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Lexicon Technicum:

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English Dictionary

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ARTS and SCIENCES:

EXPLAINING

Not only the TERMS of ART, but the ARTS Themselves.

VOL. II.

BY

JOHN HARRIS, D. D. late Secretary to the Royal Society, and Chaplain to the Lord High-Chancellor of GREAT BRITAIN.

The SECOND EDITION.

LONDON:

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MONACENSIS

TO THE

RIGHT HONOURABLE WILLIAM Lord COWPER,

Baron of WINGHAM,

AND

Lord High-Chancellor GREAT BRITAIN.

My Lord,



HE great Honour and Advantage which the former Volume of this Work received from the Patronage of His Royal Highness, the late Prince

George of Denmark, encourages me to Dedicate This to Your Lordship; as I am also oblig'd in Duty and Gratitude to do, for the many Favours I have receiv'd from You; and especially for the great Honour and Happiness of having been so long known, and so near to You: For this, my Lord, will save me from Vol. II.

A 2

DEDICATION.

the Fate of those Dedicators, who attempt Characters above Panegyrick: The Publick Part of Your Lordship's all the World knows and admires; and tho' I see every Day That which renders Your Lordship the Instruction, as well as the Delight of all that have the Honour of Your Conversation, yet I can no more describe it, than I dare attempt it: I shall therefore, my Lord, entirely forbear; fearing as much doing Violence to Your Modesty, as Injustice to Your Merit.

I am,

My LORD,

Your Lordship's

Most Dutiful, and

Most Humble Servant,

JOHN HARRIS.

THE

INTRODUCTION.



HE Design of an INTRODUCTION to a Book, being to lead the Reader into it, and to acquaint him what it contains; I shall observe that Method here.

He is therefore to understand, that when I first began this Work, I foresaw the Design could not be accomplish'd in One Volume; but however, I

thought it more proper to Publish one Volume first, than to deser Printing any thing at all of it till the Whole was sinished: For as it is easy to see, that new Matter will continually occur in a Design of this Nature, and, consequently, that there can be no such thing as a Perfect Book of this Kind; so I thought it better to send out an Imperfect one than none, and to afford some Help to Mens Improvement in Philosophy and Mathematical Studies, rather than leave them to stay four or sive Years for a more Compleat one. And the unprejudiced Part of the Learned World have been so kind, as to take my Endeavours as I meant them; and by taking off almost Two Impressions of the former Volume, and numerously subscribing to this, make me shope, the Pains I have taken, and the Time I have employed this Way, may be of some Use and Benesit to Mankind, and to the Improvement of Solid and Substantial Philosophy.

In this Second Volume, as I promised both in the Preface to the First, and also in the Proposals for This, the Matter is entirely New, and without any Repetition, that I know of, of any thing in the Former; and that shall be my Method, if ever I Publish any thing fur-

ther in this Way.

The Reader will find here many. Parts of Natural Philosophy and Anatomy largely treated of, which were either but just nam'd, as it were, or entirely omitted in the former: As in particular, the Affair of Animal Secretion; into which Dr. Keil's Book on that Subject, publish'd since my Account was printed, will let you yet further; Discourses on Thunder, a Vacuum, Vapours, Water; with a large Account of Sound, Echoes; the Transmutation of Bodies into one another; the Nature of Light and Colours, the Rays of Light, the Double Refraction found in the Island Chyrstal; Elasticity, Electricity, the Cohesion of the Parts of Bodies, &c.

And in Natural History, I have here given Schemes of Birds, Fishes, Insects, Quadrupeds, Roots of Plants, &c. by which they

are ranged and distributed into their proper Orders.

Here are also inserted pretty large Accounts of the Ear, Stomach, Spleen, Skin, Vena Porta, Lungs, Gall, and Respiration, and of the New Theory of Generation; with Descriptions of the Lymphæduds and Glands, and two very fine and large Copper Plates of the Veins and Arteries of a Human Body, which were drawn from the Original Tables, presented by that great Promoter of Useful Learning, John Evelyn of Deptford, Esq; to the Royal Society of London.

You have here also a further Account of that most amazing Property, the Attraction of the Particles of Matter one towards another, first discover'd by that Incomparable Mathematician and Philosopher Sir Isaac Newton; who by the wonderful Discoveries he hath made about the Nature of Light and Colours, hath open'd a New World in Natural Philosophy, as by his Method of Fluxions, &c. he had before done in Mathematicks, Mechanicks and Astronomy; and hath sufficiently thewn, that what he said in his Presace to his Principia Philos. Math. in these Words: Multa me movent ut non nihil suspicer catera Natura Phanomena, ex viribus quibusdam pendere posse, quibus Corporum particula, per Causas nondum cognitas, vel in se mutuo impelluntur, & secundum Figuras regulares coharent, vel ab invicem sugartur & recedunt, was what he very well knew then, tho' express'd with that Caution and Modesty, as is so peculiar to that Excellent Man.

This was printed in the Year 1687. and the Queries at the End of his Opticks, and especially as since enlarged by him in the Latin Translation of it, do sufficiently shew his Thoughts to have been long ago employ'd on this most useful Subject; and from whence those Propositions took their Rise, which those Ingenious and Industrious Brothers the Keils, have publish'd about this Affair of Attraction: But however, to do the Illustrious Author yet surther Justice, I have, with his Leave, at the End of this Introduction, printed a Latin Paper of his De Acido, with a Translation of my own; and which, tho' never publish'd before, was given by him to a Friend, as long since as the Year 1692, and which I wish had come to my Hands sooner, to have been inserted in this Lexicon under the proper Head, Acids.

And give me Leave here further to inform the Reader, That there is now printing a Latin Mathematical Treatise or two of Sir Isaac Newton's, which were written many Years ago, and which by their Date will sufficiently determine, whether the New Methods of Fluxion's were known first to him, or Mr. G. Leibnitz. But to go on: In this Second Part, I have been very full and particular in Astronomy; having not only from Mr. Hayes's Excellent Book of Fluxions given

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a short System of the New Astronomy, but have also from the Ingenious and Learned Mr. Halley, Savilian Professor of Geometry in the University of Oxford, inserted a Synopsis of the Doctrine of Comets; and from the Prelections of Mr. Whiston, Mathematick Professor of the University of Cambridge, such Astronomical Tables as are necessary for Calculation, illustrating largely the Uses of them, with proper Examples, in the most useful Astronomical Problems, and in the Calculation of Solar and Lunar Eclipses, and in those of the Satellites of Jupiter, &c.

And because I would have these Two Volumes to serve as a Kind of small Mathematical Library, and prevent in some measure the Necessity and Charge of buying many Books on these Subjects; I have also, as I design'd at first, given you in this Volume very good Tables of Logarithms, Sines, Tangents and Secants, with a full Account of the Nature, Use and Application of them; so that nothing will be wanting here to compleat Trigonometry, both Plain and Sperical, and the Practice of it in Navigation, Dialling and Astronomy,

O٠c.

I have here also given a full and clear Account of the Nature, Construction and Uses of all the Lines which are usually drawn on any Mathematical Instruments, Rules, Scales, &c. and how to use those Instruments, on which they are drawn, in the several Parts of

Practical Mathematicks for which they were design'd.

And I have here and there inserted such useful Tables for the Calculation of Interest, Annuities, Purchases, Reversions, &c. as I found most easily and readily subservient to those Uses. And because of the very many and excellent Uses of the Table of Incomposite Numbers, and its being printed no where but in Brancker's Algebra, an obscure Book, and out of Print; I have here given it you entire, and, I believe, correct; being desirous to prevent so useful a Table from being lost, or buried in Obscurity.

Here is also an Account of the Method of Levelling, in order to drain Marshes, Fens or Moratles, or to convey Water from one Place

to another.

An Account of the Rise, Invention and Progress of the Art of Printing; with a Description of the Tools and Instruments subservient thereunto.

I have added also a farther Account of the Phanomena of Prisins and the Rainbow; with a short System of Opticks from Sir Ijaac Nenton; and many Improvements in Microscopes and Telescopes; the Art of Perspective, and the Methods of Projective, Restactive and Refractive Dialling.

In Mechanicks, besides the Account of the Five Powers and Demonstrations of the Nature and Principles of that Science, here

are many things added about Centres of Gravity and Oscillation, the Resistance of Mediums, with the Description and Uses of all such Mechanical Instruments, Tools and Engines, as are used in Architecture, Fortification, Gunnery, or any Mathematical Arts and Sciences.

In Geometry, here are great additional Improvements; as two Treatises of the Order and Quadrature of Curves, written by the Incomparable Sir Isaac Newton; a Treatise of Conick Sections, translated from the Posthumous Book of the Marquis de L'Hospitall, with many other Things relating to the Properties of Curves, scatter'd up and down under particular Words; such as Cycloid, Helicoid, Retrogression of Curves, Transcendental Quantities, &c. Here are also added many new Things in Arithmetick and Algebra, and in the Doctrine of Fluxions; as about Alternations, Combinations, the Laws of Chance in Play, Infinite Series, and Political Arithmetick; and about the Roots of Equations, Renewing of Leases, Reversions, &c.

I have also here given a large Account of the Ways of Finding, Dressing, Melting, &c. of all the several Ores from whence our Metals are taken; describing also the Works, Engines, Tools and Terms of Art used by Miners; as also the Ways of making Salt, Allum, Coperas, Vitriol, and such like Mineral Productions.

In Musick, here is given an Account of the Nature and Grounds of Harmony from Dr. Holder, and a new short System of Musick by

the Ingenious Mr. Perk.

In Navigation I have added many things; as the Way of finding and allowing for the setting of Currents; an Account of the Power of the Winds on the Sails of Ships, and of the Signals used at Sea, both by Day and Night, in Sailing, and in an Engagement; together with a new Traverse Table, and its Use and Application: And at the End, you will find two very accurate Cuts of the Inside and of the Rigging of a First Rate Man of War; with the several Parts describ'd, and referr'd to by proper Letters and Numbers.

I have also inserted Tables of the Sun's Place, Right Ascension, and Declination; together with a Catalogue of the Right Ascension, Declination, Longitude and Latitude of about sifty of the principal Stars, which Mr. Hodgson supplied me with; as also a Table of the Longitude and Latitude of the most eminent Places on the Globe; all which will be very useful in Astronomy, Navigation and Dialling.

I have added also a Copper Plate, describing a new Hydrostatical Balance, which is very ready and expeditious to find the Specifick

Gravity of Bodies, as is there snewn.

I have

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I have here, under the Word Microscope, given the Reader the Figure, Nature, Use and Advantages of Mr. Wilson's Glasses of that Kind, which I could only just mention in the Introduction to my former Volume, and which I think my self oblig'd again to say, are the most ready, commodious, and universally useful, of any Microscope Lever feet.

scopes, I ever saw.

And that I might do further Justice to our Excellent Mathematical Instrument-Maker Mr. John Rowley, in Johnson's-Court in Fleet-street, I have given the Reader a Plate of a New Sextant lately made by his most accurate Hand, for the Observatory now building in Trinity-College in Cambridge; and which for its universal Use, far exceeds any Astronomical Instrument ever yet made; as you will easily perceive by the Description of it, which I have added to the Figure.

I have only one thing more to acquaint the Reader, and that is, That the ingenious and Accurate Mr. Derham, Rector of Upminster in Kent, and Fellow of the Royal Society, hath lately obtain'd from Florence an Account of the Measures and Weights used there: And we find by Mensuration and Tryal, that the Florentine Semibroccio, or Half-Brace, is in Length 11.475 of our Inches, or in Foot-Measure. 956 of our Foot: And the Florentine Ounce is 17 Peny-weight, 12 Grains, and three Fourths of a Grain Troy-weight.

The following Paper of Sir Isaac Newton's is excellently well worth the Philosophical Reader's most serious and repeated Perusal; for it contains in it the Reason of the Ways and Manner of all Chymical Operations, and indeed of almost all the Physical Qualities, by which Natural Bodies, by their small Particles, act one upon another.

Vol. II. B DE

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NATURA ACIDORUM.

Is. NEWTON.

A Cidorum particula sunt Aqueis Crassiores, & propterea minus Volatiles, at Terrestribus multo subtiliores & propterea multo minus sixe. Vi magna attrastrota pollent, & in hac vi consistit earum Activitas, qua & corpora dissolvunt & Organa sensuam agitant & pungunt. Media sunt Natura inter Aquam & Corpora, & Utraque attrabunt. Per vim suam attrastivem congregantur circum particulas corporum seu Lapideas seu Metallicas iisq; undiq; adherent artissime, ut ab iis dem deinceps per Distillationem vel sublimationem vix possint separari, Attratte vero & undique congregate, elevant, disjungunt & discutiunt particulas corporum ab invicem, id est corpora dissolvunt; & per vim Attractionis quaruunt in particulas commovent sicidum & sic calorem excitant, particulasq; nonnullas adeo discutiunt ut in Aerem convertant & sic Bullas generant. Et hac est Ratio Dissolutionis & Fermentationis; Acidum verà attrabendo Aquam equé ac Terram efficit ut particulæ dissolutæ prompte misceantur cum aqua eique innatent ad modum salium. Et quem admodum Globus terra per vim Gravitatis attrahendo aquam sorniis quam Corpora leviora, efficit ut leviora ascendant in Aquâ, & sugiant de Terrâ. Sic particula Salium attrahendo Aquam fugant se mutuo & ab invicem quam maxime recedendo, per Aquam totam expanduntur.

