinced that they would answer the end, I contracted with Messrs. John Wood and Company, ship-builders in Port-Glasgow, to build me a steam-vessel, according to my plans, forty feet keel, and ten feet six inches beam, which I fitted up with an engine and paddles, and called her the Comet, because she was built and finished the same year that a comet appeared in the north-west part of Scotland.' Owing to some misapprehension, it was erroneously stated in the Fifth Report of the Select Committee on the Roads from London to Holyhead, in 1822, that Bell went over to America to assist Fulton in establishing steam-boats in that country. In the minute and interesting narrative of Russell, who, from residing in the neighbourhood, has peculiar facilities for obtaining correct information respecting the history of steam navigation upon the Clyde, it is stated that Bell was a house-carpenter in Glasgow for many years, and was rather fond of what are called *schemes*. In the year 1808 he engaged in an undertaking somewhat of this character, by becoming proprietor of an establishment of the nature of an hotel, or bath-house, at Helensburgh, a watering-place on the Clyde, opposite to Greenock. To increase the facilities for reaching this place, and thereby to induce a larger influx of visitors from Glasgow, Bell endeavoured to introduce passage-boats moved by paddles impelled by manual labour; but his experiments failed, and at length he determined upon the construction of a steam-boat to meet the difficulty. Thus his connection with an undertaking of very different character, combined with his correspondence with Fulton, led him to take this important step.

The Comet was a vessel of forty feet keel, and ten and a half feet beam; of about twenty-five tons burden, and three-horse power. Representations of her machinery are given by the author just referred to, who now possesses her original boiler. It was inferior to those used by Symington, inasmuch as the fire was not wholly surrounded by water, so that the furnace had to be enclosed with brick-work. The boiler was placed on one side of the vessel, and the funnel, or chimney, was bent so as to rise in the centre of the vessel, where it served the purpose of a mast for carrying sail. 'It seems indeed,' observes the writer, 'to have been the anxious wish of the constructors of the early steam-boats to disguise the odious smoking funnel under the designation of a main-mast; and some even went so far as to raise up a top-mast in the thick folds of the dense black smoke.' The accuracy of this observation may be seen by the representations of the earliest steam-boats used upon the Thames, in Dodd's 'Historical and Explanatory Dissertation on Steam-Engines and Steam-Packets,' published in 1818. A single cylinder was used in the Comet, impelling a cranked axle which carried a large toothed wheel; and this wheel, working into two others fixed upon the axles of the paddles, caused them to revolve. Two paddle-wheels, or rather two sets of revolving paddles, each consisting of four paddles of a form resembling malt-shovels, were used on each side of the vessel. The engine was of the bell-crank construction, and was placed alongside of the boiler, and the two occupied the whole width of the boat.

This vessel began to run regularly between Glasgow and Helensburgh, in January, 1812, and continued to ply successfully during the following summer; her rate of motion was about five miles an hour. Improvements were soon found advisable, and Bell soon abandoned the peculiar arrangement of paddles by which his first experiment was distinguished, and adopted complete paddle-wheels. As was the case with Fulton in America, Bell had no sooner established his first steam-packet, than others were ready to follow in his track; and these, having the advantage of his experience, and possibly of more scientific knowledge also, exceeded him in success. The second steam-boat established on the Clyde, the Elizabeth, was commenced as early as March, 1812, and was ready for use about twelve months after. She was the property of Mr. Hutchison, a brewer; but she was built under the direction of an engineer named Thomson, who had been engaged in some of Bell's first experiments. She was of longer proportion than the Comet, being fifty-eight feet long aloft, fifty-one feet keel, twelve feet beam, and five feet deep; and her proportion of power to tonnage was much better, her burden being about thirty-three tons, and her engine of about ten-horse power. The Elizabeth performed the passage of twenty-seven miles, between Glasgow and Greenock, twice a day; and, according to her owner's account, made the voyage in something less than four hours, with a hundred passengers on board, and, in favourable circumstances, in two hours and three-quarters. She accomplished, it would appear from the same statement, a distance of eighty-one miles in one day, at an average rate of nine miles an hour. The arrangements for the accommodation of passengers were comfortable, although the description of the cabins contrasts rather curiously with the ample dimensions of the river steamers of the present day. These particulars are given at length by Russell; but we quote only the dimensions of the cabins, of which the best was twenty-one feet long, eleven feet three inches wide at midships, and nine feet four inches aft, and the forecastle was about eleven feet six inches by nine feet six inches. The fares for the best and inferior cabins were, respectively, four shillings, and two shillings and sixpence, being about one-third the amount of the coach fares. This speculation was immediately successful; and the profitable introduction of steam navigation on the rivers of Great Britain proceeded rapidly after the time alluded to.

Stuart relates that while Bell was engaged in establishing his steamers on the Clyde, a person named Dawson was making similar experiments in Ireland; and that he had, according to his own account, built a steam-boat of fifty tons burden, worked by a high-pressure steam-engine, as early as 1811; which, by one of those singular coincidences frequently met with in the history of inventions, he named the Comet. In 1813, it is added, Dawson established a steam-packet on the Thames, to ply between Gravesend and London, 'which was the first that did so for public accommodation, although Mr. Lawrence of Bristol, who introduced a steam-boat on the Severn, soon after the successful operations on the Clyde, had her carried to London (through the canals) to ply on the Thames; but from the opposition of the watermen to the innovation, he was in the end obliged to take her to her first station.' If this be correct, the Gravesend steam-packet alluded to must have been overlooked by the author of a pamphlet published in 1831, entitled 'An Account of the Origin of Steam-boats in Spain, Great Britain, and America; and of their Introduction and Employment upon the river Thames, between London and Gravesend, to the present time;' which, according to a MS. note on the copy in the British Museum, is by R. P. Cruden, of Milton by Gravesend. It states that the first steam-boat which plied between London and Gravesend was the Margery, of seventy tons burden, and fourteen-horse power; a vessel originally used on the Clyde, where she was built in 1813, by Messrs. Wood, of Port-Glasgow, the builders of the Comet and the Elizabeth. She was, it is stated, brought to London from Leith early in 1815, and on the 23rd of January in that year she began to ply between London and Gravesend, charging four shillings and two shillings for the best and inferior cabins respectively. She ran for some months, but had occasion to stop so frequently for repairs, that she never ran more than about three weeks without interruption. This vessel was, in the following year, removed to France, for use upon the Seine; and that tried on the Thames by Dawson was, according to Stuart, sent to Spain, to ply between Seville and San Lucar. Cruden states that the Richmond packet had been employed between London and Richmond in the year preceding the use of the Margery on the Gravesend station.

Among the enterprising individuals by whose exertions steam-boats were established upon the Thames, the name of George Dodd deserves a prominent place, although his history is a melancholy instance of the poverty which often attends the most ingenious inventors. He was, it would appear, the first to undertake a considerable voyage by sea in a steam-vessel. The boat with which this voyage was accomplished was built on the Clyde by Messrs. Wood, and was launched in 1813, under the name of the Glasgow; but was subsequently altered, and called the Thames. She was of seventy-four or seventy-five tons burden, and about fourteen or sixteen horse-power, with paddle-wheels nine feet in diameter. Dodd brought her round to the Thames by steam and sails, experiencing some very rough weather on the way, especially in the Irish Sea. A detailed account of the voyage was published in the 'Journal des Mines' for September, 1815, and subsequently at the end of Dodd's work on steam-boats. It is needless to follow minutely the extension of steam navigation in the British dominions and elsewhere subsequent to the success of Bell and his immediate followers. Bell himself said, 'I will venture to affirm that history does not afford an instance of such rapid improvement in commerce and civilization as that which will be effected by steam-vessels;' and probably there are few at the present time who would not fully acknowledge the truth of his prediction. The statistical tables hereafter given will show how rapid has been the increase of steam-vessels, although they do not embrace the whole of the steam-boats employed; but it may be interesting to give, from Dodd, an enumeration of the principal steam-vessels in use in Great Britain and Ireland at the date of his work (1818). He states that there were then eighteen steam-boats on the Clyde, two at Dundee, two on the Tay, two on the Trent, two on the Tyne, four on the Humber, two on the Mersey, three on the Yare, one on the Avon, one on the Severn, one on the Orwell, six on the Forth, two at Cork, and two intended to navigate from Dublin to Holyhead. In another part of his work he describes the vessels then in use upon the Thames, of which two, the Richmond and the London, plied between London, Richmond, and Twickenham, and had, he says, carried not less than ten thousand passengers within the last four months. These were built under Dodd's superintendence; and in consequence of having to pass under the bridges, they were made with an apparatus of his invention for lowering their chimneys. These boats experienced much but ineffectual opposition from the watermen, who deemed their use an invasion of their rights. A third steam-vessel designed by Dodd, the Sons of Commerce, intended for use between London and Gravesend, had been used, in the season preceding the publication of his work, between London and Margate, and had once performed the journey, about eighty-eight miles, in seven hours and thirty-five minutes. Her speed, when unassisted by wind or tide, was ten miles an hour. Another boat, the Majestic, plied between London and Margate in 1816. This vessel had been to Calais, and had often towed vessels of seven hundred tons burden down the river. The Regent, one of the early Thames steamers, was accidentally burnt off Whitstable, in July, 1817. Besides these, Dodd mentions the Caledonia, with two engines of fourteen-horse power, which had been from Margate to Flushing, and also on the Rhine; the Eagle, which had a single paddle-wheel in the centre, and failed, he argues, for want of room for the escape of the water agitated by the paddles; the Hope, a small vessel, built at Bristol, which proved a failure; and the Thames, the vessel which Dodd himself brought from the Clyde. In addition to British steam-vessels, it is stated that there were at that time steam-packets and steam luggage-vessels used in Russia, the Netherlands, France, and Spain; and that one was building in the East Indies. In order to give an approximate statement of the progress of steam navigation in the United States about the same period, a few facts may be quoted from the evidence of Seth Hunt, Esq., formerly commandant of Upper Louisiana, before the select committee of the House of Commons appointed in 1817 to consider the means of preventing the mischief of explosion on board steam-boats. This gentleman stated that there were then ten steam-vessels running between New York and Albany, two between New York and the State of Connecticut, and four or five to New Jersey, besides the ferry-boats, of which there were four.* On the river Delaware there were also a number of boats, which plied between Philadelphia and Trenton in New Jersey; and others between Philadelphia and Newcastle, and Philadelphia and Wilmington, besides ferry-boats. Some of these were worked with high-pressure engines. There were steam-boats from Baltimore to Norfolk, which passed a part of the Chesapeak, several miles in width; and steam-vessels had been to New London, which is still more exposed; and also up to New Hertford. The Powhatan steam-boat, which was built at New York, had been exposed to a severe gale of wind in the open ocean for three days, after which it arrived at Norfolk, and thence proceeded up the James river to Richmond. The largest steam-boats in America were those upon the Mississippi, plying between New Orleans and Natchez. These vessels, the Etna and Vesuvius, were of four hundred and fifty tons burden, and carried two hundred and eighty tons of merchandise, one hundred passengers, and seven hundred bales of cotton. This witness remembered but three steam-boat accidents in America, one of which was on the Ohio, another at Charlestown in South Carolina, and a third to the Powhatan.