Particule Salis Alkali ex Terreis & Acidis similiter Unitis constant; sed he Acide vi maxima Attractiva pollent ut per ignem non separentur à Sale; utq; Metalla dissoluta præcipitant attrahendo ab ipsis particulas Acidas quibus dissolvebantur.

Si particula Acida in minori proportione cum Terrestribus jungantur, ha tam artte resinentur à Terrestribus, ut ab ils supprimi ac occultari videantur. Neg, enim sensum jam-pungunt neg; attrahunt aquam. Jed corpora dulcia & qua cum aqua agre miscentur, hoc est pinguia, componant, ut si in Mercurio dulci, Sulphure communi, Luna Connea & Cupro quodi Mercurius Sublimatus corrosa. Ab Acidi vero sic suppressi vi attractiva sit ut pinguia Corporibus prope Universis adhareant & flammam facile concipiant, si modo Acidum calesactum inveniat alia Cor-pora in sumo accensorum qua fortius attrabat quam propria. Sed & Acidum in Suppurcis supprassum fortius attrahendo particulas aliorum corporum (scilicet Terreas) quam proprias, Fermentationem lentam & Naturalem ciet & fovet usq; ad Putrefactionem Compositi.

Qua Putrefactio sita est in eo quod Acida Fermentationem diu foventes tandem in intersiitia minima & prima Compositionis partes interjacentia sese insinuant, intim q, iis partibus Unita

mixtionen Novam efficiunt non amovendam nec cum priore commutandam.

Cogitationes Variæ ejusdem.

Flamma est Fumus Candens; differtque à Fumo ut Ferrum rubens ab ignito sed non rubente. Calor est Agitatio Partium quaqua versum.

Nibil est absoluté quiescens secundum partes suas & ideo frigidum, præter atomos, vacui sci-

Terra augetur, Aquâ in eam conversa, & omnia in aquam (vi ignis) reduci possunt.
Nitrum abit distillatione magnam partem in Spiritum Acidum, relieva terra, quia Acidum
Nitri attrabit I blegma, & idcirco simul ascendunt constituunta, Spiritum: at nitrum Carbone accensum magnum partem abit in Sal Tartari, quia ignis eo modo applicatus partes Acidi & Terre in sese impingit fortiusq; unit.

Spiritus ardentes sunt Olea cum Phlegmate per Fermentationem Unita. Anctura Cochinella cum Spiritu Vini fasta in aqua magnam molem immissa, parva licet dosi, totam aquam inficit : Sc. quia particule Cochinelle magis attrahuntur ab aquâ quam à se mutuo.

Aqua non habet magnum vim dissolvendi quia pauco Acido gaudet. Acidum enim dicimus quod multum attrabit & attrabitur, videmus nempe ea que in aqua solvuntur lente & sinc Effervescentia solvi, at ubi est attractio fortis & particula menstrui undiq; attrahuntur à purticula Metalli, vel potius particula metalli undiq; attrabitur à particulis menstrui, hæ illam aliripiunt & circumsistunt, hoc est metallum corrodunt : He eadem particule sensorio applicate ejus partes eodem modo divellunt doloremy, inferunt; à quo Acida appellantur, reliefa scilicct terrâ Subtili cui adharebant ob majorem attrastionem ad liquidum lingua, &c. In

In omni Solutione per Menstruumparticula solvenda magis attrahuntur a partibus Menstru quam à se mutuo.

In omni Fermentatione est Acidum suppressum quod coagulat pracipitando.

Oleam cum nimis magna mole phlegmatis intime mixtum, sit Salinum quiddam & sic Acetum constituit, hic etiam Tartari seu Terra admissa habenda est ratio.

Mercurius attrahitur id est corroditur ab Acidis & sicut pondere Obstructiones tollit ita vi at-

tradrice Acida infringit.

Mercurius est Volatilis & facile elevatur calore quia ejus particula ultima Compositionis sunt parva & facile separantur separataq; sese sugant; ut sit in particulis Vaporis, suidorumg, rare-

Aqua cum primi non potest quia ejus particula jamjam se tangunt. Et si se tangerent partieula Aeris (nam Aer comprimi potest, quia institut a nondum se tangunt) Aer evaderet in Marmor. Seq. ex Prop. 23. Lib. 2. Princ. Philosoph.

Aurum particulas habet se mutuo trahentes; minimarum summe vocentur prime Compositionis, harum summarum summe secunde Compositionis, &c.

Potest Mercurius, potest Aqua Regia poros pervadere, qui particulas ultime Compositionis

interjacent at non alios.

Si posset menstruum alios illos pervadere vel si auri partes primæ & secundæ Compositionis possent separari sieret Aurum, vel Fluidum, vel saltem magis malleabile. Si Aurum fermen-

tescerë posset in aliud quodvis corpus posset transformari.

Visciditas est vel solum defectus fluiditatis, que sita est in partium parvitate & separabilitate (intellige partes ultime Compositionis) vel defectus lubricitatis seu levioris partes unius supra alias labi impediens. Hujus visciditatis Acidum sape causa est; sape Spiritus alius lubricus terra junttus, ut oleum Terebimbina capiti suo Mortuo redditum su tenax.

Ratio cur Charta Oleo in unita Transitum Oleo non Aqua concedat est quia Aqua Oleo non mis-

cetur sed fugatur ab eo.

Cum Acida partes, minores scilicet, aliquid dissolvant, id faciunt, quia partem rei solvenda includunt undig; utpote Majorem quâlibet Acidi partium.

Some Thoughts about the NATURE of ACIDS; By Sir Isaac Newton.

THE Particles of Acids are of a Size groffer than those of Water, and therefore less volatile; but much smaller than those of Earth, and therefore much less fix'd than they. They are endued with a great Attractive Force; in which Force their Activity confifts; and thereby also they affect and stimulate the Organ of Taste, and dissolve such Bodies as they can come at. They are of a middle Nature, between Water and Terrestrial Bodies, and attract the Particles of both.

By this attractive Force they get about the Particles of Bodies, whether they be of a metallick or stony Nature, and adhere to them most closely on all sides; so that they can scarce be separated from them by Distillation or Sublimation. When they are attracted and gather'd somether about the Particles of Bodies, they raise, disjoin and shake them one from ano-

ther; that is, they diffolve those Bodies.

Vol. II.

By their attractive Force also, by which they rush towards the Particles of Bodies, they move the Fluid, and excite Heat; and they shake a sunder some Particles, so much as to turn them into Air, and generate Bubbles: And this is the Reason of Dissolution, and all violent Tennermation; and in all Fermentation there is an Acid latent or suppress'd, which coagulates in Precipitation.

Acids also, by attracting Water as much as they do the Particles of Bodies, occasion that the afficient Particles do seadily mingle with Water, or swim or float in it, after the manner of Sales.

And as this Clobe of Earth, by the Force of Gravity, attracting Water more strongly than it doth lighter Bodies, causes those lighter Bodies to ascend in the Water, and to go upwards from the Earth: So the Particles of Salts, by attracting the Water, do mutually avoid and recede from one another as far as they can, and so are diffused throughout the whole Water.

The Particles of Sal Alkali, do confift of Earthy and Acid united together, after the same manner: But these Acids have so great an Attractive Force, that they can't be separated from the Salt by Fire; they do also precipitate the Particles of Metals dissolved in Mensirua, by attracting from them the Acid Particles, which before had dissolved them, and kept them sufpended in the Menstruum.

If B 2

If these Acid Particles be join'd with Earthy ones, in but a small Quantity, they are so closely retain'd by them, as to be quite suppress'd and hidden as it were by them; so that they neither stimulate the Organ of Sense, nor attract Water, but compose Bodies which are not Acid, i. e. Fat and Fusible Bodies, such as are Mercurius dulcis, Common Brimstone, Luna Cornea, and Copper corroded by Mercury Sublimate.

From the Attractive Force in these Acid Particles thus suppress'd, arises that universal Property of almost all fat Bodies, that they adhere or stick to others, and are easily inflammable, if the heated Acid Particles meet with other Particles of Bodies in Fume, which the Acid attracts more strongly than it doth the Particles to which it is united. And thus the Acid that lies suppress'd in sulphureous Bodies, by more strongly attracting the Particles of other Bodies (Earthy ones for Instance) than its own, promotes a gentle Fermentation, produces and cherishes Natural Heat, and carries it on so far sometimes, as to the Putteraction of the Compound: Which Putteraction or arises hence, That the Acid Particles which have a long while kept up the Fermentation, do at long run insinuate themselves into the least Interstices that lie between the Particles of the first Composition, and so intimately uniting with those very Particles, do produce a new Mixture or Compound, which cannot fall back again into the same Form.

Note, The Paper hitherto describ'd, seems to have been a continued Discourse; but what follows are short Minutes of Thoughts relating to the same Subject.

Nitre, in Distillation, leaving its Earthy Part behind, turns most of it into an Acid Spirit: because the Acid of the Nitre attracts the Phlegm, and therefore they ascend together, and

constitute a Spirit. But Nitre, kindled with a Coal, turns chiefly into a Salt of Tartar; because the Fire applied this Way, drives the Acid and Earthy Parts towards, and makes them impinge on, and more strongly unite one with another.

The Reason why Water hath no great dissolving Force, is, because there is but a small Quantity of Acid in it: For whatever doth strongly attract, and is strongly attracted, may be called an Acid: And such things as are dissolved in Water, we see, become so, easily, without any Effervescence: but where the Attraction is strong, and the Particles of the Menstruum are every where attracted by those of the Metal, or rather, where the Particles of the Metal are every way attracted by those of the Menstruum; then the Particles of the Menstruum environ those of the Metal, tear them to pieces, and dissolve it.

So when these Acid Particles are applied to the Tongue, or to any excoriated Part of the Body, leaving the subtil Earth in which they were before, they rush into the Liquid of the

Sensory, tear and disjoint its Parts, and cause a painful Sensation.

Mercury is attracted, and therefore corroded by Acids; and as it opens Obstructions by its great Weight, so it breaks and obtunds the Power of Acids (in the Body) by its attractive Force.

All Bodies have Particles which do mutually attract one another: the Sums of the least of which may be called Particles of the first Composition; and the Collections or Aggregates arising from the Primary Sums, or the Sums of these Sums, may be called Particles of the

second Composition, &c.

Mercury and Aqua Regis can pervade those Pores of Gold or Tin, which lye between the Particles of its last Composition; but they can't get any further into it; for if any Menstruum could do that, or if the Particles of the first, or perhaps of the second Composition of Gold could be separated; that Metal might be made to become a Fluid, or at least more soft. if Gold could be brought once to ferment and putrify, it might be turn'd into any other Body

And so of Tin, or any other Bodies; as common Nourishment is turn'd into the Bodies of Animals and Vegetables.

N. B. The small Difference which there is between this Translation and the Latin above, was its being taken from another Copy a little different from this Latin Paper. And having been Supervised and approved by the Illustrious. Author, I have not alter'd it since. enter (f. 1975) (1976)

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LEXICON TECHNICUM.

OR, AN

Universal English DICTIONARY

Arts and Sciences.

VOL. II.

ABA

ABC

BACUS. Besides the former Account of the Abacus, I find that Mauclerc, in the Ionick Order, designs what the Workmen call an O. G. with a Fillet over it for the Abacus: Which Fillet is half the Breadth of the O.G. and he calls it the Fillet of the Abacus. In the Corinthian Order, he describes the Abacus as a seventh Part of the whole Capital. Palladio calls the Plinth about the Boultin (or Eckinus) the Abacus: Which from its Form, faith he, is commonly called Dado, or the Dye; and this is; of the whole heighth of the Capital.

Scamozzi calls a certain Hollow or Casement, which is the Capital of the Pedestal of the Tuscan

Order, by this Name Abacus.

ABASE, in the Sea Language, is to Lower or Take in. To Abase the Flag, is to take in the Flag.

ABBACY, is the Government of a Religious House, with the Revenues and Persons subject to an Abbat.

ABBAT, is a Spiritual Lord, having the Rule of Religious Houses according to our Common Law. Some Abbats in England were called Mitred Abbats; and such were exempted from the Juri diaion of the Diocesan, having Episcopal Authority themselves within their Limits, and were also Lords of Parliament. These were sometimes call'd Abats Sovereign, and Abbats General. The other Abbats were subject to the Diocesan in all Spiritual Government. These were also Lords Priors, which had exempt Juristion, and were Lords of Parliament. Of these Lords Abbats and Priors, Six Film Coke faith there were 20 that sat in Par-Sir Edw. Coke saith there were 29 that sat in Par-

liament, 27 Abbats and 2 Priors. But sometimes their Number was varied, there being but 25 Abbats and 2 Priors in a Pailiament held in the 20 Rich. 2

ABREUVOIRS, are the Intervals or Spaces between the Stones, or the Joints where the Mortar lies in any Pillar, Wall, or Building.

ACCORD, according to the Modern (French)

Account of Musick, is the Production, Mixture and Relation of two Sounds; of which the one is Grave, and the other Acute. They make two Kinds of Accord; those which are pleasant and agreeable, and which they call Consonances; and the as are harth and unpleasant, which are call'd Differences. Which Cas in Vol I. Dissonances. Which see in Vol. I.

ACERIDES, is a Plaister made without Wax, such as that call'd Emplastrum Norimbergense.

ACTION Civil, is that which tends only to the

Recovery of what is due to any one by Contract, Egc. as if a Man feek by Action to recover a Sum of Money formerly lent.

ACTION Penal, is that which aims at some Penalty or Punishment in the Party sued, whether Corporal or Pecuniary; as in the Action Legis Ac-

quilie in the Civil Law, and in the Common Law in Case of Appeals for Murder.

ACTION Prejudicial or Preparatory, is that which grows from some Doubt in the Principal; as suppose a Man sue a younger Brother for Land descended from his Father, and its objected that he is a Bastard, the Bastard must be first tried; that is call'd Attio Prejudicalis, because it must be first judg'd or determin'd.

ACTION

ACTION Amcestrel, is in opposition to Personal, being that which a Man hath by some Right descending from his Ancestors: This is either Deoi-

ACTOR, is sometimes used for a Proctor of Advocate in Civil Courts or Causes. Actor dominicus was also the Term formerly for the Lord's Bailey or Attorney. Actor Ecclesia was sometimes the Foreign Term for the Actor Villa was the Stew-

ard or Head Bailey of a Town or Village.

ADDICTIO in Diem, in the Civil Law, is an Agreement between Buyer and Seller, that the Seller may Contract with any other Person who will offer a better Price, before a certain Day.

ADDITION, is the Term in our Common Law for the Title which is given to any Person besides his Christian and Sirname, in order to

distinguish him by his Degree, Estate, Mystery, Trade, Place of Abode, &c.
And tis particularly provid by the Stat. 1 H. 5. 6. 5. that in Suit of Action where Process of Utlars lies, such Additions shall be given to the Name of the Defendant; and that Writs not having such Additions shall Abate, if the Defendant take Exceptions thereunto.

ADVANCE Fosse, is a Ditch of Water round the Esplanade or Glasis of a Place, to prevent its being furprised by the Besiegers: But of late this Work hath been desus d, because as foon as the Enemy could drain it, it was a Trench ready made for the Advantage of the Bessegers.

ADVOCATIONE Decimarum, is a Writ that lies for the Claim of a fourth Part, or upward, of

the Tithes belonging to any Church.

ADVOWEE or AVOWEE, in Latin Advoca-Presentation to a Benefice; and the Avowee Paramount was the highest Patron, or the King. By

the Statute of Provisors, 25 E. 3.

ADVOWSON of a Religious House; as the Builders and Endowers of a Church were the Patrons of it, so those that Founded any Religious House, had the Advanson or Patronage of it. Sometimes the Patron had the fole Nomination of the Prelate, Abbet or Prior, either by Investiture (or Delivery of a Pastoral Stass) or by direct Pre-feutation to the Diocelan. And if a free Election was left to the Religious, yet a Conge destire, or License of Election, was first to be obtained of the Patron, and the Person Elected was confirmed by Patron; and the Person Elected was confirm'd by him. If the Founder's Family was extinct, the Patronage of the Convent went to the Lord of the Mannor.

ADZ, is an Instrument whose Blade is made thin and something bending, and hath not its Edge parallel to its Handle, as the Axe and Hatchet hath, but placed athwart to it. It is ground to a Basil on the Inside to its outer Edge. Its general Use is to take off thin Chips of Timber or Boards, and fuch Irregularities as the Axe can't come at, and where a Plane, the rank Set, will not make rid-dance enough. 'Tis much us'd in taking off the dance enough. Irregularities of Floors when they are pinned and framed together; and fometimes on Polls framed apright, and ranged in with other Work framed

to them, where the Edge of the Axo can't come.

ÆSTUARY, is an Arm of the Sea running up a good way into the Land, like the Briffel Chan-

ncl, 55c.
AGE, in the Common Law, is that particular Time which enables a Person to do that, which

before he could not do for want of Age: Thus at 14 Years a Man is said to be at the Age of Discre-from, and at 21, at sull Age. At 12 Years of Age a Man may take the Oath of Allegiance at a Leet; at 14 he may confent to marry, and in Sociage chuse his Guardian; at 15 he is of Age for the Lord to have Aid pur fuir fitz Chivalier, and may be fwom so keep the King's Peace; at 12 he is bound to Appearance before the Sheriffs and Coroner for

Enquiry after Robberies.

A Woman might heretofore at 7 Years of Age, her Father being the Lord, distrain his Tenants for And pur fill Marier, and at those Years consent to marry, saith Bracton. At 9 Years she is dowable; for then, or within half a Year after (Fleta, lin. 9. 6-22. Lit. Lib. 1. c. 5.) she is able promereri dotenzes virum suffinere: But this Bracton limits to 2. Years. At 12 she is able to ratify and confirm a former Consent given to Matrimony; at 14 she is able to receive her Lands into her own Hands, and shall be out of Ward, if the be at that Age at her Ancestor's Death; at 16 she shall be out of Ward, tho' she was under 14 at the Death of her Ancestor; at 21 the is able to alienate her Lands and Tenements.

AGOGICE, is the Art of making Images or Figures in Metals, when Wax is us'd to effect or fur-

ther the Design.

AIDE, in the Law, hath feveral Significations; fornetimes 'tis the fame with Subfidy; tometimes a Protestation due from Tenants to their Lords. This Word is also us'd in matter of Pleading for a Petition made in Court, for the calling in of the Help from another that hath an Interest in the Cause in Question. Thus a Tenant for Term of Life, by Courtesy, Tenant in Tail after Possibility of Issue extinct, for Term of Years, at Will, by Elegit or by Statute Merchant, being impleaded touching her Estate, may pray in Aid of him in the Reversion; that is, desire the Court that he may be called in by Writ, to alledge what he thinks good for the Maintenance both of her Right and his own; but this Course hath been disus'd. If a King's Tenant holding in Chief be demanded a Rent of a common Person, he may pray in Aid of the King; and so may a City or Burgh, having a Fee Farm of the Crown, when any thing is demanded against them belonging thereunto.

AIR, the admirable Sir Isaac Newton, in the Obfervations mention'd in the 2d Book of his Opticks by considering the Colour'd Rings made by Compressing two Prisms, or two Object Glasses of large Telescopes together, comes to a Calculation of the Thickness of the Air contain'd between the Prisma and Object Glasses in such a State of Compression; and at last he seems (he saith) to gather this Rule, That the Thickness of the Air is proportionable to the Secant of an Angle, whose Sine is a certain mean Proportional between the Sines of Incidence and Refraction. And that mean Proportional, fo far as by the Measure he took could be determin'd. he found was the first of 106 Arithmetical Mean Proportionals between those Sines accounted from the greater of the Sines (i. e.) from the Sine of Refraction, when the Refraction is made out of the Glass into the Plate of Air; or from the Sine of Incidence, when the Refraction is made out of the Plate of Air into Glass. And in Observation 14. Page 18. He faith that the Thickness of the Air between the Glasses there, where the Rings are suc-Ceffively made by the Limits of the 7 Colours, Red, Orange, Yellow, Green, Blue, Indico and Violet, in order; are to one another as the Cube Roots of

the Squares of the eight Lengths of a Musical Chord which Sound the Notes in an Eighth, Sol, la, fa, Sol, la, mi, fa, Sol: That is as the Cube Roots of the Squares of the Numbers 1, $\frac{1}{2}$, $\frac{1}{4}$,

And according to his most accurate Observations, the Thickness of the thinned Air, which between two Glasses exhibited the most Luminous Parts of the first six Rings of Colours, were TT 178000 178000 178000 178000 Parts of an Inch.

'Tis highly probable that True and Permanent Air is made by Fermentation, (faith the fame Author) and Rarefraction of Bodies that are of a very fixt Nature: Those Particles flying and avoiding one another with the greatest Force at a Distance, which when very near, attract and adhere to one another with the greatest Violence.

The Particles therefore of true and permanent Air, being Extracted from the Densest and most six'd Bodies, will be Denser and Crasser than those of Vapour; and from hence it is likely, may be Heavier also than those, and that the Parts of a Humid Atmosphere may be Lighter than those of a dry one, as in Fact it appears to be; by the rifing of the Mercury in dry Weather, and by Clouds and Vapours rising into and floating in our Atmo-Spherical Air. And he very justly thinks that the Rarefraction and Condensation of the Air cannot be accounted for from the Spring or Elastick Forms of the Particles, without a Supposition that they are endued with some Centrifugal Force or Power by which they Fly and avoid one another, and the Dense Bodies from whence they are Extracted. See Attraction

And that this Repelling Force, which is the Caufe of Filtration and of the Ascent of Water in small Capillary Tubes to much greater Heights than the Surface of the Water in the open Vessel, in which they are placed. The Air within the Tubes being amuch rarer than in more open Spaces, and by that speans not pressing so much on the Surface of the Water within the Tubes as without. And this And this Account Dr. Hook had hinted at long ago. Sir If. did in his admirable Prin. Philo. Mathem. Prop. 23. P. 201. long ago demonstrate, That Particles endeavouring to recede from or avoid one another with Forces reciprocally proportional to the Distance between their Centers, will compose an Elastick Fluid whose Density shall be proportionable to its Compression, and from such a Property all the Appearances of our Air may be very well accounted for. And I think much better than from the Supposition of its Particles being Spires contorted into Spheres, through whose Interstices the Rays of Light may freely pass, &c. tho' this be very ingenious: But I think can never folve the prodigions Rarefraction of this most useful Fluid.

AIRS Resistance: See Resistance.
AIRS Weight, in Proportion to the same Bulk of Water, seems pretty nicely determin'd by an Experiment lately made before the Royal Society by the ingenious Mr. Hauksbee (See Phil Trans.

N. 305.) to be nearly 885 to 1.

ALARM Poft, is the Ground appointed to each Regiment by the Quarter-Masser-General, for them to march to in Case of an Alarm; in a Garrison 'tis the Place where every Regiment is order'd

to draw up in on all Occasions.

ALBULA. This Word is used somerimes for a Spot in the Eye, and then seems so be the same with Albugo: But in the Plural Albula, fignifies

such very astringent Mineral Waters as have a great deal of Allum in them, and are chiefly used externally for Cleansing and Healing of Wounds and Ulcers.

ALCOLA, is sometimes used for Aptha, and sometimes signisses a Tartarous Sediment in Urine, and from hence Urine is sometimes call'd Alcolita.

ALGEBRA, besides the Authors mention'd in the Account of this Science under this Word in Vol. I. those that please to have a thorough infight into this wonderful and useful Art, may confult the following Authors,

Diophanti Alexandrini Arithmeticorum Lib. 6, E36. cum Comment. C. G. Bacheti & Observationibus D. P. de Fermat. cui accessit Dostr. Analytica inventum novum. Tholosa. 1670. Fol. Labyrinthus Algebra per Job. Jac. Ferguson.

1667, 4to.

Kerfey's Algebra, 2 Vol. Fol. Lond. 1683. Baker's Geometrical Key of Equations. Lond. 1681.

Tradatus de Principiis Calculi Exponentialis. Analysis Geometrica, sive nova & vera Methodus Resolvendi tam Probl. Geometr. tam Quast Arithmeticas pars prima, de Planis. Authore Hugo de Omerique Sanlacarense. Cadiz. 1698.
Vieta oper Math. Lugd. Bat. 1646. Fol.
Jeak's Arthmetick. Lond. 1696.

Des Cartes Geometria cum Commentariis Schooteni. Amfter. 1659.

Brancker's Algebra, by Dr. Pell. Lond. 1668. Erasm. Bartholini Dioristice, seu determination Equationum. Haunia. 1663.

Wallisii Opera Mathematica. Oxon. 1657.

his Algebra English. Lond. 1685. Comercium Epistolicum. Lond. 1652. De Billy's Diaphantus Redivivus. Lugdu. 1670. Wells's Arithmetica numerosa & Speciosa Ele-

menta. Oxon. 1698. Oughtredi Clavis Mathematica denuo Limata,

Oxon. 1667.

Moor's Algebra. Lond. 1660.

Parsons and Wastell's Clavis Arithmetica. Lond.

Sturmii Mathesis Enucleata.

Balaam's Algebra. Lond. 1653. Ward's Algebra. Lond. 1698. and his Young

Mathematicians Guide. 1706. Harris's Algebra. Lond. 1705. Hays's Fluxions. Lond. 1709.