The introduction of steam-packets upon the open sea was a favourite object with Dodd. He observes particularly the great importance of their establishment between Dublin and Holyhead, as the intercourse by sailing packets was liable to great delays. They were sometimes, it is stated, more than seventy-six hours at sea, although the distance is only about sixty miles. The use of steam-vessels upon this station was advocated for several years before they were regularly established; and Dodd had, on behalf of himself and friends, offered to bear the expense of two packets for making the experiment, provided the Post-office authorities would guarantee to him the conveyance of the mails, in the event of those packets fully answering his representations; but his offer was not accepted. It has been shown that some sea-voyages were performed at an earlier date; but the regular establishment of ocean steam navigation may be considered to have commenced with the Rob Roy, a steamer of about thirty-horse power and ninety tons burden, which commenced running in 1818 between Greenock and Belfast. This vessel was established by Mr. David Napier, who, says Russell, from the year 1818 until about 1830, 'effected more for the improvement of steam navigation than any other man.' This gentleman must be distinguished from his cousin, Mr. Robert Napier, of Glasgow, who is also honourably known for improvements of the same kind, but of a somewhat later date. David Napier, according to the interesting narrative of the progress of steam navigation in Britain, given by the above-mentioned writer, ventured at once to establish regular communication between Britain and the neighbouring countries, Ireland and France, by steam-vessels plying even during the stormy months of winter; though, previous to the time of his improvements, such vessels had scarcely ever ventured to sea except in fine weather. In order to make himself well acquainted with the difficulties to be overcome, he took passage, at the worst season of the year, in one of the sailing vessels which formerly plied between Glasgow and Belfast, and which often required a week to perform a journey that is now done by steam in nine hours. After anxiously watching the effect of the waves when the vessel was tossed in a storm, and satisfying himself that there was no insuperable difficulty, he retired contentedly to his cabin, leaving the captain of the vessel puzzled at his strange curiosity respecting the effect of rough weather. He subsequently tried experiments upon the best form of hull for getting through the water with the minimum of resistance; and these led him to adopt a fine wedge-like form for the fore part of his vessels, instead of the round full bow common in those propelled by sails. The Rob Roy, after plying two winters between Greenock and Belfast, was removed from that line, and employed as a packet between Dover and Calais. In 1819 he employed the Messrs. Wood to build the Talbot, of one hundred and fifty tons burden, into which he fitted two engines of thirty-horse power each. This fine vessel, the most perfect of her time in all respects, plied between Holyhead and Dublin; and she was soon followed, on the same line, by another excellent vessel, called the Ivanhoe. In 1821 steam-vessels were regularly established as Post-office packets on that important station. They had been intended merely as auxiliaries to the sailing packets; but they soon superseded them. From the evidence given before the Holyhead Roads Committee in 1822, it appears that even then the intercourse between the two countries had been reduced almost to a certainty; and that while, in the year preceding their adoption, exactly one hundred mails arrived in London after the proper time, there were only twenty-two cases of delay in the first nine months in which the steam-packets were used, although this period included the winter season, during the early part of which the weather was worse than had been known for more than sixty years. The vessels which were built expressly for this purpose were strengthened by diagonal framing upon the plan of Sir Robert Seppings.

It would occupy great space to follow, however imperfectly, the rapid progress of steam navigation in this country alone, and it may be more readily traced by reference to the tables hereafter inserted, which are founded upon parliamentary documents. The adoption of steam-vessels in every direction upon the ocean, and their use upon the rivers and lakes of every civilised country, have produced, and are daily producing, results which it is impossible fully to estimate. But we must notice the successful accomplishment of Transatlantic steam navigation, of which not only the probability was questioned even a few years since, but which was almost proved to be impossible down nearly to the time of its accomplishment. Experience has shown the great advantage of large over small steamers, because the capacity and buoyancy of the vessel increase in so much larger a ratio than the resistance; but in order to obtain sufficient room for carrying the enormous supply of fuel required for a voyage across the Atlantic, and at the same time to allow accommodation for passengers and cargo to a remunerative amount, it was necessary to build vessels of extraordinary dimensions. At length the great problem was solved by the voyages, in 1838, of the Sirius and the Great Western, each of which crossed the Atlantic direct for New York, without touching, as many advocates of Transatlantic steam navigation had considered desirable, at the Azores, St. John's, or Halifax. The Sirius, of seven hundred tons burden, and three hundred and twenty horse-power, had previously run between London and Cork. She was therefore prepared for the trial a few days earlier than her formidable rival, a vessel of thirteen hundred and forty tons burden, and four hundred and sixty horse-power. The Sirius started from Cork on the 4th of April, and arrived at New York early on the 23rd of the same month, having performed the voyage at the average rate of one hundred and sixty-one miles daily, or a little short of seven miles per hour. In her return she averaged a hundred and sixty-seven miles daily, or as near as possible seven miles an hour. The Great Western started from Bristol on the 8th of April, and arrived at New York on the same day as the Sirius, but some hours later. Her average speed on the outward voyage was two hundred and eight miles a day, or between eight and nine miles an hour, and in returning two hundred and thirteen miles daily, or very nearly nine miles per hour. The enterprise which thus commenced so favourably has been checked by some unfortunate occurrences, especially by the loss of the President; and consequently one of the companies formed for carrying on a steam communication between England and America has relinquished it, and the British Queen, one of the noble vessels built for the purpose, has been sold to parties who purpose running her between Belgium and New York; but,

* In Robertson Buchanan's 'Practical Treatise on Propelling Vessels by Steam, &c.,' which was published at Glasgow in 1816, allusion is made to ferry-boats then in use in America, under the name of *team-boats*, which were propelled by paddle-wheels worked by cattle.

notwithstanding all discouragement, the use of steam-vessels for long voyages may be considered fairly established.

The immense influence which steam navigation would have upon maritime warfare has attracted much attention, and has led to the construction, in this and other countries, of many steam-vessels adapted for the purposes of war. Happily there has been, since its practical introduction, little opportunity for this application of steam navigation. Our statistics may therefore be limited to the progress of commercial steam navigation, which, so far as Great Britain and its dependencies are concerned, may be accurately traced by means of the following tables, which are founded upon Custom-House returns and other official documents. They are however necessarily incomplete, because no correct information can be obtained respecting unregistered vessels, which ply only within the limits of their respective ports. Government steamers, of which several are employed as mail-packets, are not included. Tables I., II., and III. are extracted from the 'Tables of Revenue, Population, and Commerce,' for 1836, issued by the Board of Trade; and continued to the latest period of which the returns have been published, from the subsequent volumes of the same series.

I. *Table showing the Number and Tonnage of Steam-Vessels Built and Registered in the British Empire in each year from* 1814 *to* 1839.

| Years. | England. | | Scotland. | | Ireland. | | United Kingdom. | | Isles of Guernsey, Jersey, and Man. | | British Plantations. | | Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. |
| 1814 | .. | .. | 5 | 285 | .. | .. | 5 | 285 | .. | .. | 1 | 387 | 6 | 672 |
| 1815 | 2 | 161 | 7 | 625 | .. | .. | 9 | 786 | .. | .. | 1 | 608 | 10 | 1,394 |
| 1816 | 4 | 298 | 4 | 270 | .. | .. | 8 | 568 | .. | .. | 1 | 670 | 9 | 1,238 |
| 1817 | 4 | 227 | 3 | 194 | .. | .. | 7 | 421 | .. | .. | 3 | 1,633 | 10 | 2,054 |
| 1818 | 3 | 1,124 | 3 | 216 | .. | .. | 6 | 1,340 | .. | .. | 3 | 1,198 | 9 | 2,538 |
| 1819 | 2 | 175 | 2 | 167 | .. | .. | 4 | 342 | .. | .. | .. | .. | 4 | 342 |
| 1820 | 3 | 102 | 4 | 403 | 1 | 150 | 8 | 655 | .. | .. | 1 | 116 | 9 | 771 |
| 1821 | 12 | 1,463 | 10 | 1,545 | .. | .. | 22 | 3,008 | .. | .. | 1 | 258 | 23 | 3,266 |
| 1822 | 23 | 2,080 | 4 | 369 | .. | .. | 27 | 2,449 | .. | .. | 1 | 185 | 28 | 2,634 |
| 1823 | 17 | 2,344 | 2 | 125 | .. | .. | 19 | 2,469 | .. | .. | 1 | 52 | 20 | 2,521 |
| 1824 | 12 | 1,687 | 5 | 547 | .. | .. | 17 | 2,234 | .. | .. | .. | .. | 17 | 2,234 |
| 1825 | 19 | 2,600 | 5 | 403 | .. | .. | 24 | 3,003 | .. | .. | 5 | 1,189 | 29 | 4,192 |
| 1826 | 50 | 5,920 | 22 | 2,718 | .. | .. | 72 | 8,638 | .. | .. | 4 | 404 | 76 | 9,042 |
| 1827 | 18 | 2,264 | 9 | 994 | 1 | 118 | 28 | 3,376 | .. | .. | 2 | 408 | 30 | 3,784 |
| 1828 | 25 | 1,687 | 5 | 352 | .. | .. | 30 | 2,039 | .. | .. | 1 | 246 | 31 | 2,285 |
| 1829 | 13 | 1,080 | 3 | 671 | .. | .. | 16 | 1,751 | .. | .. | .. | .. | 16 | 1,751 |
| 1830 | 10 | 931 | 8 | 814 | .. | .. | 18 | 1,745 | .. | .. | 1 | 481 | 19 | 2,226 |
| 1831 | 24 | 2,054 | 7 | 695 | .. | .. | 31 | 2,749 | .. | .. | 5 | 1,687 | 36 | 4,436 |
| 1832 | 19 | 943 | 14 | 1,908 | .. | .. | 33 | 2,851 | .. | .. | 5 | 1,239 | 38 | 4,090 |
| 1833 | 27 | 1,964 | 6 | 964 | .. | .. | 33 | 2,928 | .. | .. | 3 | 1,017 | 36 | 3,945 |
| 1834 | 26 | 3,453 | 10 | 1,675 | .. | .. | 36 | 5,128 | .. | .. | 3 | 628 | 39 | 5,756 |
| 1835 | 63 | 6,844 | 23 | 4,080 | .. | .. | 86 | 10,924 | .. | .. | 2 | 357 | 88 | 11,281 |
| 1836 | 43 | 5,924 | 20 | 2,834 | .. | .. | 63 | 8,758 | .. | .. | 6 | 942 | 69 | 9,700 |
| 1837 | 53 | 6,223 | 22 | 4,488 | 3 | 958 | 78 | 11,669 | .. | .. | 4 | 478 | 82 | 12,147 |
| 1838 | 66 | 6,286 | 18 | 3,263 | .. | .. | 84 | 9,549 | .. | .. | 3 | 288 | 87 | 9,837 |
| 1839 | 43 | 2,885 | 18 | 2,968 | 1 | 286 | 62 | 6,139 | .. | .. | 3 | 383 | 65 | 6,522 |
| Total . | 581 | 60,719 | 239 | 33,573 | 6 | 1,512 | 826 | 95,804 | .. | .. | 60 | 14,854 | 886 | 110,658 |

II. *Table Showing the Number and Tonnage of Registered Steam-Vessels belonging to the British Empire, in each year from* 1814 *to* 1839.