Bern. Nieuwentiit Analysis Infinitor. Amst. 1695. Arithmetica Universalis, by Sir Isaac Newton.

imbridge. 1707. ALGEBRAIC-Curve, in Geometry, is of fuch a Nature, that its Abscisse or intercepted Diameters bear always the same Proportion to their Re-spective Ordinates. Thus if the Product of any Abscissa multiplied into one and the same determinate Quantity be always equal to the Square of its corresponding Ordinate; then if that determinate Quantity be call'd p, the Abscilla x and the Ordinate; the Expression of the Nature of the Curve by way of Equation will be p = yy, where p is the Parameter or Latus Resum of the Figure; Curve by way of Equation will be p x: and the Curve is the common Apollonian Parabola; and because the two indeterminate or flowing Quantities α and y, do here denote firait Lines; therefore the Curve is call'd an Algebraick or Geametrick Curve. And 'tis plain that the Number of such Curves must be infinite; because there may be an Infinity of Proportions or Relations between the Ordinates and the Abscissa. But

But when the Nature of any Curve is expressed by an Equation, wherein one of the indeterminate or flowing Quantities represents a Curve Line; then that Curve is call'd a Transcendental Curve, and if the Curve which enters the Equation be Geometrical, or a Curve, as they call it, of the first Kind or Degree; then the transcendent Curve is call'd a Curve of the second Kind or Degree: And when the Curve which enters the Equation represents a Curve of the second Kind or Degree; then the Transcendental Curve is call'd one of the Third

Kind; and so on infinitely.

ALLUM-Works, Allum is made of a Stone of Sea-weed and Urine. The Stone is found in most of the Hills between Scarborough and the River of Tees in the County of York, and also near Preston in Lancasbire; 'tis of a blueish Colour, and will cleave like Cornish Slate. The Mine which lies deep in the Earth and is pretty well moistned with Springs is the best. The dry Mine is not good, and too much Moissure cankers and corrupts the Stone, making it nitrous. In this Mine are found feveral Veins of Stone call'd Doggers, of the same Colour but not so good. Here are found those alfo which are commonly call'd Snake-Stones. For the more convenient working of the Mine which fometimes lies 20 Yards under the Surface or Cap of the Earth (which must be taken off and barrow'd away) they begin their Work on the Declivity of a Hill, where they may be also well furnish'd with Water. They dig down the Mine by Stages, to fave Carriage, and so throw it down near the Places where they calcine it. The Mine before it is calcin'd, being expos'd to the Air will moulder into Pieces, and yield a Liquor whereof Copperas may be made: But being calcin'd it's fit for Allum; as long as it continues in the Earth, or in Water, it remains an hard Stone. Sometimes a single by the iffue out of the Side of the Mine, which by the natural Allum. The remains an hard Stone. Sometimes a Liquor will Sun's Heat is turn'd into natural Allum. The Mine is calcin'd with Cinders of New Castle Coal, Woods and Furzes; he Fire made about two Foot and thick, two Yards broad, and ten Yards long. Betwixt every Fire are Stops made with wet rubbish; so that any one or more of them may be kindled, without Prejudice to the rest. After, there are 8 or 10 Yards Thickness of broken Mine laid on this Fewel, and 5 or 6 of them so covered; then they begin to kindle the Fires, and as the Fires rise towards the Top, they still lay on fresh Mine: So that to what Height you can raise the Heap, which is oftentimes about 20 Yards, the Fire without any farther Help of Fewel, will burn to the Top stronger than at the first kindling, so long as any Sulphur remains in the Stones.

In calcining these Stones, the Wind many times does hurt, by forcing the Fire too quickly through the Mine, leaving it black and half burnt; and in others, burning the Mine too much, leaving it red. But where the Fire passes softly and of its own Accord, it leaves the Mine whole, which yields the best and greatest Quantity of Liquor.

The Mine thus calcin'd is put into Pits of Water supported with Frames of Wood, and ramm'd on all Sides with Clay; They are about ten Yards long, 5 broad, and 5 deep, and set with a Current that turneth the Liquor into a Receptory, from whence its pumpt into another Pit or Mine. So that every Pit of Liquor, before it comes to boiling, is pumpt into four several Pits of Mine; and every Pit of Mine is steeped in four several

Liquors before it be thrown away, and the dast Pi being always of the fresh Mine.

This Mine thus steeped in each of the several Liquors 24 Hours, or there abouts, is of course four Days in passing the sour several Pits from whence the Liquors pass to the boiling-House.

whence the Liquors pass to the boiling-House.

The Water, or Virgin Liquor often gains in the first Pit, two Pounds Weight; in the second it increases to five Pounds, in the third to eight Pounds, and in the last Pit which is always fresh Mine to twelve Founds; and so in Proportion according to the Goodness of the Mine, and its being well calcin'd. For sometimes the Liquors passing the four several Pits, will not be increas'd to above six or seven Pounds Weight, and at other times above twelve Pounds; seldom holding a constant Weight one Week together: Yet many times Liquor of seven or eight Pounds Weight produces more Allum than that of ten or twelve Pounds Weight, either through the Badness of the Mine, or its being ill calcin'd, which is the usual Reafon.

And if by passing the weak Liquor thro' another Pit of fresh Mine, you bring it to be ten or twelve Pounds Weight, yet you shall make less Allum with it, than when it was but eight Pounds Weight. For what it gains from the last Pit of Mine will be most Nitre and Slam, which possons the good Liquors, and disorders the whole House, till the Slam be wrought off.

That which they call Slam, is first perceived by the Redness of the Liquor when it comes from the Pit, occasion'd either by the Badness of the Mine, or more usually its being over or under calcin'd, which in the Settler sinks to the Bottom, and there becomes a muddy Substance, and of a dark Colour. That Liquor which comes whitest from the

Pits is the best.

When a Work is first begun, they make Allum of the Liquor only that comes from the Pits of Mine, without any other Ingredients. and so might continue, but that it would spend so much Liquor as not to quit Cost.

Kelp is made of a Sea-weed call'd Tangle, such as comes to London in Oyster Barrels. It grows on Rocks by the Sea-side, between high and low Water Mark. Being dry'd it will burn and run like Pitch; when cold and hard, 'tis beaten to Ashes, steeped in Water, and the Lees drawn off to two Pound Weight or thereabouts.

Because the Country People who furnish the Work with Urine, do sometimes mingle it with Sea-Water, which cannot be discover'd by Weight, they try it, by putting some of it to the boiling Liquor; For then if the Urine be Genuine it will work like Yeast put to Beer or Ale; but if mingled, it will stir no more than so much Water.

They observe that the best Urine for that Purpose, is such as comes from poor labouring People

who drink but little strong Drink.

The boiling Pans are made of Lead, nine Feet long, five broad, and two ½ deep, fet upon Iron Plates about two Inches thick; which Pans are commonly new Cast, and the Plates repair'd five times in two Years.

When the Work is begun, and Allum once made, then they fave the Liquor which comes from the Allum, or wherein it shoots, which they call the Methers, with this they fill? of the Boilers, and put in 3 of the fresh Liquor which comes from the Pits. Being thus fill d up with cold Liquor, the Fires having been never drawn out, it will boil

again in less than two Hours time. And in every two Hours time the Liquor will waste four Inches, and the Boilers are fill'd up again with Green Liquor.

The Liquor if good, in the boiling, will be greafy, as it were, at the Top: If Nitrous, it will be thick, muddy and red. In boiling 24 Hours it will be 36 Pound Weight. Then is put into the Boiler about an Hogshead of the Lees of Kelp, of about two Penny Weight, which will reduce the whole Boiler to about 27 Pound Weight.

If the Liquor be good, as soon as the Kelp Lees are put into the Boiler, they will work like Yeast put to Beer. But if it be Nitrous, the Kelp Lees will stir it but very little; and in that Case the Workmen must put in more and stronger Lees.

Presently after the Kelp Lees are put into the Boiler, all the Liquor together is drawn into a Settler, as big as the Boiler and made of Lead, in which it stands about two Hours, and in that time most of the Nitre and Slam sink to the bottom.

This Separation is made by the help of the Kelp Lees, for when the whole Boiler consists of Green Liquor drawn from the Pits, it is of power strong enough to cast off the Slam and the Nitre; but when the Mothers are us'd, the Kelp Lees are needful to make the said Separation.

Next the faid Liquor is scooped out of the Settler into a Cooler, made of Deal Boards, and ramm'd with Clay. Into this is put 20 Gallons, or more of the Urine, according to the Goodness or Badness of the Liquor, for when the Liquor is Red and Nitrous, the more Urine is required.

In the Cooler, the Liquor in temperate Weather flands four Days; the second Day the Allum begins to strike, gather and harden about the Sides, and at the bottom of the Cooler.

If the Liquor should stand above four Days,

then it would turn to Copperas.

The Use of the Urine is as well to cast off the Slam, as to keep the Kelp Lees from hardning the Allum too much.

In hot Weather the Liquor will be a Day longger in cooling, and the Allum in gathering, than in temperate Weather. But in Frost, the Allum shoots or strikes too soon, not giving time for the Nitre and Slam to sink to the bottom, whereby they are mingl'd with the Allum. This produces double the Quantity, but being foul 'tis consumed in washing.

When the Liquor hath stood four Day in the Cooler, than that call'd *Mother*, is scooped into a Cistern, the *Allum* remaining on the Sides and Bottom; and from thence the Mothers are Pumpt back into the Boilers again: So that every five Days the Liquor is boil'd again, until it evaporate or turn into *Allum* or *Slam*.

The Allum taken from the Sides and Bottom of the Cooler, is put into a Cistern and washed with Water, that they use for the same Purpose; being about 12 Pound Weight, after which it is Roached as follows.

Being washed, it is put into another Pan with a Quantity of Water, where it Melrs and Boils a little; then 'tis scooped into a great Cask, where it commonly stays 10 Days, and is then sit to take down for the Market.

The Liquors are weigh'd by Tro, Weight; so that half a Pint of Liquor must weigh more than so much Water, by so many Penny Weight. From Phil. Trans. N. 142.

Vol. IL

ALMAN Furnace or Almond, as some write its is a Furnace us'd by Refiners, and by them call'd the Sweep: By it all sorts of Metals are separated from Cinders, parts of melting Pots, Tests, Bricks and all other harder Bodies; which must first be beaten to Powder, before they are put into the Furnace.

This Furnace is about fix Foot High, four Wide and two Thick, made of Brick, having a hole in the midst at the top, eight Inches over, and growing narrow towards the Bottom, whereon the forepart ends in a small hole environed with a Semicircle of Iron, to keep the melted Metal; about the middle of the Back there is another hole to receive the Nose of a great pair of Bellows.

When the Furnace is Annealed with Charcoal and hot, they throw two or three Shovels of Coal to one of the foremention'd powder'd Stuff, and so proceed during the whole Work, which continues without Intermission three Days and Nights.

After eight or ten Hours the Metal begins to run; and when the Receiver below is pretty full, they lade it out with an Iron Ladle, and cast it into Sows, in Hollows, or Forms made with Albes.

ALMONER, is an Officer in a King's or Prince's House, whose Business is to distribute Alms to the Poor; he hath Forfeiture of all *Deodands* and the Goods of *Felons de se*, which he is to dispose of to the Poor. *Terms de Lay* 39.

ALNAGER, Aulnager; properly one that meafureth Cloth by the Ell, the doing of which is Alnage. He is a publick sworn Officer of the King, who either by himself or his Deputy, looks to the Affize of Woollen Cloth throughout the Kingdom, and to the Seals for that purpose ordain'd. Now there are three Officers belonging to this Affair, the Searcher, the Measurer, and the Alnager; which last is now become the Collector of the Subsidy granted to the Crown by several Statutes.

ALOOF, is a Sea Term, fignifying as much as keep your Luff; being a Word of Command from him that Conns, to the Man at the Helm to keep the Ship near the Wind, when she Sails upon a Quarter Wind.

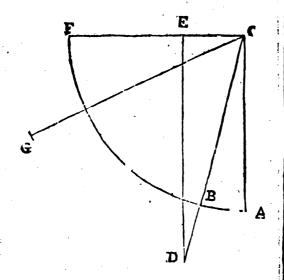
ALOPEX, is by some Writers, a Term us'd for the Muscle Psoas.

ALTITUDE of the Eye in Perspective; See Height. Vol. II.

ALTITUDE

ALTITUDE of the Sun. To find it readily at any time without a Quadrant or such like Instrument.

On any plain Place erect a Pin or Wire perpendicularly as in the point C: From which point, you had before with 60 of a Line of Chords, described the Quadrantal Arch AF, make CE equal to the Heigth of the Pin or Wire, and through E



draw ED parallel to CA, and make it equal to CG the Length of the Shadow. Then will a Ruler laid from C to D, intersect the Quadrant in B, and BA is the Arch of the Sun's Altitude, when measur'd on the Line of Chords.

ALVUS, is the lower Belly; but in a medical Sense is sometimes us'd rather for the State and Condition of the Intestines and their Contents. If the Patient be too Laxative, they call it Alvus Liquida or Fluida: if he be too Costive, Alvus dura; and when he is so in a very great Degree, Alvus adstricta.