| Years. | England. | | Scotland. | | Ireland. | | United Kingdom. | | Isles of Guernsey, Jersey, and Man. | | British Plantations. | | Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. | Vessels. | Tonnage. |
| 1814 | .. | .. | 1 | 69 | .. | .. | 1 | 69 | .. | .. | 1 | 387 | 2 | 456 |
| 1815 | 3 | 209 | 5 | 429 | .. | .. | 8 | 638 | .. | .. | 2 | 995 | 10 | 1,633 |
| 1816 | 5 | 315 | 7 | 632 | .. | .. | 12 | 947 | .. | .. | 3 | 1,665 | 15 | 2,612 |
| 1817 | 7 | 462 | 6 | 514 | 1 | 63 | 14 | 1,039 | .. | .. | 5 | 2,911 | 19 | 3,950 |
| 1818 | 10 | 1,586 | 8 | 683 | 1 | 63 | 19 | 2,332 | .. | .. | 8 | 4,109 | 27 | 6,441 |
| 1819 | 11 | 1,459 | 11 | 825 | 2 | 264 | 24 | 2,548 | .. | .. | 8 | 4,109 | 32 | 6,657 |
| 1820 | 17 | 1,639 | 14 | 1,127 | 3 | 252 | 34 | 3,018 | .. | .. | 9 | 4,225 | 43 | 7,243 |
| 1821 | 29 | 3,377 | 26 | 2,344 | 4 | 330 | 59 | 6,051 | .. | .. | 10 | 4,483 | 69 | 10,534 |
| 1822 | 52 | 5,322 | 28 | 2,701 | 5 | 434 | 85 | 8,457 | .. | .. | 11 | 4,668 | 96 | 13,125 |
| 1823 | 69 | 7,527 | 26 | 2,347 | 6 | 487 | 101 | 10,361 | .. | .. | 10 | 3,792 | 111 | 14,153 |
| 1824 | 80 | 8,642 | 29 | 2,682 | 5 | 409 | 114 | 11,733 | 2 | 214 | 10 | 3,792 | 126 | 15,739 |
| 1825 | 112 | 12,280 | 36 | 3,292 | 3 | 192 | 151 | 15,764 | 2 | 214 | 15 | 4,309 | 168 | 20,287 |
| 1826 | 162 | 16,791 | 51 | 4,496 | 15 | 2,899 | 228 | 24,186 | 2 | 214 | 18 | 4,558 | 248 | 28,958 |
| 1827 | 173 | 17,734 | 59 | 5,390 | 21 | 4,194 | 253 | 27,318 | 2 | 214 | 20 | 4,958 | 275 | 32,490 |
| 1828 | 191 | 18,367 | 56 | 4,903 | 25 | 4,740 | 272 | 28,010 | 2 | 214 | 19 | 3,808 | 293 | 32,032 |
| 1829 | 203 | 19,085 | 57 | 5,399 | 27 | 5,017 | 287 | 29,501 | 2 | 214 | 15 | 2,568 | 304 | 32,283 |
| 1830 | 203 | 18,831 | 61 | 5,687 | 31 | 5,491 | 295 | 30,009 | 3 | 330 | 17 | 3,105 | 315 | 33,444 |
| 1831 | 223 | 20,304 | 62 | 5,777 | 35 | 6,181 | 320 | 32,262 | 4 | 433 | 23 | 4,750 | 347 | 37,445 |
| 1832 | 235 | 20,813 | 73 | 7,205 | 40 | 7,220 | 348 | 35,238 | 4 | 474 | 28 | 5,957 | 380 | 41,669 |
| 1833 | 268 | 23,290 | 71 | 7,075 | 43 | 7,757 | 382 | 38,122 | 5 | 555 | 28 | 6,340 | 415 | 45,017 |
| 1834 | 301 | 27,059 | 77 | 8,187 | 46 | 8,183 | 424 | 43,429 | 6 | 711 | 32 | 6,595 | 462 | 50,735 |
| 1835 | 344 | 30,351 | 85 | 9,833 | 68 | 12,583 | 497 | 52,767 | 6 | 718 | 35 | 7,035 | 538 | 60,520 |
| 1836 | 388 | 34,314 | 95 | 11,588 | 71 | 13,460 | 554 | 59,362 | 7 | 914 | 39 | 7,693 | 600 | 67,969 |
| 1837 | 422 | 37,240 | 109 | 13,368 | 87 | 18,437 | 618 | 69,045 | 6 | 832 | 44 | 8,411 | 668 | 78,288 |
| 1838 | 484 | 43,877 | 105 | 13,113 | 84 | 17,694 | 673 | 74,684 | 5 | 709 | 44 | 7,323 | 722 | 82,716 |
| 1839 | 517 | 45,160 | 117 | 15,704 | 86 | 18,376 | 720 | 79,240 | 3 | 389 | 47 | 7,102 | 770 | 86,731 |

III. *Table showing the Number and Tonnage of Steam-Vessels which Entered and Cleared from the Ports of the United Kingdom in each Year from* 1820 *to* 1839, *distinguishing the Countries to which they belonged, and separating the Vessels employed in the Coasting Trade from those engaged in Foreign Voyages. The figures give the number of Voyages, and the aggregate Amount of Tonnage for the Year. Vessels in Ballast, or with Passengers only, are not included.*

| Years. | Countries to which the Vessels belonged. | COASTING TRADE. Inwards. Ships. | Tons. | Outwards. Ships. | Tons. | FOREIGN TRADE. Inwards. Ships. | Tons. | Outwards. Ships. | Tons. |
|---|---|---|---|---|---|---|---|---|---|
| 1820* | United Kingdom | 9 | 505 | .. | .. | .. | .. | .. | .. |
| 1821 | United Kingdom | 188 | 20,028 | 158 | 6,166 | .. | .. | .. | .. |
| 1822 | United Kingdom | 215 | 31,596 | 295 | 42,743 | 159 | 14,497 | 111 | 12,388 |
| | France | .. | .. | .. | .. | 10 | 520 | .. | .. |
| 1823 | United Kingdom | 434 | 55,146 | 647 | 73,424 | 129 | 8,942 | 108 | 9,027 |
| | France | .. | .. | .. | .. | 7 | 364 | 7 | 364 |
| 1824 | United Kingdom | 888 | 124,073 | 1,197 | 147,523 | 139 | 10,893 | 208 | 15,796 |
| | France | .. | .. | .. | .. | 6 | 312 | 8 | 416 |
| 1825 | United Kingdom | 1,666 | 257,734 | 1,946 | 279,384 | 186 | 16,155 | 256 | 19,685 |
| | France | .. | .. | .. | .. | 11 | 652 | 13 | 756 |
| 1826 | United Kingdom | 2,810 | 452,995 | 3,833 | 518,696 | 334 | 32,631 | 268 | 27,206 |
| | France | .. | .. | .. | .. | 38 | 2,206 | 31 | 1,742 |
| 1827 | United Kingdom | 4,404 | 737,020 | 5,617 | 820,361 | 443 | 50,285 | 439 | 47,322 |
| | France | .. | .. | .. | .. | 74 | 4,558 | 43 | 2,566 |
| 1828 | United Kingdom | 5,591 | 914,414 | 6,893 | 1,009,834 | 482 | 52,679 | 472 | 51,887 |
| | France | .. | .. | .. | .. | 58 | 3,406 | 31 | 1,802 |
| 1829 | United Kingdom | 5,792 | 978,981 | 6,875 | 1,066,041 | 497 | 51,754 | 428 | 47,480 |
| | France | .. | .. | .. | .. | 2 | 124 | 21 | 1,206 |
| | Holland | .. | .. | .. | .. | 1 | 281 | 1 | 280 |
| 1830† | United Kingdom | 6,840 | 1,050,392 | 6,808 | 1,054,850 | 560 | 62,613 | 475 | 54,372 |
| | France | .. | .. | .. | .. | 19 | 1,318 | 21 | 1,282 |
| | Holland | .. | .. | .. | .. | 23 | 6,463 | 32 | 8,992 |
| 1831 | United Kingdom | 7,123 | 1,133,110 | 7,087 | 1,129,975 | 537 | 65,946 | 563 | 67,930 |
| | France | .. | .. | .. | .. | 60 | 4,320 | 19 | 1,368 |
| | Holland | .. | .. | .. | .. | 25 | 7,025 | 38 | 10,678 |
| 1832 | United Kingdom | 7,835 | 1,223,133 | 7,797 | 1,221,628 | 537 | 71,493 | 564 | 73,898 |
| | France | .. | .. | .. | .. | 66 | 4,752 | 35 | 2,520 |
| | Holland | .. | .. | .. | .. | 8 | 2,248 | 36 | 10,116 |
| 1833 | United Kingdom | 9,070 | 1,427,493 | 9,083 | 1,431,968 | 681 | 98,224 | 704 | 102,639 |
| | France | .. | .. | .. | .. | 47 | 2,584 | 29 | 2,108 |
| | Holland | .. | .. | .. | .. | 4 | 1,124 | 16 | 4,496 |
| 1834 | United Kingdom | 10,046 | 1,609,324 | 9,941 | 1,597,270 | 988 | 146,720 | 896 | 137,607 |
| | France | .. | .. | .. | .. | 1 | 73 | 19 | 1,378 |
| | Holland | .. | .. | .. | .. | 11 | 3,091 | 38 | 10,640 |
| 1835 | United Kingdom | 11,227 | 1,849,409 | 11,105 | 1,833,496 | 1,015 | 170,151 | 1,146 | 189,305 |
| | France | .. | .. | .. | .. | .. | .. | 38 | 2,906 |
| | Holland | .. | .. | .. | .. | 18 | 5,058 | 39 | 10,920 |
| 1836 | United Kingdom | 13,003 | 2,238,137 | 12,649 | 2,178,248 | 1,122 | 195,722 | 1,225 | 202,499 |
| | France | .. | .. | .. | .. | .. | .. | 121 | 9,265 |
| | Holland | .. | .. | .. | .. | 50 | 10,948 | 67 | 14,249 |
| 1837 | United Kingdom | 15,481 | 2,671,577 | 15,019 | 2,604,739 | 1,123 | 217,640 | 1,278 | 234,919 |
| | Hanse Towns | .. | .. | .. | .. | 1 | 80 | 1 | 109 |
| | Holland | .. | .. | .. | .. | 32 | 7,164 | 40 | 10,080 |
| | Belgium | .. | .. | .. | .. | 25 | 4,925 | 27 | 5,319 |
| | France | .. | .. | .. | .. | 2 | 335 | 138 | 10,665 |
| | Spain | .. | .. | .. | .. | .. | .. | 1 | 165 |
| 1838 | United Kingdom | 15,771 | 2,959,125 | 15,489 | 2,871,506 | 1,983 | 286,264 | 2,004 | 289,977 |
| | France | .. | .. | .. | .. | 368 | 35,666 | 354 | 33,894 |
| | Holland | .. | .. | .. | .. | 34 | 7,718 | 37 | 8,399 |
| | Belgium | .. | .. | .. | .. | 39 | 11,017 | 72 | 20,263 |
| | Portugal and Brazil | .. | .. | .. | .. | .. | .. | 3 | 453 |
| 1839 | United Kingdom | 15,556 | 2,926,521 | 15,498 | 2,894,995 | 2,293 | 356,595 | 2,296 | 351,361 |
| | Russia | .. | .. | .. | .. | .. | .. | 1 | 217 |
| | Holland | .. | .. | .. | .. | 40 | 8,409 | 42 | 8,863 |
| | Belgium | .. | .. | .. | .. | 61 | 18,021 | 69 | 20,236 |
| | France | .. | .. | .. | .. | 410 | 44,343 | 360 | 39,221 |
| | Portugal and Brazil | .. | .. | .. | .. | .. | .. | 5 | 550 |
| | Turkey | .. | .. | .. | .. | .. | .. | 2 | 473 |

In the Report of the Commissioners appointed by the Privy Council in 1839 to inquire into the subject of steam-vessel accidents, an attempt is made to supply some of the deficiencies of the Custom-House returns relating to steam-vessels, by the publication of the table which is here marked IV. This table gives, *approximately*, the numerical tonnage and power of British steam-vessels, at the close of the year 1838, stating the *actual* as well as the *registered* tonnage, and giving much other information not comprised in any other published statement. In the course of their investigation of the subject more immediately before them, the commissioners obtained detailed information respecting eighty-three unregistered steam-vessels, nearly all of which were used to convey passengers. Of these vessels (which are included in the table) thirty-seven plied on the Mersey, twenty-six on the Humber, sixteen on the Thames, and four on the rivers on the east of Scotland; and the commissioners observe that there are, no doubt, many others unregistered at ports which they did not visit. The great number

* A note appended to the original document states that steam-vessels were not used in this kingdom for the conveyance of merchandise before the year 1820; but this statement must not be taken absolutely; for Dodd, writing in 1818, mentions steam-boats then in use upon the Clyde for the conveyance of goods. The original table is much more extensive than the above; separate returns being given from the ports of England, Scotland, and Ireland.

† The returns relating to the coasting trade from 1830 to 1836 are taken from the volume of tables for 1837; an error having been discovered in those previously published

of such steam-vessels may be conceived from the statement of the Report, that while there were only twenty-five registered steamers in the Humber, Ouse, and Trent, there were twenty-six unregistered, and that at Liverpool there were thirty-nine registered and thirty-seven unregistered. It is also difficult to ascertain to what place many vessels properly belong. 'Two Liverpool companies alone,' says the Report, 'possess more vessels than the total number registered there. Of the large number of trading-steamers between Ireland and Liverpool, some of which are registered in English and some in Irish ports, we (the commissioners were informed that nineteen-twentieths are owned in Ireland.' It further states, that of the seven hundred and sixty-six steam-vessels mentioned in the table as belonging to Great Britain, Ireland, and the isles of Guernsey, Jersey and Man, 'four hundred and eighty-four may be considered as river-steamers and small coasters; and two hundred and eighty-two as large coasters and sea-going ships.'

IV. *Table showing the approximate Number, Tonnage, and Power of Vessels belonging to the Mercantile Steam-Marine of the United Kingdom and its Dependencies at the end of the year* 1838.

| Size of Vessels per Custom-House Returns. | No. of Vessels per Custom-House Return. | Registered Tonnage. | Tonnage of Engine-room, &c.; not registered. | Total Computed Tonnage. | Computed Amount of Horse-power. | Average Horse-power per Vessel. | Average Computed Tonnage per Vessel. |
|---|---|---|---|---|---|---|---|
| Tons. | No. | Tons. | Tons. | Tons. | Horse-power. | Horse-power. | Tons. |
| Less than 50 | 256 | 6,106 | 10,816 | 16,922 | 6,400 | 25 | 66 |
| From 50 to 100 | 145 | 10,267 | 7,458 | 17,725 | 6,866 | 47 | 122 |
| 100 to 150 | 84 | 10,034 | 7,761 | 17,795 | 7,483 | 90 | 211 |
| 150 to 200 | 63 | 10,982 | 7,147 | 18,129 | 7,560 | 120 | 287 |
| 200 to 300 | 76 | 16,654 | 10,839 | 27,493 | 11,188 | 147 | 361 |
| 300 to 400 | 41 | 14,247 | 7,580 | 21,827 | 10,914 | 266 | 532 |
| 400 to 600 | 10 | 4,488 | 3,506 | 7,994 | 3,000 | 300 | 769 |
| 679 | 1 | 679 | 661 | 1,340 | 450 | 450 | 1,340 |
| 1,053 | 1 | 1,053 | 810 | 1,855 | 500 | 500 | 1,855 |
| Number of registered vessels in 1838 | 677* | 74,510 | 56,578 | 131,080 | 54,361 | .. | .. |
| Number not registered | 83 | 4,154 | 5,484 | 9,638 | 2,129 | 50 | 116 |
| Total number in Great Britain and Ireland | 760 | 78,664 | 62,062 | 140,718 | 56,490 | .. | .. |
| Registered vessels belonging to the isles of Guernsey, Jersey, and Man, in 1837 | 6† | 832 | 618 | 1,450 | 600 | 100 | 241 |
| Ditto, belonging to the British Plantations, in 1837 | 44† | 8,411 | 7,253 | 15,664 | 6,160 | 140 | 356 |
| Grand Totals | 810 | 87,907 | 69,933 | 157,840 | 63,250 | .. | .. |

Shortly before the date of the British inquiry into steam-vessel accidents, which led to the publication of the preceding facts, a Report was made to the Congress of the United States of America 'on the number of steam-engines and steam-boats in actual use; and of the number, nature, and causes of the disasters which have been occasioned by them.' From this Report, which is dated December 12, 1838, and has been reprinted by the English commissioners, a few statistical facts relating to steam-vessels in the United States may be gleaned. It is computed that since the first employment of steam-boats in the United States the numbers built, lost, and worn out have been about as follows.—

| | | |
|---|---|---|
| Number of steam-vessels built | | 1300 |
| Lost by various accidents | 260 | 500 |
| Worn out | 240 | |
| Remaining in use in 1838 | | 800 |

The tonnage and power of these steam-vessels are stated to be nearly as follow:—

| | |
|---|---|
| Aggregate tonnage, upwards of | 155,473 ton . |
| Average tonnage per vessel, near | 200 tons. |
| Aggregate horse-power of engines | 57,019 h.-p. |
| Average horse-power, rather more than | 70 h.-p. |

'The largest boat in the United States,' it is observed,' is supposed to be the Natchez, of eight hundred and sixty tons, and near three hundred horse-power, destined to run between New York and the Mississippi; the Illinois and the Madison, on Lake Erie, are the next in size, the former being seven hundred and fifty-five, and the latter seven hundred tons; the Massachusetts, in Long Island Sound, is the next largest, being six hundred and twenty-six tons; and the Buffalo, on Lake Erie, next, being six hundred and thirteen tons.' The government never owned, it appears from this document, more than two steam-vessels of war; and even these were at different times. The first, called the Fulton, was launched in 1815, and lost by accident in 1829 The second, of the same name, was built in 1838. The government had however, at the date of the Report, thirteen other steam-vessels, which were employed by the war department on the public works, and in the transportation of troops and stores.

*Form, Structure, and Mechanism of Steam-Vessels.*—As a ship, a steam-vessel should possess the qualities that favour rapid and steady motion through the water, combined with safety and strength to enable it to bear, without injury, the strain of the propelling machinery. The steam-engine employed to work its propelling machinery requires such modifications of arrangement as shall allow of its convenient stowage in a small space, and, in most cases, in such a position as to make the centre of gravity of the vessel as low as possible; its structure should be such as to enable it to bear the varied motions of the vessel without injury; and its power must be accurately calculated to produce the required velocity. When all these points are attended to, it still remains to provide a suitable apparatus for applying the power of the engine to the propulsion of the vessel. Considering the numerous and widely different departments of science with which an intimate acquaintance is necessary, in order to the attainment of all these requisite qualities, it need excite little surprise that so many steam-vessels have failed, and continually do fail, to accomplish as much as their builders have anticipated. The difficulty of the case is much increased by the circumstance that many of the questions to be considered are involved in uncertainty, so that nothing short of costly experience can positively determine the expediency of adopting particular forms of vessel, or arrangements of machinery, or the comparative advantages of different forms of paddle-wheels, or other contrivances for effecting progressive motion. Most of what has been effected by way of improvement upon the imperfect models of the first steam-boat builders, in Great Britain as well as in North America, has been the result of repeated

* A note to the original table, at p. 17 of the 'Report on Steam-Vessel Accidents,' observes that the Custom-House Return enumerates 678 steam-vessels; but that the tonnage of one which had been burnt was omitted. Neither number, it will be perceived, agrees perfectly with Table II., but we have no data for ascertaining where the error, if there be one, lies.

† The compilers of this table took the numbers thus marked from the Returns for 1837, because Mr. Porter's Statistical Tables for the year 1838 were not then published. The matter could not be corrected here, because we have not the information necessary for altering the following columns. The registered number and tonnage for 1838 will be found in Table II.

trials, stimulated by the generous rivalry of different builders, rather than of any minute investigation of scientific principles.

It forms no part of the plan of this article to enter at length into the consideration of those points which, taken collectively, form the science of steam navigation; yet it would be improper to pass entirely unnoticed such of them as bear upon the form and proportions of steam-vessels, especially as much light has been thrown upon the subject by the important investigations of Mr. John Scott Russell upon the subject of waves, which have been reported at the recent meetings of the British Association for the Advancement of Science. Without giving any undue prominence to the particular theory which he has himself brought forward, that gentleman has, in his article 'Steam Navigation,' in the seventh edition of the 'Encyclopædia Britannica' (which, with the article 'Steam,' also written, in part, by Mr. Russell, has also appeared in a separate form), treated very ably upon the theory of steam navigation, particularly as regards the form and proportions of steam-vessels. Referring to that essay itself for more minute information, it will be sufficient to touch upon a few points very briefly. The advantages of a long proportion and a fine wedge-shaped entrance or fore-end have been slightly adverted to in mentioning the improvements of Stevens of Hoboken and of Mr. David Napier; and from those notices it will appear evident that the early steam-boat builders, both in America and in Great Britain, erred in adhering too closely to the form and proportions of sailing-vessels. The proportions of steam-vessels were originally, like those of sailing-vessels, short and full, their length being only about three or four times their breadth; while now the proportion of six breadths to the length is common in the best sea-going steam vessels, and many of the fast river-boats are still longer, ranging in length from seven to ten times their width. In America the proportion of length to breadth is sometimes made even greater than as ten to one; and boats have been built the length of which is twelve times their breadth. These dimensions of course apply to the hull only; and in the steamers of North America the form of the deck is very different, it being made to project far over the sides. In the Rochester, for instance, a steam-boat plying between New York and Albany, of which an account is given in Stevenson's 'Sketch of the Civil Engineering of North America,' while the maximum breadth of the hull is stated to be twenty-four feet, the deck was about double that width, projecting thirteen feet on each side. These projecting portions of the deck are denominated the *wheel-guards*. The proportion of depth to breadth increases with the size of the vessel. In a table of the dimensions of sea-going steam-vessels, according to the best British examples, which is given by Russell, the proportion of depth varies from rather less than one-half the breadth, in vessels of little more than one hundred tons burden, to about two-thirds in those of from five to six hundred tons, and three-fourths in vessels of fifteen hundred tons. The table runs as high as three thousand five hundred and ninety tons, for which the dimensions given are three hundred feet long, fifty wide, and forty deep; but these dimensions have never been tried, the largest steam-vessels yet built being those for Transatlantic voyages. The dimensions which are here given are for vessels with a fine entrance and run, and with sides nearly upright, and they require to be modified according to the *form* adopted. The depth, it is observed, is suitable for flush-decked vessels, without poop or forecastle; and in vessels which have these, the depth given should be the *mean* depth.*

Considered merely as a boat to be propelled by the machinery contained within it, which always acts in the same direction, that is, in the same direction as the line of the keel, the question of the best form of a steam-vessel is much simpler than that of a sailing-vessel, which is to be impelled by an external force, applied in various directions, and but rarely in that of the line of progress. The form to be aimed at in a vessel to be propelled by steam alone is indeed little more than that of a solid capable of passing through the water with the least possible resistance. The essential qualities of a steam-vessel have been sometimes considered incompatible with those requisite for sailing; and it has consequently appeared very difficult to construct a vessel adapted for the combined use of steam and sails. Russell however conceives that there exists no such incompatibility, and observes that 'vessels built expressly for the purpose of steaming, and adapted for that purpose in the best possible way, have been found, when under canvass, to equal the fastest ships in sailing qualities.' 'Their great length and fine ends,' he continues, 'prevent them from falling to leeward; their fast formation adapts them for going through the water; their boilers and machinery form a well-placed and well-distributed ballast; their fine ends and flaring bows render them lively as sea-boats; and the small amount of their midship section, and small resistance, give them great speed under comparatively little canvass.' In confirmation of his position, the writer further states 'that the fastest schooners, cutters, smugglers, yachts, and slavers approach more nearly to the form of the best steamers than any other class of sailing-vessels.'

In the formation of steam-ships, one class of builders adopts a sharp bottom, a great rise of floor, great breadth o. beam, extensive bearings on the surface, and round sides and water-lines; thus producing a full, capacious, stable, sea-going ship, merely varied in its proportions to adapt it for steaming. Another adopts a flat bottom, long floor, more angular bilge, upright sides, straight entrance, clean run, and sharp ends; peculiarities which give little stability, but are chosen with a view to passing through the water in all weathers with little resistance or change of position. A third school adopts the formation of which Russell has established the principles, and of which what he calls the 'hollow wave-lines' are the distinguishing feature.