AMABYR, or Anwabyr, was the old Custom of the Pretium virginitatis Domino Solvendum. Henry Fasted Arundel, by Deed dated 31 Aug. 3, 4. of Phil. and Mar. released this Custom to his Tenants by the Name of the Custom of Amabyr and Cherage.

AMAASA, are such Pieces of Glass as are us'd in Enammelling, and are sometimes call'd Encausta; by some Smalta and Terra Saracenica.

AMARACINON, is a very precious Ointment prepared with rich Oyls and highly Aromatick Spices.

AMBIGENAL Hyperbola, is an Hyperbola which hath one of its infinite Legs inscrib'd in it, and the other circumscrib'd about it.

AMERCEMENT. 'Dr Kennet, in the Glossary at the End of his Parochial Antiquities, shews that Amerciamentumis a pecuniary Punishment impos'd upon Offenders a la mercie, at the Mercy of the Court; and therefore in our Law is frequently call'd Miseri cordia, and there is this stated Disserence between Fines and Amercemens; Fines are Punishments certain and determin'd by some Statute; but Anercements are Arbitrary Impositions proportion'd to the Fault, at the Discretion of the Court.

AMETHYSTA, are such Medicines as will preserve Men from being soon inebriated with Wine or strong Liquor. Bruno.

AMMONION, is by some Writers us'd for Collyrium. Which see.

AMPHORA, was anciently a Measure of Capacity, sometimes call'd use "mor, and was of 2 Sorts; the Italian Amphora, which Galen saith, held 72 Pound of Water: The Attick Amphora, which was larger, and was call'd unge of See Weights and Measures.

ANALEMMA, when all the whole Furniture of this kind of Projection is drawn on a latge Plate of Brass or Wood; with an *Horizon* and *Carfor* fitted to it; then that Instrument is call'd an *Analemma*; and is indeed a very useful one. For by it may readily and universally be found, such things as these:

1. Having the Pole's Height and Day of the Month; to find the time of the Sun's Rifing and Setting, and confequently the Length of Day and Night any where.

Count the Latitude from the polar Point where all the Elliptical Meridians meet either N or S, as suppose 49 deg. and bring the Fiducial Edge of the Horizon to that degree of Latitude in the Limb, and mark where the Horizon cuts the Parallel for that Day; as suppose April 20. or when the Sun enters into &. Observe also which of the Hour Circles that point of Intersection is nearest to; and that will give you the Time of the Sun's Rising, in this Case about five or a little after; and therefore it will Set as much before 7. The time of its Setting being doubled gives the Length of the Day; and that of its Rising doubled, gives the Length of the Night.

II. To find the Length of the longest Day in any
Latitude.

Bring the moveable Horizon to the Pole's Height in the Limb as before; and then mark the Point where it cuts the Parallels of 50 or v3; (according as your Latitude is North or South) and then observe which of the Hour Circles is nearest to that Point of Intersection as before.

III. Having the Latitude, Sun's Place, and Altitude, to find the Hour of the Day.

Bring the Horizon to the Latitude, suppose as before 49 deg. N. and the Sun's Place being on of of and his Aktitude observed by a Quadrant or otherwise 18 deg. Then since the Degrees of the Cursor denote the several Parallels of Aktitude, move the Cursor till 18 deg. on it, will just cut the Parallel of on of or April 20. for then that Hour Circle, which (as before) is next the Point of Intersection, will shew the time of the Day, which in this Instance will be either seven in the Morning or sive in the Asternoon. And this will give the Hour very well, except between 11 and 12, and 12 and 1, where the Hour Circles run a little too close to shew it exactly.

How to find the Sun's Declination, Right Ascenfion, Altitude, Azinmth and Hour, &c. by a ready and easy Projection of part of the Analenma; you will find under these Words.

ANALYSIS of Infinites. Se Fluxions and Ge-

ANCESTOR. The Law distinguishes between Ancestor and Predecessor, the former being applied to a Natural Person; as AB and his Ancestor;

the latter to a Body Politick or Corporate; as a Bithop and his Predeceffors.

Tho' the Word Antecessor, whence Ancestor is deriv'd, is not applied to the Ancestor of a Family, but to the Prepossessor of an Estate, or a Predecessor in Office. Ancestrel Homage, is such Homage as hath been perform'd by our Ancestors.

ANCHORS, in Architecture, is a certain Kind of Carving, in the Form of an Anchor or Arrow Head, which is placed by way of Ornament to the Boultins of Capitals of the Tuscan, Dorick and lonick Orders; and also to the Boultins of Bed Mouldings, of the Dorick, lonick and Corinthian The Anchors and Eggs being placed Cornishes.

alternately.

ANCIENT Demesse or Demays, is a certain Tenure whereby all Manors belonging to the Crown in St. Edward's or William the Conqueror's Time were held. The Numbers and Names, &c. of such Manors were entred by the Conqueror, in a Book call'd Dooms day Book, and now remaining in the Exchequer; so that such Lands as by that Book appear'd to have belong'd to the Crown at that Time, are call'd Ancient Demesne. Tenants in Ancient Demesne are of two Sorts; one that hold their Lands frankly by Charter, the other by Copy of Court-Roll, or by the Verge at the Will of the Lord, according to the Custom of the Manor. The Advantages of this Tenure are, 1. That Tenants holding by Charter cannot be rightfully impleaded out of their Manor; and when they are, they may abate the Writ by pleading the Tenure. 2. They are free from Toll for all things relating to their Livelihood and Huf-bandry: Nor can they be impannell'd upon any Inquest.

ANCONY, is the Term in the Iron Works for Bloom, wrought into the Figure of a flat Iron Bar of about three Foot long, with two square rough Knobs, one at each End, which are after-

wards to be wrought at the Chafery. See Iron.
ANGARIA, was formerly the Word for any troublesome or vexatious Duty or Service paid by

the Tenant to the Lord.

ANGEL, the Name of a Gold Coin in England, which seems to be so call'd from the Figure of an Angel impress'd upon it: Its Value in 1 H.6. was 6 s. 8 d. in 1 H. 8. 7 s. 6 d. in 34 H. 8. 8 s. in 6 Ed. 6. 10s. and the half Angel, or as it was fometimes call'd the Angelet, was the Moiety of

Chron. Preciof.

ANGLE of Inclination of the Plane of a Planet's or Comet's Orbit to that of the Ecliptick, is the Angle made by the Intersection of the Planes of the Orbits. For the Orbits of the Planes nets are by no means all in the same Plane, but diversely inclined to one another and to the Orbit of the Earth; which is taken for the Standard, and is call'd the Plane of the Ecliptick, in the N. Aftronomy. And to this Plane the Planes of the Primary Planets Orbits are thus inclin'd. The Angle of Saturn's Orbit with the Earth's Orbit is 2°. 30'. that of Jupiter is 1°. 20'. that of Mars a little less than 2 Degrees; that of Venus a little more than 3°. 20'. and that of Mercury almost 7°.00'.

ANGUINEAL Hyperbola, is one of an Eel-like Figure, which cuts its Asymptote with contrary Flexions, and is produced both ways with contrary

Legs. See Curves.

ANGULAR Motion, in Astronomy, is the Increase of the Distance between any two Planets &c. revolving round any Body as the Centre of Vol. II.

their Motion; and is express'd by two Right Lines drawn from the said Centre to the Revolving Bodies, which will open wider, and consequently grow greater, as the Revolving Bodies pait farther

and farther from one another.

ANIMAL Secretion, is that Action in an Animal Body, whereby, by means of the Glands, all proper Separations of Particles proper to be fecerned or feparated from the Blood are made, throughout its whole Course of Circulation. How these Secretions are every where made in the Body, its of very great Use to understand; and some of our Modern Physicians, who have apply'd themselves to consider the wonderful Machine of a H man Body Geometrically and Mechanically, have made great Advances this way; such as Borelli, Bellini, Baglivi, Pitcairne, Cherne, Wainwright, &c. from whom you have the following Account of this important Affair.

The Nature of Secretions in general depends upon these three Things. (1.) The different Diameter of the Orifice of the Secretory Duct; for thereby all Particles, whose Diameters are greater than those of the Ducts, must be excluded; and it may be concluded, that any Peccant or Morbifick Matter may be evacuated therefore by any of the Glands, provided that their Orifices be but sufficiently enlarg'd, together with the Diameters of the

Secretory Ducts.

(2.) The different Angle which the Secretory Dust makes with the Trunk of the Artery. For all Fluids press the Sides of the containing Vessels in a Direction perpendicular to its Sides; and this is evident in the Pulsation of the Arteries, since 'tis to that Pressure that this Pulsation is owing. It is likewise evident, that the Blood is urg'd forward by the Force of the Heart; so that this Motion of Secretion must be compounded of both these Motions. Now this Lateral Pressure is greater when the Velocity of the Longitudinal Motion is so too; but yet 'tis not in the Proportion of this Velocity. For the Lateral Pressure is considerable, even when the Fluid is at rest; being then in Proportion to the Specifick Gravity of the Fluid. And in a Fluid, like the Blood in the Arteries, which is urg'd by a Longitudinal Direction, this Lateral Pressure is in a Compound Proportion of both: From whence it will follow, that if two Particles of equal Diameters, but of unequal Specifick Gra-vity do arrive, with the same Velocity, at an Ori-fice capable of admitting them, yet they will not both enter it and pass, because their Motion of Direction is different. So that this Diversity in the Angles, which these Ducks make with the Trunk of the Artery, seems altogether necessary to account for the possible Diversities of Secernsd Fluids, even supposing their Diameters and Figures to be the same: For no doubt the Blood is a Heterogeneous Fluid, and contains Parts of very different Specifick Gravities, Cohasions and Densities; whereas the separated Fluid must be Homogeneous, in order to perform the uniform Functions of Life.

(3.) The different Velocities with which the Blood arrives at the Orifices of these Secretory Ducts. For since the Secretions are made in Form of a Fluid, no possible Reason can be assign'd, why since Animals have a soft loose Texture and Union of the Solid Parts, and why one Part of the Body is of # tender, loose, easily separable Texture, and others of an harder, firmer, and more close Coha-fion; but this different Velocity of the Blood, at the Orifices of the Secretory Dulls. And tho' the Diver-

Diversity of the Diameters of these Ducts, is certainly that which is of the greatest Moment in this Affair of Secretion; yet'tis impossible to account for the Similarity of the Secerned Fluids from one to Heterogeneous, as the Blood is from this alone: Since all Particles of never so different Kinds and Natures will be indifferently separated there, if their Diameters are less than those of the Secretory Duffs, and their Direction right.

Again, more particularly from what the abovemention'd Authors have deliver'd, such Propositions

as these may be establish'd.

I. That of an Heterogeneous Fluid at rest in the Body, and equally press'd, the most Liquid Part must be forc'd out first. II. That of such an Heterogeneous Fluid as the Blood, when it flagnates, its heavy Parts will precipitate, and its light be elevated; and all will take place according to their Specifick Gravities. And when it doth not flagnate, the Separation of the heavy Parts from the light, will be in Proportion to the Slowness of the Motion of the Fluid. III. The red Fibrous Part of the Blood on its Stagnation retires to its Centre, and forces the Serum to the Sides of the Vessel which contains them; and from these two Propositions it will follow, that the flower the Blood's Motion is, the more Serum will be separated from it, ceteris paribus. IV. The most viscid Parts of the Serum are the highest, viz. such as are separated in the Glands of the Nose, Mouth, Palate, Windpipe, Stomach, Guts, &c. because these swim in Water, which is lighter than Serum. V. Fluids resist the Motion of such Bodies most, whose Surfaces are greater in Proportion to their Solidities, or whose Specifick Gravities are the least. Wherefore the most viscid Part of the Serum must be the least Susceptible of Motion, or must be moved with the greatest Difficulty through the Arteries. VI. A Fluid fore'd thro' a Concave Cylinder (and much more fo thro' a Concave Cone) moves with greater Celerity at the Axis than at the Sides. This Baglivi faith, he hath observ'd in the Arteries of Frogs. Wherefore the lightest Parts being least susceptible of Motion, will be forc'd to the Sides of the Arteries where there is the least Motion: So that where there is the least Motion, there will the lightest or most viscid Part of the Serum be separated: and from hence it will follow also, That the Viscidity of the separated Fluid will be reciprocally as the Celerity of the Blood at the Orifice of the feparating Canal. Again, Since Bellini hath prov'd that the Velocity of the Blood, at the Orifice of the Secretory Duct, is as the Number of Plications, Folds or Turns in the complicated Artery (Prop. 40. de Motu Cordis,) therefore the Viscidity of the Secerned Matter, will be also as the Number of Phcations in the complicated Actery. VII. When the Motion of the Blood is too flow, the most Serous Part is thrown on those Arteries which are the smallest, most complicated, or at the greatest Di-struce from the Heart. VIII. The Intestines in an Animal are a Gland, and the Lasteals are the Secretory Vessels. IX. The Orifices of the Excretory Vessels of any Gland are Circular, because all the Vessels of the Body, in which the Blood or other Fluids move, are either hollow Cylinders or Cones: for the Pressure of a Fluid being always Normal to the Sides of the containing Vessel, and being at equal Distances from the Centre, the Sides must be every where equally distracted, viz. a Section perpendicular to the Axis of the

Vessel must be a Circle, and therefore the Vessel must be either of a Cylindrick or Conical Figure. Now from hence it will follow, that the Orifices of Secretory Ducts of different Glands, differing not in Figure but only in Magnitude; The Fluids separated in different Glands, will differ only in De-grees of Cohesion and Fluidity. X. The Relaxed Coat of any Gland increases the Viscidity of the Secerned Matter, vice versa. The Reason of which is, that the Matter will grow much more Viscid by staying longer in the Gland, the thin Parts being evaporated by the Heat of the Body. XI. Such Glands, whose Compounding Arteries are most complicated, secern the most Viscid Matter from the Blood; for in these Arteries, the Resistance being greater than in strait ones, the Motion of the Blood must be slower in Proportion to the Number of their Plications; and where the Blood runs slowest, its Viscidity will be greatest, &c. XII. The Quantity of Fluid Matter separated in any Gland, is in Compound Proportion of the Quantity of the Blood; its Celerity at the Orifices of the Excretory Vessels, and the Wideness of those Orifices directly, and the Viscidity of the Blood reciprocally. XIII. An increased Quantity of Bl od increases the Fluid Secretions, in a Proportion greater than the Viscid; and a decreas d Quantity will lessen the Fluid Secretions more than the Viscid. XIV. An increas'd Celerity of the Blood's Motion increases the Fluid Secretion more than the Visitid, & vice versa. XV. An Universal Enlargement of the Orifices of all the Glands increases the Fluid Secretions, &c. & vice versa. XVI. An increas'd Viscidity of the Blood decreaseth the Fluid Secretions more than the Viscid: & vice versa, an increas'd Fluidity increaseth the Fluid Secretion more than the Viscid ones. See Dr. Moreland's Letter to Dr. Mead about the Secretions in an Animal Body, Philof. Trans. N. 283. See also an Account of the Nature of Animal Secretion, by Franciscus Spolatus, in the Leipsick Acts of Nov. 1687.

ANNIVERSARY, was called by our Forefathers, a Year-Day and a Mind-Day, i. e. a Memorial-Day; and is properly the yearly Return of the Day of the Death of any Person: And this Day the Religious registred in their Obitual or Martyrology, and annually observed in Gratitude to their Founders and Benelactors.

ANNUALIA. The Learned Author of the Chron. Precinsum saith, that these were such Oblations as were made by the Relations of deceas'd. Persons on the Day of their Deaths every Year: Which Day our Forefathers called the Year's-Day or Year's-Mind; and on it Mass was celebrated with very great Solemnity.

ANNUITY: For the Recovery of an Annuity no Action lies, but only a Writ of Amuity against

the Grantor, his Heir, or Successors.

ANNULETS in Architecture, this signifies 2 narrow flat Moulding, which is common to other Parts of a Column, the Bases, & c. as well as the Capital. And 'tis the same Member which sometimes is called a Fillet, a Listelle, a Coinsture, a Supercitium, Liste, Tince, Square, and Rabit.

ANT £, the same with Antes.

ANTIPÆGMENTS, in Architecture, are the Ornaments or Garnithings in Carved Work which are set on Architraves, whether of Wood or Stone

ANTIPATHY, is properly an Affection of a contrary Nature to another; and therefore what we do in a very high Degree dislike, or have an AverAversion against, we say we have an Antipathy to. Tis easy to see that this may have place in the Affections and Passions of Mankind; but whether there be any such thing in the Properties of Natural Bodies, has been questioned; and I think, as Dr. Hook hath long since observed, the Effects which some have thought owing to some secret Antipathies

in the Natures of Things, ought rather to be afcribed to an *Incongruity:* See Congruity.

ANTIQUE, is a Word much used by Architests, Sculptors, and Painters; and by it they mean all the ancient Pieces of Architecture, Sculpture, and Painting, from the Time of Alexander the Great, to the Irruption of the Goths; as also Intaglias within that Time: All which they call Antique; and whatever is done in Imitation of the great Masters of that Age, they say is after the Antique Manner

APERTIONS, in Architecture, are the Openings in any Buildings; such as Doors, Windows, Stair-cases, Chimneys, Outlets or Inlets for Light,

Smoak, 69c.

APHRODITARIUM, is a dry Medicine made of an equal Weight of Frankincense, Pomegranate, Ceruss, Meal, and Scales of Brass; and Galen calls a kind of Collyrium by this Name.

APHROGEDA, is Milk beat into an entire Froth, and was a Medicine used by Galen.

APRON, is a piece of Lead which laps over or covers the Vent or Touch-hole of a great Gun.

APPETITUS Caninus, is an Inordinate extravagant Hunger, to the Degree of a Disease, so that Men come to devour every thing like Dogs, attended with a Lienteria usually, or some such 'Cœliacal Flux, by which it is distinguish'd from βυλιμία: 'Tis called sometimes Phagedana.

APPROPRIATION, is the granting a Parochial Church, or the great Tithes and better Profits, ad Propries usus, to the proper Use of some religious House, to enjoy for ever: Whence it was

call'd Perpetuum Beneficium.

ARCHES, are part of the inward Support of any Superstructure, and they are either Circular, Elliptical or Streight. Of the Circular Arches some are exactly Semi-circular, as the Arches of Bridges, &cfc. some are such as the Workmen call Skeen or Scheme, which are flatter Arches, less than a Semi-circle. Some Circular Arches are such as those in our Gothick Buildings, di Tarzo &cf di quarto acuto, as the kalians call them, or as we say of the third and fourth Point. Because they consist of two Arches of a Circle (meeting in an Angle at the Top) and drawn from the Division of a Chord into three or four, or more Parts at pleasure. Eliptical Arches were formerly much us'd instead of Mantle-Trees in Chimneys: They had a Key-stone, and Chaptrels or Imposts, and consisted of two Hanses and a Scheme. Strait Arches are us'd over Windows and Doors, & c. having plain strait Edges both upper and under; these Edges are parallel, but both the Ends and Joints do all point towards a certain Centre. They are now usually about a Brick and a half thick, which when rubbed is abour 12 Inches. The Workmencall the levelling End of this Arch the Skew-back; and the level Joints' between the Courses of Bricks in the Arch, they call the Sommering.

ARCHES, the Judge of the Court of the Ar-

ches is call'd the Dean of the Arches, or the Official of the Arches Court, &c. with this Officialty is commonly joined a peculiar Jurisdiction of 13 Parishes in London, term'd a Doanery, and exempt from

the Authority of the Bilhop of London, and belonging to the Archbilhop of Canterbury: Or which the Parish of Bow is one, and the Principal, because the Court is kept there. Others think he was first call'd the Dean of the Arches, because the Official to the Archbishop being many times employ'd abroad in Embassies for the King and Realm, the Dean of the Arches was his Substitute in this Court, and by that means the Names became confounded. The Jurisdiction of this Judge is ordinary and extendeth it self through the whole Province of Canterbury, so that on any Appeal made, he forthwith, and without any farther Examination of the Cause, fends out his Citation to the Appellee, and his Inhibition to the Judge from whom the Appeal was made. Vid. Histor. de Antiq. Eccles. Britan. and

4. part of Instit. Folio 337. 60c.

ARCH-DEACON, being only a Person chose out of those Deacons which were originally the Attendants on, and Servants to the Bishop in Spiritual Affairs, at first was a Person employ'd by the Bishop in more servile Uses, and he always was in Sub-servience to the Urbans or Rural Deans of Christianity; to whom Arch Deacons were as much inferior, as their Order of Deacon was to that of Priest. Till by the Advantages of a Personal Attendance on the Bishop, and a Delegation to examine and report some Causes, and a Commission to visit some remoter Parts of a Diocese, their Power and Dignity was advanc'd above the Arch-Presbyter or Dean. Dr. Kennet's Glossary. Tis now allow'd, that Arch-Deacons have a Power, not only to Visit, but to Suspend, Excommunicate, and in many places to prove Wills, and in some to Institute to Benefices. Tis one part of the Arch-Deacon's Office to Induct all Clerks into their Benefices within his Jurisdiction, and by the A& of Uniformity he is now obliged to be in Priest's Or-

ARCHITECTURE. Some Writers on this Subject.

Vitruvius in Latin at Amsterdam, 1649. Fol. In English by Mr. Christopher Wase.

In French by Mr. Claude Perrault. Paris, 1673. Fol. Course d' Architecture Enseigni dans l' Academie Royal d' Architecture. Par Mr. Fran. Blondell, a Paris, 1675. Fol.
Mr. Evelyn's Parallel of Architesture, last Edit.

1706. Lond. Fol.

Adami Boecleri Architestura curios i nova cum multis Figuris. Norimberg

Albert Dureri, Architectura & Geometria Paris, 1535.
Potsis Architecture in 2 Vol. Fol. in Latin and

Italian, and lately done into English.

L' Architecture par Jacques Androuet du Cerceau Paris, 1615.

L' Architectura d' Andria Palla lio. Venet. 1642: con Fig. This is translated into English.

Vitruvius and Vignoia, abridged by Mr. Perault. Palladio's Architecture.

Scamozzi's Architecture. Wotton's

ARCHIVES, are the Rolls, Chancery, Exchiquer Office, or any Places where ancient Records, Charters and Evidences are kept.

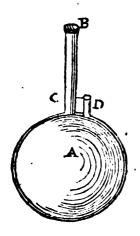
ARCH-PRESBYTER, the same with Rural

ARCUALIA Offa, are the Bones of the Sinciput; and according to Barthol. were the Offa Temporum. And the Coronal Sature, is by some Writers call'd also Arcualis.

AREC.

ARM

AREOMETER, besides that mention'd in Vol.1. are some also hung round the Tops, and these are Mr. Homberg of Paris hath invented a new Instrument of this Kind, which is described in Phil. Trans. N. 262. Thus, A is a Glass-Bottle or Matrass with so slender a Neck, that a Drop of Water takes up in it about five or six Lines, or so an Inch. Near that Neck is a small Capillary Tube D, about six Inches long, and Parallel to the Neck.



When the Vessel is filled, the Liquor is poured in at the Mouth B (which is widen'd to receive a Tunnel) till it run out at D; that is, till it rise in the Neck to the Mark C, by which means you have always the same Bulk or Quantity of Liquor; and consequently, can easily tell when different Liquors fill it which make median ferent Liquors fill it, which weighs most, or is most intensively heavy. But some Regard is to be had to the Season of the Year and Degree of Heat and Cold in the Weather: For some Liquors will rarify with Heat, and condense with cold; and accordingly take up more or less Room, See the Memoirs of the French Academy of Sciences for the Year 1699

ARIETUM Levatio, an Old Sportive Exercise, frequently forbidden in our Episcopal Synods and Constitutions, and seems to have been the same with the Quintane or Quintal, as Dr. Kennet See his Paroc. Antiquities.

ARITHMETICK, Authors on this Subject are, Wingate's Arithmetick, the last Edition.

Tacquet's Arithmetick in Latin or English. Willisford's Arithmetick Natural and Artificial,

Lond. 1656. a good old Book.

Diophanti Alexandrini Arithmeticorum Lib. 6, ET de Numeris Multangu'is lib. unus cum Commentariis G. Bocheti, & Observationibus P. P. de Fermat. cui accessit Dostrina Analytica inventum Nomum. Tolofa 1670. Folio.

Moor's Arithmetick.

Parson's and Wastall's Arithmetick and Algebra. Jeak's Arithmetick in Folio. Well's Arithmetick in Latin. Oxon.

Sir Isaas Newton's Arithmetica Universalis. Cambridge. 1607.

Ward's Arithmetick, in his young Mathematician's Guide.

ARMINGS, in a Ship, are the same with Wift-cloaths, which are Red-cloaths hung about the out-fides of the Ship's upper Works fore and aft, and before the Cubbridge Heads; and there as in the Adult.

call'd Top Armings.

ARQUEBUSS a Croc, is a Sort of small Fort
Arms, carries a Ball of about 3! Ounces, and is now us'd only in Old Castile, and in some Garisons of the French.

ARTERIA Bronchialis, is a small Artery (described by Mr. Ruysh) which in the Lungs creeps along upon the Branches of the Trachea, or the Bronchia.

ARTERIES and VEINS.

A Description of the Veins and Arteries of a Human Body in the two Plates annexed, as presented to the Royal Society in London, by that Generous Promoter of all useful Learning, John Evelyn, late of Say's Court in Deptford, Esq; and explained and illustrated by that accurate Anatomist and Surgeon, Mr. William Cowper.

HESE * Figures are closely drawn after the Original Schemes, and

I am apt to flatter my felf they will be acceptable to the inquisitive. It is some Satisfaction, that I find the Arteries here so agreeable to a Figure which I drew and published not long since, from the Arteries of a Fetus in-jected with Wax. But this Figure of the Veins differs so much from any extant, as would incline one to suspect all of the Subject hitherto published are fictitious, not excepting even those of Vefalius. But first of the Arteries.