In treating of the form of steam-vessels under several heads, our authority commences with the transverse midship section, and shows that, owing to the necessity of providing a wide and solid base for the engines, in as low a position as possible, it is advisable to make about two-thirds of the width of the vessel in the middle nearly flat; and that it is desirable to make the sides at the same part as nearly vertical as may be, consistently with giving an easy turn to the bilge. Where the sides are made full, spaces are left on each side of the engines, of which no convenient use can be made; and the greater breadth of beam consequent on such a form is injurious to the vessel. The form of the water-lines, or the degree and manner of fulness or fineness which the ends of a vessel should possess in reference to the middle, is the next point considered, and is one upon which there exists much difference of opinion. The use of full round ends has many disadvantages besides that of increasing the resistance to the passage of the vessel through the water; among these may be mentioned the tendency of a long vessel when so formed to sink down in the middle with the weight of the engines. It is evident that in order to the equal support of the vessel, which is necessary to avoid injurious strain, the amount of bearing surface in each part of the vessel should be in proportion to the weight it has to sustain. Another defect of the full ends consists in the circumstance that if they be used for stowage, their weight diminishes the facility of steerage, and impairs the quality which is termed liveliness; to rectify which the ends are sometimes bulk-headed off, so that any apparent advantage on the score of increased capacity is lost. In vessels constructed upon the wave-line system, the principle followed is, 'that the hollow lines forming the entrance are to correspond, as nearly as may be consistent with the form of a ship, to the form of a certain wave capable of moving with the same velocity as the vessel.' 'The analogy between the displacement of the water by a wave of the first order,' observes the author of this beautiful theory, 'and its displacement by a vessel moving with the same velocity, being so very close as to approach to identity, rendered it probable that the same mode of displacement would be followed in both cases with the same result, viz. the production of minimum resistance.' 'It was further to be anticipated,' he adds, 'that as a wave, when allowed to follow the usual mode of displacing the particles of water over which it passes, presents a smooth and unbroken swelling surface, so the vessel, if of the

* Of the steam-ships intended for Transatlantic navigation the largest yet completed is the British Queen, which is two hundred and seventy-five feet long, forty feet wide between the paddle-boxes, and sixty-one feet over all. Her depth of hold is twenty-seven feet, and she is propelled by steam-engines of five hundred horse-power. Her engine-cylinders are seventy-seven inches and a half in diameter, and seven feet stroke; and her paddle-wheels are thirty-one feet in diameter. The Great Western and other steam-vessels built for this passage are nearly equal to the British Queen in size; and the Great Britain, an iron steamer now building at Bristol, is of much larger dimensions. Two other vessels now in progress at the same place, for the Post-office department, are stated to be larger than the Great Western. These are to be named the Avon and the Severn.

proper shape, according to these wave-lines, would divide the water at the bow in a smooth unbroken sheet, instead of showing the usual head of water or surge exhibited at the bow of ordinary vessels at high velocities. On the other hand, when a wave encounters a shapeless rock, or breaks on a rugged coast, it exhibits the same violent surges which are presented on the bow of vessels of the usual form.' In order to test the accuracy of this theory, an experimental vessel, seventy-five feet, long was built of the form proposed; and when it was moved at the rate of seventeen miles an hour, the water parted smoothly and returned peaceably to its place without any white spray or other symptom of high speed and great resistance. This vessel was constructed in 1834, and has been followed by several steam-vessels of considerable size, which have succeeded admirably, although their form is considered to be only an approximation to the true wave-line. The Shandon steamer, which was altered in 1840 to the new form, affords a striking proof of its advantage, as the alteration increased her speed with the same engines between two and three miles an hour. The Fire-King, a fine steam-vessel of six hundred and sixty tons burden, and two hundred and twenty horse-power, which has been employed successfully on the sea-voyage between the ports of Fleetwood and Ardrossan, is another example of this construction, and has a speed of fifteen miles an hour in still water. The velocity of fourteen miles an hour has been attained by a much less powerful vessel built on the wave-line principle, the Flambeau, of two hundred and eighty tons, and seventy horse-power.

One of the important questions which has of late years attracted much attention in connection with steam navigation, is that of the comparative advantages of iron and wood as materials for steam-vessels. Small vessels of iron have for many years past been occasionally used for river and canal navigation; and recently steam-vessels of considerable size have been built of the same material. A first-rate iron steam-ship, now building for Transatlantic voyages, has been mentioned in a note on the preceding page. It is difficult, between the sanguine statements of those who favour the use of iron, and the sweeping condemnation of such as are prejudiced in favour of wood, to arrive at a correct estimate of the comparative merits of the two materials. It is however certain that, owing to the superior strength of iron, and its power of bearing strain in any direction, an iron vessel may be made much lighter than one of wood of equal strength; the saving of weight being sometimes estimated at one-half. Another great advantage of iron consists in the facility with which it may be formed into any shape. An iron hull is also superior to one of wood in its security from fire and its greater cleanliness.

Whatever material be adopted, a steam-vessel should be strengthened or stiffened by such a system of trussing as will enable it to bear the weight and strain of the machinery without alteration of form. The river-steamers of North America are remarkable for the skill with which this object is effected, notwithstanding their extremely slight build. In some of these vessels a trussed framing rises to a considerable height above the deck, and distributes the weight and strain of the engine over a great space. Steam-vessels may be greatly strengthened by means of water-tight bulkheads or transverse partitions in the hull, the general adoption of which would, more than any other proposed improvement, increase the safety of steam navigation. In a vessel of the ordinary construction a small local injury from striking upon a rock, from collision, or from any other cause, may occasion the sinking of the vessel, because the water has free access to every part of it. Fire also, wherever it may commence, is pretty sure to spread through the whole length of the boat. The adoption of water-tight bulkheads, to confine the effect of an accident to the particular division of the vessel in which it originates, was suggested by Dodd as early as 1818. He mentions them in p. 220 of the treatise which has been alluded to in the former part of this article, proposing to use them between the engine-room and the cabins; and he states that he intended to introduce them in two boats which he was then building. Whether he did so or not we are not aware; but the recent adoption of this excellent precautionary apparatus appears to be due to Mr. C. W. Williams, managing director of the city of Dublin Steam-packet Company. A minute description of his bulkheads, and a very satisfactory statement respecting their importance and their efficiency, are given in a communication from that gentleman to the commissioners on steam-vessel accidents in 1839, which is printed in the appendix to their Report. He therein states that he first applied water-tight bulkheads in an iron steamer called the Garryowen. The hull, as well as the partitions, being of iron, the application was, in this case, very easy; but additional contrivance was necessary to introduce them in wooden vessels, owing to the liability of the timber to shrinkage and alteration of form. The bulkheads themselves are always of plate-iron; and, to prevent the possibility of water passing at the sides and bottom of the vessel, the timber-work is made solid for the space of eighteen inches before and behind each bulkhead. By this, and some other precautions, a very strong and secure partition may be made, capable of preventing the escape of either water or fire from the compartment in which an accident may originate. In the case of fire, indeed, Mr. Williams considers it questionable whether the mere closing of the hatches over the section or division in which it occurs, would not be sufficient to extinguish it; as the supply of air would be thereby completely cut off, there being no communication below deck between the several divisions of the vessel. For several reasons which are specified in the document referred to, Mr. Williams conceives the best arrangement to be the division of the hull into five sections, by four bulkheads; appropriating the central division to the boilers, engines, and coal-bunkers, and the others to cabins or stowage-room. For the purpose of showing the efficiency of this means of securing the safety of a vessel, experiments were tried at Liverpool upon a steam-vessel called the Royal Adelaide. She was one hundred and sixty feet long, and divided into five sections; that containing the engines and boilers being fifty-eight feet long, the two next thirty-five feet each, and the end sections sixteen feet each. Water being admitted into the fore-end section, by boring through the vessel, the bow was depressed about six inches, and the stern was raised about two inches. The water being then pumped out from this section, an aperture was made in the adjoining one, and the result was that the bow was depressed about twelve inches, but the stern was not perceptibly raised. A still more decisive proof of the security obtained by this plan was afforded by the collision of the Royal William and the Tagus, near the Isle of Wight, on the 7th of November, 1837. The former vessel, which was fitted with water-tight bulkheads by Mr. Williams, was stove in with great force on the starboard-bow, and the water immediately rushed into the section before the engine-room. As soon as the alarm was over, the carpenter of the Royal William went under the bow in a boat, and covered the breach with planks and tarpaulin. In that condition the vessel steamed into Plymouth Harbour, where some extra fastenings were applied, after which she finished her passage to Dublin, and then crossed to Liverpool with the same temporary covering. The inconvenience occasioned by the want of communication between the different parts of the vessel, and the extra expense of the bulkheads, are objections by no means commensurate to the great advantages of this means of ensuring safety.

Perhaps this may be the best place for noticing the ingenious contrivance of Captain George Smith, for carrying life-boats upon the paddle-boxes of steam-vessels. The utter inadequacy of the boats commonly carried by steam-vessels, in the event of an accident rendering it necessary for the crew and passengers to abandon the ship, is notorious; and it is evident that a sufficient number of boats for such an emergency could not be carried upon deck without serious inconvenience. There is also considerable delay in getting out such boats; and sometimes, as in case of fire, it might be impossible to unship them. These circumstances led Captain Smith to contrive a kind of life-boat of such form and dimensions that it might serve, when inverted, for the upper part of the paddle-box; and might, when necessary, be immediately turned over and lowered outside the paddle-wheel. In a letter to the Commissioners of Steam-Vessels Inquiry, printed in the same document as Mr. Williams's communication on water-tight bulk-heads, Captain Smith describes his invention as tried on her Majesty's steam-vessel Carron, of between two and three hundred tons burden:—'The upper section of her paddle-wheel,' he says, 'is covered by a life-boat twenty-five feet long, nine feet beam, having four air-tight cases, which may be removed if required on particular occasions. This life-boat is capable of containing between forty and fifty persons. When in her place over the paddle-wheel, the midship thwarts are unshipped, which admits of the wheel revolving within about six inches of her kelson; she lies bottom upwards, on two iron davits, having hinges, which enable her to be turned over and lowered down by six men in two or three minutes.' A boat of similar capacity, if stowed in the usual position upon deck, could not, it is stated, be got out by the whole crew in less than twenty minutes. This contrivance affords great facility for inspecting or repairing the paddles, as the boats may be easily raised a little on their davits. Captain Smith suggests that if it be thought requisite to add to the number of boats, the cabins before and abaft the paddle-wheels may be roofed by others, smaller than those forming the upper part of the paddle-boxes. The paddle-box boats might, it has been observed, be especially valuable in the landing or embarkation of troops. The whole apparatus is represented in one of the plates accompanying the commissioners' Report.

Another contrivance, which is very important for the safe management of river steam-vessels, may be mentioned before adverting to the actual apparatus of propulsion. It is that by which the steering-wheel is situated in the fore part of the vessels, its motion being communicated to the rudder by ropes, chains, or rods. An apparatus of this kind was used by Symington in his tug-boat upon the Forth and Clyde Canal, about 1802; but whether its subsequent adoption in North America is in any degree to be attributed to that circumstance, we are not aware. The peculiar arrangement of the river steamers of America, which have the engines and some of the cabins on deck, combined with their great length, renders it impossible for the steersman, if in the situation usual in the steam-vessels of this country, to see his course; and therefore he is usually elevated on a platform near the bow. Ropes were formerly used to connect the wheel with the helm, but the occurrence of serious accidents in consequence of the burning of the ropes has led to an enactment enforcing the use of rods or chains. The different construction of British steamers renders the use of a contrivance for steering from the bow less essential than in America; yet the numerous accidents to small boats in the Thames, from steam-vessels running into them, indicate the desirableness of such an apparatus. There might be also a steering-wheel in the usual situation, which might be used when at sea, or in case of an accident to the forecastle steering-apparatus.