That the Arteries are the Vessels which convey Blood from the Heart to all Parts of the Body, is well known; and we see by Fig. the 1st, that the common Practice of Nature in distributing these Vessels, to supply the Parts with Blood, is from the next adjacent Trunk, till their ascending and descending Trunks become Conical, as well as their collateral Branches: Not that all the Trunks and Ramifications of Arteries are uniform, and become Conical in the same manner; nor do all of them pass directly to the Parts to which they convey Blood; nor do all Parts receive Arteries

from the neighbouring Trunks.

The Trunks of the Carotid, Vertebral and Splenick Arteries are not only contorted in their Progress, in the Adult; but the Diameters of their Bores are variously dilated in divers Parts of them, especially where they are contorted; but as these Dilatations of their Trunks are caus'd by the Resistance the Blood meets with at those Angles of Inflection; so those Enlargements of them afterwards contribute to retard the Protrusion of the Blood to the Extremities of those Arteries: Hence it is, That as the Arteries of the Fatus are not contorted in such Acute Angles as in full grown Bodies, so their Trunks are more Conical, and not here and there dilated in divers Parts of them,

The

The Trunk of the Splenick Artery has a straight Progress in the Fatus and in Infants; but in the Adult I have hitherto constantly found it very much contorted, as is express'd in

Fig. 1, 2, 3.

The peculiar Contrivances of the Spermatick Arteries of Quadrapeds as well as Men, shew a conflant Design in Nature of taking off that Velocity with which the Blood would otherwise pass thro' the Glands of the Testes: It seems to be for this End that the Testes of most Animals (especially Men and Quadrupeds) hang out of the Cavities of their Abdomens, that the Canals of their Blood Vessels may be lengthened: For the Spermatick Arteries (contrary to all others) arise from their Great Trunk, at a far greater Distance from the Testes than the Arteries of any other Part of the Body. Nor would the Testes (which are such necessary Organs) have been thus exposed to external Injuries, if the End of Nature in lengthening their Blood Vessels had not been very considerable. Belides this lengthening of the Spermatick Arteries, we find Nature still contriving other Impediments to check the Current of the Blood in those Parts, it seems for this End that the Spermatick Arteries are lessen'd at their Original from the Trunk of the Arteria Magna in Men, and that the Spermatick Arteries of Quadrupeds are so much contorted before they reach their Tri-

The principal Inducement of Nature in making use of these different Contrivances in the Sperenatick Arteries of Men and Quadrupeds seems

to be,

That if the Human Spermatick Arteries were contorted, as in Quadrupeds, before they reach their Testes, the Apertures in the Abdominal Muscles of Man must be much larger than they now are, and would frequently let the Intestines defcend into the Scrotum; which we know nevertheless often happens: Such Ruptures (as they are call'd) are not so incident to Quadrupeds, tho' the Passages for their Spermatick Vessels (through their Abdominal Muscles) are much wider than in Men, because the Position of the Trunks of their Bod es is Horizontal, and their Intestines therefore cannot press on the Processes of the Peritonami, as in Men, who are erect.

Besides these Artifices in disposing the Trunks of Arteries, I doubt not much more will be detected by the inquilitive: In the mean time, I shall, at present, pursue the Thread, and describe the Extremities of the Acteries, with their Communications with the Veins, and afterwards produce some Instances of the Art of Nature in conveying the refluent Blood to the

After the Circulation of the Blood through the Heart, Lungs, and large Blood Vessels, was demon-Grated by Dr. Harvey, it was only guess'd how the Extremities of the Arteries transmitted the Blood to the Veins, till Mr. Lewenhoeck's Micro/copes had discovered the Continuation of the Extremities of tho'e Vessels in Fish, Frogs, 53c. which is now commonly shown by Microscopes made by other Hands: Yet there are not wanting those, who doubt of the like Continuations of the Extremitics of Arteries and Vains in human Bodies and Quidrupeds; fince those Animals it has hitherto been seen in (to any Satisfaction, as Mr. Lewenboeck confesses) have been either such Fi/b, or of the Amphibious Kind, that have but one Ventriele in their Hearts, and their Blood actually cold, except in Bats, in which it appears very obscurely: Add to this, that the Blood in those Creatures does not circulate with such Rapidity as in Animals whose Hearts have Two Ventricles. For all Animals that have Biventrous Hearts, the Vessels of the rest of the Body return their blood to the Heart in equal Time and Quantity with those of the Lungs, notwithstanding the Inequality of their Courfe.

This Difference in the principal Organs of the Girculation of the Blood in those Creatures (on which only these Experiments have been hitherto made) mov'd me to make some, on Animals whose Organs differ only from the Human in their gross Figure, and not in their intlmate Structure: For this End I took a young Cat, about ten or twelve Days old, and fastned it to a Board as in Vivesection; and making an Incision thro' the Linea Alba, the Omentum and Intestines were extruded, then causing the Creature to be so held (on the Board) under a large double Microscope, where a flat Glass for receiving of Objects was placed Horizontally, on which I expanded the Omentum or Caul, (a Light being placed underneath) I saw the Globules of the Blood move very swiftly in the small Vessels, which are only to be seen in the most transparent Parts of the Membranes of its Omentum; but the Motion of the Blood foon abated, and its Globules were withdrawn from the Extremities of its Blood Vessels; and in a little time became stagnant in their larger Branches.

This Appearance of the Continuation of the Extremities of the Arteries with the Veins, while the Blood was moving in them, in the Omentum or Caul, is express'd by Fig. 4. A A shews the Trunks of the Arteries, B B the Veins, which were distinguishable by contrary Currents of the Globules of the Blood in each Vessel. C C C shews the branching of the Extremities of the Arteries and Veins, that no longer associate with each other, but are united, as here express'd. ter I had seen this, I attempted to shew the like to several Friends, but did not always succeed so well as when Mr. Chambers and Mr. Buckeridge favoured me with their Presence, at a time when I happened to have a young lean Doz, that was not large; in whose Omentum we saw it very well; but by the Affistance of an Instrument I had prepared to expand the Mesentery, we all saw it there much better, that Part having not only larger and clearer Spaces than the Omentum, but its Blood Vessels are distributed more regular, as appears by Fig. the 5th, where the same Letters of Reference

serve as above.

Those who will entertain themselves in viewing the transparent Parts of living Creatures with Microscopes, will find that the Extremities of their Arteries and Veins are not all equally lessen'd, tho' united. In the Tail of the Lacerta Aquatica, Tadpols, and in most Fish (I have examin'd) i have frequently observ'd several Communications between the Arteries and Veins; in which more than two Globules of Blood have pass'd abreast: And in the same Area I have seen some of those Communications fo small, as that but one Globule could pass, and that very slowly before the other. young Fish, particularly in Grigs, I have frequently observed a Communicant Branch, so very small as that one Globule of Blood only has passed it in two or three Seconds of a Minute: At other times I have found considerable Intervals in pasfing of one Globule in such a Communicant Branch, even half a Minute, a whole Minute, and once in two or three Minutes I have seen one Globule of Blood only pass in a particular Tract.

The prompt passing of Liquors injected by the Splenick Arteries, to the Veins, shews the Communications between those Vessels are more open than the Arteries and Veins of other Parts, of which I have elsewhere spoken.

Liquors also injected into the Pulmonick Arteries pass to their Veins, tho not altogether so free-

ly as in the Spleen.

On viewing the Extremities of the Pulmonick Blood-Vessels in a living Frog with my Microfcope, I found their Communications much larger than those that I had before seen in the Membrane between the Toes and in the Feet of the same Creature. Nor can we reasonably doubt of the like patent Communications of the Arteries and Veins of Human Lungs and those of Quadrupeds, when we consider the Blood of their Lungs must return to the Heart in equal Time and Quantity, with that of all the Parts of the Body belides, as before noted. Hence it appears, the Bronchial Blood Vessels (first taken Notice of by the accurate Ruysch) are absolutely necessary, else the Parts of the Lungs could not receive Nourishment; nor could the Glands of the Bronchia separate their Liquor, if they were supplied with Blood from the Pulmonick Blood Vessels which is so quickly dispatched thro' the Lungs.

On viewing the Membrane that is between the Toes of one of the hinder Feet of a living Frog. after I had frequently taken hold of the same Leg of that Creature, to apply it to the Microscope, I found that Membrane very transparent, and without any Motion of the Globules of the Blood in it, as if the Part had been dead; but while I was looking on it, it was, I confess, not a little entertaining to see the Globules creep into it by Degrees, and at length the Blood move in all the Branches of its Veins and Arteries as before when no Violence had been offered to the Part: while the Blood is thus leisurely creeping through the Vessels, you may plainly see its Globules compress'd into Oval Figures, which are made more or less oblong, by the Resistance those Globules meet with, by the Contraction of the Sides of the Vessels they pass through; and this I have more than once observed in the Tails of the Water Newts or Lizzards: But on examining the Blood of these Creatures with a Microscope, and comparing it with the Human Blood, I found the Globules of the Lizzard's Blood more incline to an oval Figure, and were as big again as the Globules of Human Blood, and that of a small Fish; which I in like Manner viewed at the same Time. It is not unlikely a sudden Retrocession of Blood, from the Extremities of its Vessels often happens, and its Circulation in the same Vessels is afterwards carried on without any Impediment; as on some Passions of the Mind, Deliquiums by the Effusion of Blood, or otherwise. But if the Blood is once become stagnant in its Vessels, (especially the Arteries) the Part is in no small Danger of a Mortification, unless its neighbouring Vessels, which enjoy the Motion of the Blood, drive on the stagnant Blood, and it escape by the Sides of the Vessels that retain'd it. Experience affures us, that in Bruises when the Blood is extravalated, it goes off either by Transcolation, or

else causes an Abscess; for there's little Reason (in my Opinion) to suspect any of the stagnant Globules of the Blood will be fit to re-unite with the Circulating Mass. But that the Blood after Stagnation in its Vessels will sometimes pass their Sides, appear'd to me from the following Experiment.

On viewing the Melentery of a Dog when living, in which I had before feen the Blood paffing the Extremities of the Arteries and Veins, I consider'd how to preserve the Blood in its Vessels that I might afterwards at any Time see it in their Extremities when stagnant: For this End I caus'd several Parts of the Mesentery to be tied on as many Pieces of small round Pill-Boxes, cur transversly like little Hoops; on which, Portions of the Mesentery were extended like the Head of a Drum; and on viewing them afterwards with my Microscope, I found the Extremities and Branches of the Blood Vessels charged with Blood, which before appeared in Motion; some of which Parts of the Mesentery I still keep by me. On laying one of these Parts of the Mesentery (thus expanded) in Water, the stagnant Blood in its Vessels disappear'd; but on just immersing another of those Pieces in Water, I could with my naked Eye fee the stagnant Blood diffused in the Interstices of the Blood Vessels, and between the Membranes of the Mesentery: Hence it sevident, the Blood may pass the Sides of its Vessels after Stagnation in 'em; but whether its Globules are broken, or what Figure renders them fit to pass those Pores that are in the Sides of the Vessels, I leave to the inquisitive; but we must return to our Tables, and first of that of the System of the Vena Cava.

As the Arteries are known to export the Blood, fo the Veins carry it back again to the Heart; but having already described their Extremities, we come next to the large Trunks of the Veins; and here, as in the Arteries, we find the common Practice of Nature, in disposing the Branches of Veins to discharge the refluent Blood into the next adjacent Trunk, and so on to the Heart. As the Arteries afford Abundance of Instances of Checks given to the Velocity of the Current of the Blood through several Parts, so the Veins supply us with as many Artifices to affish its regular Return to the Heart, as well as to favour those Contrivances in

the Arteries.

The Trunks of the Carotid, Vertebral and Splenick Arteries are not only variously contorted, but are also here and there dilated. The Beginnings of the internal Jugulars. have a Bulbons Cavity (Fig. 7. H, H,) which are Diverticuli to the refluent Blood in the Sinus's of the Dura Mater, lest it should descend too fast into the Jugulars. The like has been also taken notice of by Dr. Lower in the Vertebral Sinus's. The Splenick Vein has divers Cells opening into it near its Extremities in human Bodies, but in Quadrupeds the Cells open into the Trunks of their Splenick Veins.

The Spermatick Veins do more than equal the Length of the Arteries of the Testes in Men; their various Divisions and several Inosculations, and their Valves, are admirably contrivit to suspend the Weight of the Blood, in order to discharge it into the larger Trunks of the Veins; and were it not that the resuent Blood from the Testes is a Pondus to the insuent Blood from the Arteries, and still lesses its current in the Testes, these Spermatick Veins, like those of other Parts, might have discharged their Blood into the next adjacent Trunk.