The mechanism of steam-engines having been described in a previous article, it only remains here to notice the principal modifications required in order to their convenient application to the propulsion of vessels. As an ample supply of cold water can always be commanded for the purpose of condensation, there is less inducement for the use of high-pressure steam in marine engines than in almost any others; and this circumstance, combined with the prejudice against the safety of high-pressure boilers, has led to the universal adoption of low-pressure, or condensing engines, in European steam-vessels; although many of the steamers of North America are worked with steam of enormous pressure, far exceeding that allowed even in railway locomotive engines in this country. Stevenson mentions a vessel in which he rode on the Ohio, in which the steam was commonly used at a pressure of *one hundred and thirty-eight pounds* to the inch; and when passing places where there was a strong adverse current, at *one hundred and fifty pounds*. This last pressure the captain informed him 'was never exceeded, except on extraordinary occasions.' In the government report on steam-engines, which was alluded to in a previous page, it is stated that in competitions between rival boats the steam has often been raised to *two hundred pounds* or more on the square inch.

The common form of steam-engine known as the beam or lever engine, in which the impulse of the piston is applied under one end of a vibrating lever or beam, pivoted on its centre, and is communicated to a crank by means of a connecting-rod descending from the opposite end of the beam, is not well adapted to a steam-vessel, because it would require much of the weight of the machinery to be placed high above the deck. This arrangement is nevertheless common in the river steamers of North America; and, by leaving the whole space below deck free from machinery, it allows room for cabins of very large dimensions; the principal cabin, or saloon, being, in vessels so constructed, the full length of the hull. In American sea-steamers, and in all British steam-vessels, the machinery is either entirely or principally below deck, and consequently a very different arrangement is necessary.

The kind of engine most commonly used, which is known by the name of the side-lever engine, has been described under Steam-Engine, p. 481, where it is also stated that it is usual to employ two distinct engines, working separate cranks upon the same axis. This remark applies chiefly to British steam-vessels; for it appears that in American steamers it is common to use single engines, and sometimes counterbalance weights are attached to the paddle-wheels, to assist them in passing their centres; but the use of engines of very long stroke, and paddle-wheels of very large diameter, renders the use of a single crank less inconvenient than in vessels of the European construction. Stevenson states that even in those American vessels in which two engines are employed, their connecting-rods are not attached to the same axle, but each engine works independently of the other, and drives only one of the paddle-wheels.

The form of engine above described, though that most commonly adopted, is not by any means the only marine engine used in this country. Many plans have been contrived for rendering the machinery lighter and more compact, and simplifying the connection between the piston-rods and the cranks. One of the great difficulties to be overcome is the want of depth in the engine-room. The paddle-shaft or axis must be either below the level of the deck, or so little above it that, when covered in, persons may easily step over it; and if, as in the various plans for connecting the piston-rod more immediately with the crank, the cylinder be placed directly under the crank-axis, a considerable space is necessary between them, to allow for the length of the stroke, and the connecting apparatus by which the rectilinear motion of the piston is converted into a rotatory motion. In some small vessels the connection is very simple, the cylinders themselves vibrating on trunnions or gudgeons, so that they adapt themselves to the position of the cranks, and impart the force of their pistons to them without the intervention of a jointed connecting-rod. Another very simple plan is that recently adopted in the Gorgon and some other steam-frigates. In these the cylinders are fixed, and the movement of the piston-rods is vertical, but they are surmounted by connecting-rods, pivoted to them, which adapt themselves to the position of the cranks. This mode of connection is the same, excepting in the circumstance of the vertical instead of the horizontal position of the apparatus, as that commonly adopted in railway locomotive engines, and it has the advantage of great simplicity; but, as it requires a space equal to about three times the length of the stroke between the paddle-shaft and the base of the cylinder, it involves the necessity of either raising the former to an inconvenient height, using a cylinder of very short stroke, or employing a very short connecting-rod, by which the power is applied disadvantageously. In another modification of the plan of direct connection, which is represented in *Figs.* 1 and 2, an ingenious contrivance

*Fig.* 1.

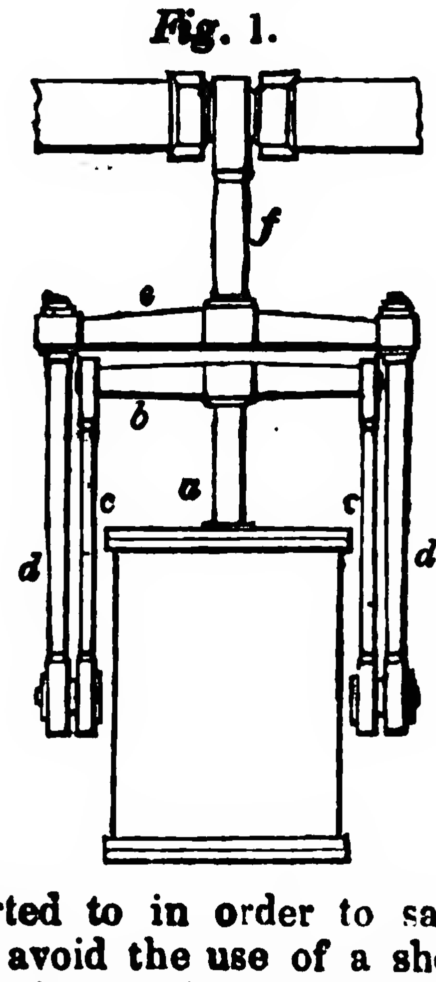
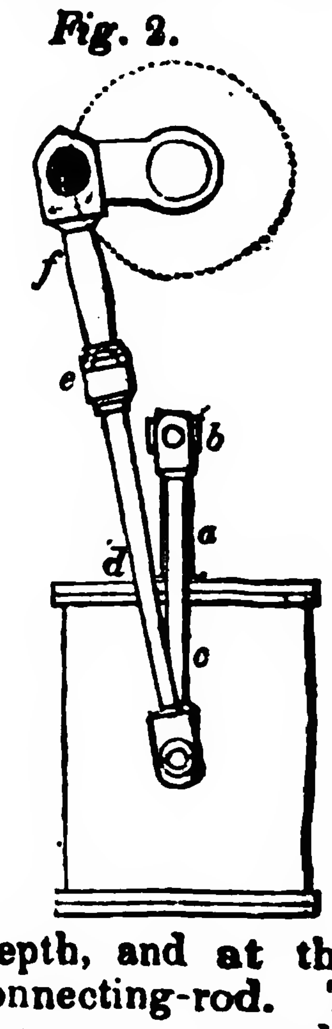



*Fig.* 2.




is resorted to in order to save depth, and at the same time to avoid the use of a short connecting-rod. The top of the piston-rod, *a*, carries a transverse cross-head, *b*, from which descend two rods, *c*, *c*, one on each side of the cylinder. To the lower ends of these side-rods are attached the lower ends of two connecting-rods, *d*, *d*, at the upper ends of which is another cross-head, *e*, and from the centre of this cross-head a short rod, *f*, communicates motion to the crank. This plan has been simplified by Mr. David Napier, by uniting each cross-head with its pair of side-rods into one forked piece of metal. By this mode of communicating power, the connecting-rods may, if required, be nearly double the length of the stroke, while the total height of the engine-room need be little more. The side-levers or beams are not always dispensed with in this form of engine, although, as they are merely required for working the pumps, and not for communicating the power to the crank-axis, they may be of small dimensions. They are moved by means of the side-rods from the cross-head of the piston, as in the common side-lever engine; and the similarity in other parts of the apparatus is considerable; the main difference being that, instead of these side-rods and the connecting-rods being attached to opposite ends of the beam, they are both attached to the same end. Another arrangement for accomplishing the same object as the preceding is that to which the name of the steeple-engine has been given. In this the upper end of the piston-rod carries a frame of iron, which rises considerably higher than the paddle-shaft; the sides of the frame passing up on each side of the shaft, and being so far apart that the crank may turn freely within it. The connecting-rod descends from the upper part of the frame to the crank, and so imparts to it the motion of the frame and piston-rod. The steeple-frames may be made of various forms, but the simplest is that of a triangle, of which the upper angle, where the connecting-rod is attached, is kept steady by means of vertical guides. This contrivance is represented in *Figs.* 3, 4, and 5, which show the positions assumed by the apparatus at

*Fig.* 3.

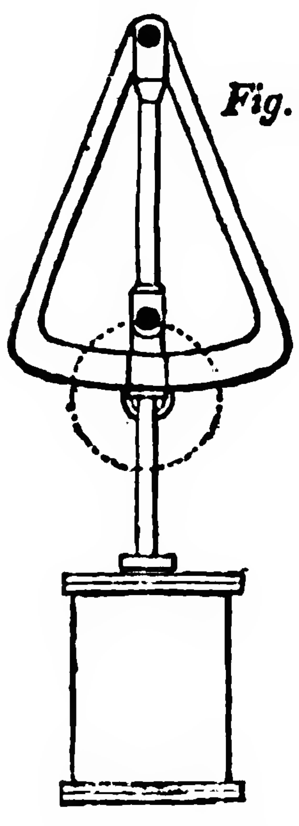


*Fig.* 4.

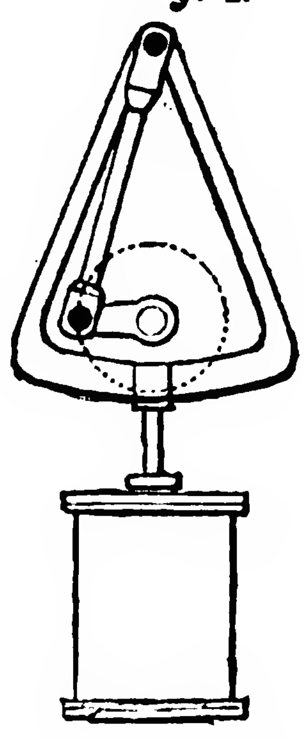
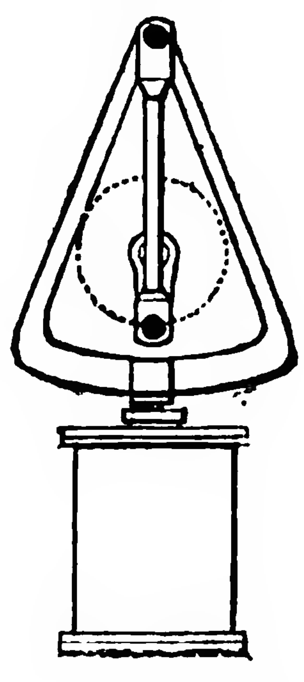


*Fig.* 5.



the top, middle, and bottom of the stroke respectively. Of course the machinery in this arrangement rises to a considerable height above the deck; but, as the steeple-frames merely rise through an opening or hatch, they do not interfere much more with free passage from end to end of the ship than the common side-lever engine, in which the cranks and cross-heads usually rise above the level of the deck in like manner. Among inventions of this class may be mentioned two novel forms of engine patented by Messrs. Maudslay and Field, with the intention of affording, by the extensive piston-surface, facility for the use of steam expansively. In one of these two cylinders and pistons are placed near together, the movements of the pistons being simultaneous. The two piston-rods carry a cross-head, from the centre of which descends a bar, and to the lower end of this bar the lower end of the connecting-rod is attached. The other plan consists of one very large cylinder and piston, with two piston-rods; the arrangement resembling that of the steeple-engine, but being more compact, because, as the piston-rod is double in every part, the crank may revolve close to the top of the cylinder. A very singular contrivance for the like purpose, which has been patented by Mr. Humphreys, and previously, according to Russell, by another person, dispenses entirely with the use of the ordinary piston-rod, and effects the direct connection of the piston with the crank without having any apparatus above deck, or at least without anything more than the ordinary crank. The connecting-rod, *a*, *Figs.* 6 and 7, proceeds direct from the crank to a pin or pivot attached to the piston; and the lateral play required to enable it to accommodate itself to the movement of the crank is provided for by a trunk or case, *b*, attached to the piston, and sliding up and down with it

*Fig.* 6.

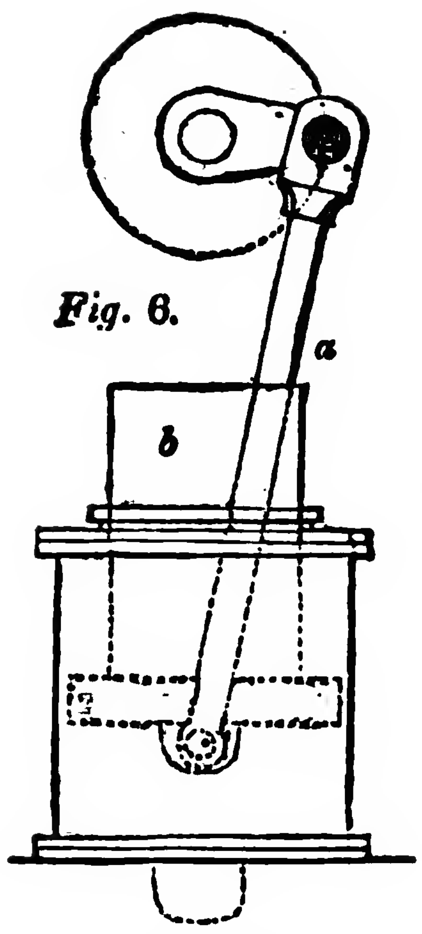
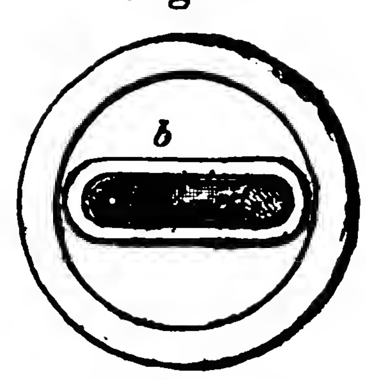



*Fig.* 7.




through a steam-tight slit, or long stuffing-box, in the head of the cylinder. It is needless to detail the contrivances by which, in engines of direct connection, the working of the pumps and other apparatus is effected. Such engines are convenient in small boats, but they do not appear to afford any great advantage, excepting economy of space.

The proportion between the length of the piston's stroke and the diameter of the cylinder is a point upon which much difference of opinion exists; some advocating a very long stroke and comparatively small diameter, and consequently a crank of large radius, while others prefer the more compact arrangement of a small crank and short stroke, and obtain the requisite power by using a piston of large surface. The former system is carried to the extreme in the steam-vessels of North America, some of which have a length of stroke equal to three or four times the diameter of the cylinder; while in this country the length of stroke is generally not much greater than the diameter, and in some cases is even less. Russell mentions a vessel on the Clyde with a stroke of four feet, and a diameter of five feet, or, to use the common form of description, of sixty inches.* He also gives a table showing the dimensions proper for the cylinders of marine engines from ten to five hundred horse-power, according to the practice of the best British engine-makers, from which it appears that the stroke is usually about one-sixth greater than the diameter; but he observes that in deviating from this proportion a longer stroke will be preferable to a shorter one. This will be especially the case as the plan of working steam expansively, and of increasing the velocity of the piston beyond what has been generally considered the most advantageous limit, becomes more generally adopted. In both these particulars American steam-navigation affords a precedent worthy of attentive examination. While it has been considered advisable by most British engineers to limit the speed of the piston to about two hundred and twenty feet per minute, a velocity of five hundred feet per minute has been maintained in some American vessels; and, with large supply and exit pipes for the steam, and valves of suitable construction, there appears to be no practical difficulty in such a speed.

The means adopted for condensing the steam is a matter of great importance in sea-going steamers. The most effectual method of condensation is by the injection of cold water into the condenser, or by causing it to fall in a thin sheet, to which the steam is exposed. By this actual contact with cold water the steam is instantaneously condensed, and consequently the effective action of the engine is ensured; but, as the condensed steam is necessarily mixed with the condensing water, it follows that, during a sea-voyage, the boilers must be fed with salt-water, which, as it evaporates, deposits salt and other sedimentary matter on the interior surfaces of the boiler. The crust or deposit thus formed is a bad conductor of heat, and hence it not only impedes the formation of steam, but also, by preventing contact between the water and the iron, allows the latter to become overheated, and thereby liable to bursting or opening at the joints. Several different measures have been adopted for avoiding or mitigating this inconvenience, either by

* It is usual, in describing the proportions of a steam-engine cylinder, to express the length of the stroke in *feet and inches*, and the diameter in *inches only*.

working the boiler with fresh water only, or by using sea-water with such precautions as may prevent the injurious deposition of salt. Of the latter class of measures that called *blowing-out* may be first alluded to. It consists in allowing a large quantity of water to escape from the boiler into the sea, whenever it is becoming so salt as to render the deposition of sediment likely to commence, and supplying its place with the comparatively fresh water from the condenser. As that portion of the water which contains the greatest proportion of salt sinks, by its greater specific gravity, to the bottom of the boiler, the blow-off cocks are usually placed very low down. It is usual to blow out a portion of the water about every two hours; but, as the performance of the operation involves loss of fuel, from the coldness of the water introduced to restore the proper level, it is very desirable to avoid blowing out too often, as well as to avoid delaying it too long. A beautiful contrivance for indicating when the operation is necessary has been recently introduced by Messrs. Seaward, consisting of a glass gauge communicating with the boiler, and containing two hydrometer balls, of slightly different weight, so adjusted that neither of them will float in common sea-water, which contains about $\frac{1}{33}$ part of its weight of salt, but that the lighter one will float when the proportion of salt rises to $\frac{4}{32}$, and the heavier one when it is more than $\frac{5}{32}$ parts. Deposition takes places when the salt amounts to $\frac{6}{32}$ parts. Thus the rising of one or other of the balls indicates the degree of saltness, and the proper time for blowing-out. Messrs. Seaward also use an apparatus by which the water is blown into a separate chamber before it is turned into the sea, and this chamber, being made to contain exactly a ton of water, prevents the accidental discharge of too large a body of water at once, while the valves are so arranged that no negligence can possibly occasion the boiler to be left in communication with the sea. Messrs. Maudslay and Field adopt a different method for preserving the proper state of the water, using pumps, called *brine-pumps*, to remove constantly a small portion of water from the lower part of the boiler. When these are used, the feed-pumps are made to inject an extra quantity of water, to take the place of that removed by the brine-pumps, and the current of hot brine is conducted along a pipe which passes through the feed-pipe, by which means much of its heat is imparted to the water entering the boiler. This apparatus appears to be very effectual, and has been tried in the Great Western and other steam-vessels. The use of copper instead of iron as a material for boilers lessens the evil attending the use of salt-water, as the sedimentary matter does not form a crust upon it, but is precipitated in a loose form, and easily removed by blowing-out; but both materials are alike subject to another serious evil—the rapid corrosion of the flues by the chemical action of the soot, when mixed with salt, of which minute particles will escape through the joints in spite of every precaution. This evil can only be avoided by the use of fresh-water in the boilers, a measure which, in sea-voyages, cannot be adopted without the use of a condensing-apparatus of such construction as to preserve the condensed steam free from any admixture of sea-water. This is accomplished by what is termed surface or dry condensation; a method which has been repeatedly tried, from the days of Watt to the present time, but which has never, we believe it may be safely affirmed, been found equally efficient with the condensation by jet. In the case of steam navigation, however, although no advantage may be gained in the act of condensation, the method may be highly advantageous, because, by saving all the water produced by condensation, and returning it to the boiler, the use of sea-water may be avoided. Mr. Samuel Hall, who is also the author of several other inventions connected with steam navigation, has laboured with more success than most experimentalists in this important attempt to obviate what has been shown to be a very serious difficulty. His condenser consists of a great number of small tubes, kept at a low temperature by means of cold water, of which a copious supply is made to flow around them. The steam passes through these tubes, and is condensed by their coldness; and to prevent, as far as possible, any waste of the fresh water with which the boiler is to be fed, the steam which escapes from the safety-valves, as well as that from the cylinders, is conducted to the condenser. Another invention in which the steam is constantly reproduced from the same water, is that commonly known as Howard's Vapour-Engine. Here a boiler, in the ordinary sense of the term, is dispensed with; steam being formed by injecting a small quantity of water on to the surface of mercury, which is heated in a shallow iron vessel, over a coke fire, to a temperature of 300° or 400°. The mercury is covered with a thin plate of iron; so that, although it is the medium by which heat is communicated, the water is never in actual contact with it. Further information respecting this and several of the other inventions alluded to in this part of our subject, may be found in the seventh edition of Lardner on the Steam-Engine.

In the construction and arrangement of marine boilers, safety, and the power of generating steam with great rapidity, are the grand requisites. The furnaces should be, as much as possible, surrounded with water; and, to economise heat, as well as to avoid the injurious effect of its radiation upon the vessel, the boilers and steam-pipes should be coated with felt, which is applied to the surface by means of a thick covering of white and red lead. 'This expedient,' says Lardner, 'was first applied in the year 1818 to a private steam-vessel of Mr. Watt's, called the Caledonia.' The boilers, of which there are three or four in most large vessels, are placed side by side across the vessel, immediately in the rear of the engines, and their flues are usually conducted into one large funnel or chimney. The boilers of sea-going vessels should be so arranged that any one of them may be emptied, and repaired or cleaned, during a voyage, without impeding the use of the others or stopping the engines.

The frame-work of the engines should be so contrived as to relieve the vessel as far as possible from strain, by causing the inevitable strain of the machinery to be, as it is termed, self-contained. The general arrangement should also be such as to allow free access to every part, and to bring the valve-gear within convenient reach of the engineer. In all the engines hitherto described, excepting those of Bell's Comet, the power of the engines is communicated at once to the paddle-shaft; but this, while by far the most common, is not the universal arrangement. In some towing-vessels, for instance, where great power is requisite, but speed is of minor importance, the paddle-wheels are mounted on a separate axis, which, by means of toothed gear, receives a slower motion than the crank-shaft turned by the engines.

It remains to notice, in connection with marine steam-engines, the question as to the best proportion of steam-power to the tonnage of a vessel, a question upon which very different opinions are entertained. In most of the early steam-vessels, a very low proportion of power was used; but experience has, in most cases, shown the superior economy attending the use of powerful machinery, capable of propelling the vessel at a high speed. It is not pretended that, simply considered, a high velocity can be maintained as cheaply as a slow one; but, independent of mere speed under favourable circumstances, it is essential that a steam-vessel should be able to make way against adverse winds and currents, without any very great diminution of velocity; and its power of doing this, in which its regularity and ultimate economy greatly consists, increases in proportion to the degree in which its average speed in still water exceeds the speed of the winds or currents which may be opposed to its progress. Thus a steam-vessel with a mean speed of six miles an hour, if opposed to a current of three miles an hour, will only move at half her usual rate, thereby occasioning great irregularity in the time of her voyages, and a very wasteful consumption of fuel; while a vessel whose mean speed is nine miles an hour will, under like circumstances, merely be reduced to two-thirds of her average speed. Hence, although the consumption of fuel increases in a larger ratio than the increase of speed, it may, in many cases, prove more economical to use a very powerful engine, capable of performing the required voyages with tolerable regularity in all weathers, than one of less power, which, though it may attain a moderate speed with less cost in fine weather, will be almost brought to a stand under difficult circumstances. In British steam-vessels the proportion usually ranges between two and four tons measurement to each horse-power.

Notwithstanding the defects commonly imputed to it, and the great number of contrivances which have been devised for avoiding them, the common paddle-wheel continues to be the only means of propulsion commonly used. It consists of a number of flat boards, called float-boards or paddles, bolted to the radii or arms of a light but strong iron wheel, which is fixed securely upon the crank axis of the engine, and it should be so placed that the lowest float-board is entirely immersed in the water. It is evident that the paddles produce the greatest effect in propelling the vessel when they are in or very near a vertical position; and it is urged as an objection to the common paddle-wheel, that the float-boards necessarily enter and leave the water in an inclined position; so that in entering they have a tendency, by pressing upon its surface, to lift the vessel out of the water, while in leaving the water they have the contrary effect, tending to depress the vessel, and to throw back the water, thereby occasioning a heavy swell. This evil is however less than might be supposed from a hasty consideration of the subject, as the motion of the paddles is not simply that of revolving round an axis, but that of revolving round an axis which is continually moving forward; so that, although the evils adverted to may be very apparent in starting the vessel, they disappear in a great measure when it moves with considerable speed. The action of a paddle-wheel of the common and of several modified forms may be more readily comprehended by the diagrams published in the new edition of Tredgold on the Steam-engine, than by any mere description; but it may be sufficient here to quote the words of Russell, who, after tracing the motion of a paddle of the common form during the progress of the vessel, comes to the conclusion that it 'is inserted into the water in an angular position, resembling closely the entrance of an oar into the water; that it is then made to act horizontally on the water during a short interval, after which it is withdrawn from the water edgeways, in an easy and elegant manner, which the dexterous rower might envy and try to equal, but which he could hardly excel.' It is admitted that, in order to the attainment of this perfect action, it is necessary that the paddle and the boat be well proportioned and placed; yet the writer argues that 'the common paddle-wheel is in practice, as it ought to be in theory, exempt from the faults generally attributed to it.' Perhaps, so far as regards mere efficiency as a propeller, this may be correct; but few will deny that some means of propulsion which shall occasion less agitation in the water, and less vibration in the vessel, is a desideratum. Several improvements upon the common paddle-wheel have been introduced, which tend to diminish the defects attributed to it. Among these is the divided paddle-wheel, which was invented by the younger (American) Stevens, and is commonly used in the steam-vessels of North America, which often have very large paddle-wheels. In this kind of wheel the float-boards, instead of extending the whole width of the wheel, are in two or sometimes three sets, each of which extends across only one-half or one-third of the width; one set of float-boards being placed opposite to the intervals of the other set. *Figs.* 8 and 9 give side and front views of such a wheel; the

*Fig.* 8. *Fig.* 9.

shaded parts in *Fig.* 8 being those which belong to the off-side of the wheel. This kind of wheel resembles in fact two or three narrow paddle-wheels placed close together on the same axis, the paddles of one being opposite to the intervals of that adjoining it. By this means the shock occasioned by the paddles entering the water is diminished, and the resistance is rendered more equal. Another kind of divided paddle is that in which the float-boards extend across the whole width of the wheel, but each of them consists of two, three, or more narrow strips, placed a little in advance of each other, so as to strike the water at slightly different times. *Fig.* 10 represents such a wheel, with the paddles divided into three parts. Under the name of the *cycloidal* paddle-wheel this has excited much attention. It has been used with apparent advantage in the Great Western and many other sea-steamers. A similar advantage is attained by the expedient of dividing the float-board into three slips, and bolting one of them on the opposite side of the arm of the wheel to the other two. Many of the contrivances intended as improvements on the common paddle-wheel have moveable float-boards, which, by various ingenious arrangements, are made to enter and leave the water in a nearly vertical position. The unavoidable complexity of such an apparatus, which renders it very liable to derangement, is fully sufficient to prevent its extensive use; yet a wheel of this kind, known as Morgan's paddle-wheel, has been adopted in several large vessels. Professor Barlow, in a paper 'On the Motion of Steam-Vessels,' which was published in the 'Philosophical Transactions' in 1834, and subsequently, with additions, in the appendix to Woolhouse's edition of Tredgold, expresses his belief, after trying experiments on different kinds of paddle-wheel, that when the wheel is but slightly immersed, little or no advantage is derived from the vertical position of the paddles, and 'that in the navigation of rivers or smooth water, where generally little variation is required in the degree of immersion of the vessel, the common wheel, if properly proportioned, is preferable to the vertically acting wheel, in consequence of its admitting a larger surface of paddle-board.' On the other hand, as the vertical paddles have greatly the advantage when the wheel is deeply immersed, he considers them best 'for sea purposes or long voyages, where the immersion of the vessel is constantly diminishing by the exhaustion of the coals and stores required at the commencement of the voyage.'

Another class of paddle-wheels have the float-boards placed obliquely across the width of the wheel, instead of in the usual position; and some have one-half of their width inclining one way, and the other half in the opposite direction. The paddle-wheels patented in 1836 by Mr. Samuel Hall were intended to reduce the tremulous motion of the vessel, and the quantity of back-water, by affixing the paddle-boards on one-half of the circumference of the wheel with an obliquity in one direction, and those on the other half with a contrary inclination; so that during one-half of the revolution of each paddle-wheel the water should be put in motion in one direction, and during the other half of the revolution it should be moved in the opposite direction. Mr. Hall states that the angle of obliquity may vary from 30° to 60°, but that he prefers 45°, and he proposes in large wheels to vary the inclination four times instead of twice in the circumference. A very singular scheme for propelling is that patented by Mr. Perkins in 1829, in which the paddles are fixed at an angle of 45° with the wheel, and the wheel itself is placed at an angle of 45° with the line of the keel; so that while the paddles enter and leave the water edgeways, they assume the most effective position for propelling when performing the lowest part of the revolution. Full details of this ingenious contrivance may be found in the 'Mechanics' Magazine,' vol. xiv., p. 305, &c. Conical paddle-wheels, resembling those of the common form, excepting in the circumstance of the diameter being greater on the side adjoining the vessel than on the outer side, have been tried by Mr. Russell, who says that they prevent much of the concussion of the common wheel, without any sacrifice of power or speed. Some proposed paddle-wheel improvements have reference to the convenient adaptation of the paddles to the depth of the vessel's immersion. Something of this kind is very desirable, because it often happens that a vessel is, in consequence of a heavy load and a large stock of fuel, so deeply immersed at the commencement of her voyage that the action of her paddles is impeded; while, after the consumption of great part of her supply of coal, she swims so high that her paddles have not sufficient hold upon the water. When the paddle-wheels are fixed immediately upon the crank axis of the engine, it is impossible, without too great a derangement of the machinery, to make the paddle-shaft itself rise and fall according to circumstances; and although many plans have been proposed for reefing the paddles, or removing them to a greater or less distance from the centre of the wheel, we believe that none has been introduced to any important extent. In some steam-vessels the inconvenience alluded to is in some degree remedied by admitting sea-water into the coal bunkers when they are emptied, so as to maintain a uniform degree of immersion. It would often be a convenience if, instead of being firmly keyed on to the shaft, the paddle-wheels were capable of being detached from the engines, so that either might move independently of the other. Many of the American steamers have such a provision, whereby the boat may be stopped by simply throwing the wheels out of gear, the engines continuing to work, so as to pump water into the boiler. By this means also the paddle-wheels are preserved from strains while the vessel lies at anchor, exposed to the influence of tides.

In noticing some of the early projects connected with steam navigation, allusion has been made to several other methods of propulsion, some of which have been revived of late years. Our space will not allow of any account of the numerous schemes which have been propounded for moving vessels by contrivances which have been expected to prove superior to paddle-wheels, either from producing a greater effect with a given exertion of power, from superior compactness, or from occasioning less disturbance in the water. Some apparatus that would effect the latter object without the sacrifice of power or speed, appears very desirable; and among many inventions which have been tried for the purpose, that commonly, though not very aptly, called the Archimedes' Screw,* appears to succeed very perfectly. It has been tried with considerable success on a large scale. This apparatus has been alluded to under SCREW OF ARCHIMEDES, vol. xxi., p. 111.

The means of diminishing the risk of steam-vessel accidents have been made the subject of parliamentary investigation in 1817, 1831, and 1839; in the latter year by means of commissioners. The valuable information collected on the last occasion has been repeatedly referred to in this article, and our space will not allow an analysis of the important suggestions made for increasing the safety of steam navigation. It is however very satisfactory to find, that while very much remains to be accomplished in this way, the number and character of the accidents which have happened to British steam-vessels will bear a very favourable comparison with those of North America. It is also observable that, while the total number of accidents is by no means large, considering the great number of steam-vessels in use, a considerable proportion of them, and those by far the most fatal in their consequences, were of a character by no means peculiar to vessels propelled by steam. The commissioners give a detailed table of ninety-two accident[s] which happened between 1817 and April, 1839, of whic[h] the following is an abstract. This account is merely give[n] as an approximation to the truth, especially as regards th[e] former years of the period embraced.

| Nature of Accidents. | No. of Vessels. | No. of Lives lo[st] |
|---|---|---|
| Wrecked, foundered, or in imminent peril | 40 | 308 |
| †Computed number of persons lost on board the Erin, Frolic, and Superb | .. | 120 |
| Explosions of boilers | 23 | 77 |
| Fires from various causes | 17 | 2 |
| Collisions | 12 | 66 |
| Totals | 92 | 573 |

In copying this table, we have omitted an item of for[ty] lives lost in the Thames, from May, 1835, to November, 183[8,] by accidents to barges and small boats by the use of stea[m-]vessels, and a similar item of twenty-one lives lost with[in] ten years in the Clyde, apparently from similar accident[s;] as these scarcely full under the denomination of stea[m-]vessel accidents, although they intimate the necessity [of] increased precaution in the use of steam-vessels up[on] crowded rivers. It is stated that the greatest number [of] lives lost at any one time by each of the above classes [of] accident was as follows:—

| Nature of Accident. | Name of Vessel. | Date. | Lives lost. |
|---|---|---|---|
| Wreck | Rothsay Castle | 1831 | 119 |
| Collision | Comet and Ayr | 1825 | 62 |
| Explosion | Union | 1837 | 24 |
| Fire | Medway | 1837 | 2 |

The far greater number and more fatal character of stea[m-]vessel accidents in the United States may be seen from t[he] document from which the statistics of American stea[m] navigation given in a previous page were derived. T[he] first accident therein noticed took place in 1816, and t[he] total ascertained number, down to 1838, was as follows:—

| | |
|---|---|
| Wrecks, from collisions, gales, &c. | 25 |
| Destroyed by snags and similar obstructions | 52 |
| Explosions, &c. | 99 |
| Fires | 28 |
| Various causes | 24 |
| Total | 228 |
| Ascertained number of lives lost | 1,676 |
| Ascertained number of persons wounded | 443 |

The report states that the computed number of lives l[ost] was about two thousand; but that some persons think t[he] aggregate treble that number. The following table giv[es] in the same form as has been done with British acciden[ts] the most fatal instances of each class of casualties:—

| Nature of Accident. | Name of Vessel. | Date. | Lives l[ost]. |
|---|---|---|---|
| Wreck | Home | 1837 | 10[illegible] |
| Snags, &c. | St. Louis | 1834 | 1[illegible] |
| Collision (and consequent sinking) | Monmouth | 1837 | 30[illegible] |
| Explosion | Oronoka | 1838 | 13[illegible] |
| Fire | Ben Sherrod | 1837 | 13[illegible] |

* It has been stated, but we know not on what authority, that this name has not been intended to imply an identity in principle between the propeller alluded to and the hydraulic machine known as the screw of Archimedes; but has been given simply because it was first tried, on a large scale, in a vessel called the Archimedes. That the vessel was named after the propeller is more likely; but be this as it may, the action of the screw-propeller is very different from that of the screw of Archimedes.

† This item is differently placed in the commissioners' table; but as [the] difference between the cases to which it refers and those included in the [pre]ceding item consists simply in the circumstance that the numbers lost [are] computed instead of being exactly ascertained, there appears to be no suffic[ient] reason for separating the two. The vessels alluded to were wrecked or founde[red,] and are included in the ninety-two cases classified in the table.

END OF VOLUME THE TWENTY-SECOND.

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