Who can avoid Surprize at the Art of Nature, in contriving the Veins that bring Part of the Refluent Blood from the lower Parts of the Body? when they consider the Necessity of placing the Human Heart, as well as that of most Quadrupeds, so far from the Centre of the Bedy towards its upper Part? It is for that End necessary the large Trunks of the Veins and Arteries should not associate each other; for if all the Blood sent to the lower Parts, by the descending Trunk of the Aorta, should return to the Heart again by one single Trunk (as it is fent out from thence) the Weight of so much Blood in the ascending Trunk of the Vena Cava, (Fig. 6. C, C, A) (for so its lower Trunk is call'd) would oppose the Force the Heart could give it from the Arteries, and hinder its Ascent; For this Reason the Vena Azygos (Fig. 6, b.) or fine pari, is contriv'd to convey the Blood fent to the Muscles of the Back and Thoraz into the descending Trunk of the Vena Cava, (ib. B. A.) above the Heart: Hence 'tis evident, more Blood comes into the Heart by the descending, or upper Trunk of the Vena Cava, (Fig. ib. B, A.) than passes out by the ascending Trunks of the Aorta. Nor does this Quantity of Blood convey'd to the Heart by the superior Trunk of the Cava, seem without some other Design in Nature, besides transporting it thither to free the inferior Trunk from its Weight: But perhaps it was necessary so much Blood should be ready there to joyn with the Chyle, (Fig. 6. +) for its better Mixture, before it reaches the right Auricle of the Heart.

I might here add the Descripition of a peculiar Valve, I lately discovered in the lower Trunk of the Vena Cava, near the right Auricle of the Heart; but the annex'd Figures have taken up too much Room in those Copper Plates to insert it: For the same Reason, the Figures of some Contrivances in the Arteries here mention'd, particularly the Spermaticks, are omitted: This being what occurr'd to my Thoughts at present on this Subject, which is not to be found (at least not commonly) in the Books of Anatomy: The greatest Part of which have been added to these Papers, on their lying by me since the Graver began the Figures.

The Explications of the Figures.

F I G. 1.

R Epresents the Trunks and large Branches of the Arteries, dissected from an Adult Hu-man Body, when displayed and dried; as they are now to be seen in the Repository of the Royal So-

1. The Trunk of the Aorta cut from the Basis

of the Heart.

2. That Part of it, whence the Coronary Arte-

ry of the Heart does arise.

3. That Part of the Arteria magna, where the Canalis Arteriosus of the Fatus terminates; which in an Adult becomes a Ligament. Vid. Fig. 2, 3. Vol. II.

That Part of the Axillary-Arteries, by some called the Subclavian Arteries.

5. The left Carotid Artery (in this Subject it feems) arising from a common Trunk with the right Caretid and Axillary Arteries, as in some

Quadrupeds.

6. The left Cervical Artery, in this Subject arising from the Trunk of the Arteria Magna, as express'd in a Figure given by Bergerus in the A7a Eruditorum An. 1698. pag. 295. But in all the human Bodies in which I have hitherto examined these Arteries, I have constantly found them as express'd Fig. 2.6.6.

7. The Arteries that carry Blood to the lower Parts of the Face, Tongue, adjacent Muscles and

Glands.

- 8. The Trunk of the Temporal Artery, springing from the Carotid, and parting with Branches to the Parotid Gland 9, and Temples 10, and Parts

11. The Occiputal Arteries.
12. The Arteries that convey Blood to the Fauces, Gargareon, and adjacent Muscles.

13. The Trunk of the Carotid Artery cut off, before it is Contorted in passing the Skull.

14. The Trunk of the Artery of the Arm parting with Branches to the adjacent Muscles and

Parts.

* That Part of this Artery which is sometimes
and makes an Aneurisina, prick'd in letting Blood, and makes an Aneurifina, in which Case this Trunk of the Artery must be bared and firmly tyed above the Aneurisma; and if it afterwards happens (as it has been frequently known) that the Flux of Blood to the Ansurisma in the Artery is not very much abated, tho' the Artery has been tyed above; the Operator in that Case must make another Ligature on the Trunk of the Artery below its Aneurisma: These Collateral Communications of the Trunk of the Artery at the bending of the Cubit, preserve the Circulation of the Blood in the Cubit and Hand, tho' the Trunk is totally compress'd both above and below; and the same Trunk afterwards divided between those Ligatures. Hence it is, if one Ligature made above the Wound in the Artery is not fufficient, but the Blood still pours out from below; the Patient will sooner recover the Action and Strength of the Muscles of the Cubit, than those in whom the upper Ligature proves sufficient; the Reason of which is obvious to any who consider that the Communicant Branches must be larger where the lower Ligature is required, than when the superior Ligature only is sufficient. These communicant Branches (as I have seen them in some Subjects) are here mark'd out in prick'd Lines, vid. the Figure.

While these Papers were lying by me, the two following Instances happen'd, in which the Communications of the large Trunks of the Arteries of the Cubit and Arm were remarkable. The first was

A Boy of thirteen Years, who, about three Weeks before I saw him, received a Wound near the middle of the Cubit in which the Trunk of the Artery (mark'd in the Fig. †) was divided. Surgeon who was first call'd, had frequently bound up the Wound, and put a Stop to the several discharges of Blood (which they told me did not amount to less than 6 or 7 Quarts at Times) but not without a Compress on the Trunk of the Artery above the Wound. On another impetuous Flux

Flux was I call'd; but seeing no small Quantity of Blood discharged, I was contented to let the Wound be bound up, in the same Manner as it had been done before; omitting the Compress on the Trunk of the Artery above, and adding a Piece of Deal-board, on which the Hand and Cubit were fastened, to prevent any Motions of those Parts, as well as the Fingers; Three Days after, the Applications were taken off, and little or no Blood appear'd; but two or three Hours were scarce e lapsed e're I was alarm'd with Notice of a fresh Flux. The By-standers being instructed in that Case, to compress the Trunk of the Artery above the Cubit, they had thereby prevented no small Essusion of Blood, which must otherwise have happen'd; his Surgeon being out of the Way, I laid the Trunk of the Artery bare above the Wound as expeditionfly as I could, being forced more than once to let loose the Compress above to discover its Orifice by the Flux of Blood. I passed a Needle with strong waxed Thread under the Artery, and made a Ligature on its Trunk, which lay concealed in the Interstice of the Musculus Flexor Digitorum, and the Musculus Ulnaris Flexor Carpi; but notwithstanding this Ligature on the Trunk of the Artery above the Wound, the Blood still slow'd from the lower Trunk of the Divided Artery; yet the Velocity of its Current was so much abated, that it seem'd like Blood flowing from a Vein. I left the Wound with a Digestive, and the Part without hard Bandage; it being now five Weeks since, I hear the Wound is almost cicatriz'd. The Learned Dr. Harris was present at the other Operation, by which the Communications of the large Trunks of the Arte-

ries of the Arm were very evident.

A Boy about eight Years of Age, who came to Town with an Aneurisma of the left Arm, upon bleeding six Weeks before. The Tumour was indeed very large in Proportion to so small an Arm. After laying the Aneurisma or Tumour bare, and making a Ligature on the Superior Trunk of the Artery (in the annex'd Fig. *...) I found, on loosening the Compress on the superior Trunk of the Artery, very little Abatement of the Pulsation of the Aneurisma; I then passed a Ligature in like manner on the Trunk of the Artery below the Tumour; but notwithstanding, the Pulfation continued, tho' much abated. I then discovered another Trunk of the Artery, arising from the lower Part of the Tumow, on which also I made another Ligature, and the Pulsation was then taken off. However, on cutting off the Surface of the Cyftis or dilated Artery, and clearing it of the coagulated Blood, which was foon stopped with a common Astringent, I left the Part without any other Ligature or hard Bandage. It is now eighthen Days since the Operation, the Ligatures on the Arteries are all come off, and the Pulsation of the Artery of the Wrist begins to be very manifest, nor does any Symptom appear that threatens Success.

15. The Division of the Trunk of the Artery of the Arm below the Flexure at the Cubit.

16. The external Artery of the Cubit, which makes the Pulse, that is commonly felt near the

17. The Arteries of the Hand and Fingers.

18. The Mammary Artery.

19. 19. The descending Trunk of the Arteria

- 20. 20. The Intercostal Arteries.
- 21. The Arteria Caliaca.
- 22. The Arteria Hepatica.
 23. The Trunk of the Arteria Splinica.
- 24 The Arteria Epiploica Sinistra.
- 25. A Branch of an Artery which passes to the Bottom of the Stomach.
- 26. The superior Coronary Branch of the Stomach.
 - 27. 27. The superior Mesenterick Artery.28. 28. The emulgent Arteries.

 - 29. The inferior Mesenterick Artery.
- 30. 30. The Lumbal Arteries, 31. 31. The two Spermatick Arteries, which in this Subject, seem to arise at a greater Distance from each other than commonly.
 - 32. The Iliack Artery.
 33. The Arteria Sarca.
- 37. Branches of the external Iliack Artery, passing to the oblique Muscles of the Abdamen.
- 38. 38. The Arteries that pass to the Muscles
- of the Thigh and Tibia.

 30. The Crural Artery.

 40. The Umbilical Artery, with those of the Penis.
- 41. That Part of the Crural Trunk that passes the Ham:
 - 42. The three Trunks of the Arteries of the
 - 43. The Arteries of the Foot and Toes.

F I G. 2.

- THE Trunks and some of the Ramications of the Arteries of an adult human Body fill'd with Wax, to show the Variety in Na-ture, and supply the Defects of the former Figure.
- 1. The Aorta cut off at the Basis of the Heart.
- A. The three semilunary Valves as they appear when the Heart is in Diastole, and hinder the Blood coming back from the Arteries into the left Ventricle of the Heart.
- B. A Portion of the Trunk of the Arteria Pulmonalis. b, b. its Division before it passes to the
- right and left Lobes of the Lungs.

 C. The descending Trunk of the Arteria Mag-
 - D. D. The internal Mammary Arteries.
- 2. The Trunk of the Coronary, cut off.
 3. The Ligamentum Arteriosum. Which in the Fatus is the Canalis Arteriosus, and conveys Blood from the Palmonick Artery to the great Artery
 - 4 The Trunk of the subclavian Artery.

 - 5. 5. The Carotids.
 6. 6. The Vertebrals.
 - 7. 7. The Arteries which pass to the lower

Parts of the Face, Tongue, adjacent Muscles and

The Trunks of the Temporal Arteries arising from the Carotids, giving Branches to Parotid Glands (9. 9.) and the Temples (10.10.) &c.
11. 11. The Occiputal Arteries.

12. The Arteries of the Fauces, Gargareon,

13. 13. The Contortions of the Carotid Arteries, as they pass the Basis of the Skull: These Trunks of the Carotid Arteries in Dogs (like those I guess of most Quadrupeds) are very much contorted before they reach the Basis of the Skull: On filling these Vessels of that Animal with Wax, I found those Branches of them which pass to the Brain, first clipping the hinder Parts of the lower Jaw, immediately under its condiloide Processes; where those Ateries are received in two Sinus's of that Bone, which Simus's may also be seen in the Jaw-bones of other Quadrupeds, but not in human Bodies.

14. 14. Those Parts of their Trunks that pass by each Side of the Sella Turcica, whence divers small Branches arise, and help to compose the Rete Mirabile; which is more conspicuous in Quadru-

peds than in human Bodies.

.15. 15. The Contortions of the Vertebral Arteries, where we find their Trunks confiderably dilated.

16. The vertebral Arteries, as they ascend on the Medulla Oblongata towards the Annular Protuberance or Pons Varoli.

17. 17. The communicant Branches of the Vertebral and Carotid Arteries.

18. 18: The Atteries of the Brain displayed.

F I G. 3.

Chuse to place this Figure on the Copper Plates of one of the Trunks of the Arteries of the Tibia (dissected from the Leg after Amputation) rather than the following Diffich, which I find written on the Original Table of this Scheme of the Arteries.

Pulsificus Sanguis de Cordis Ventre sinistro. Funditur ut Corpus nutriat bisce viis.

Before I explain the Letters of Reference of this third Figure, it will be necessary to let you know that Mr. Stringer was in his fixty seventh Year when this Artery was taken from him, and near twenty Years before lost the Use of both his Legs; and in that time he had been so persecuted with Convussions in them, that neither Leg was free a quarter of an Hour together, whether sleeping or waking. At length one of his little Toes mortified, which was taken off by Mr. Coldwyer, an expert Surgeon of Salisbury; not long after more Toes of the same Foot followed the like Fate: The Convulsions following that Leg Aronger and quicker: That Part of the Foot next the Toes became tumid and inflam'd, the Tumon cer passed by the Side of one of the Metatarfan Vol. II.

Bones; the Extremity of which Bone (whence the Toe was taken off) lying bare. In this Condition 1 found the left Foot and Leg of this Gentleman, when I had the Honour to wait on him, by Co.nmand of the Right Honourable the present Earl of Shaftsbury, he living in the Neighbourhood of that Noble Peer in Wiltshire; where I met with Mr. Goldwyer above-mention'd; and finding the Leg very chilly, the Necessity of parting with it was too evident; which Mr. Stringer suffer'd with extraordinary Fortitude, He not so much as expressing the least Outcry during the Operation, tho' the Part did not want the most exquisite Sense of feeling: On the Abscission (which was about five or fix Inches below the Knee) it was unexpected by me, I must confess, to see so little Blood spouting from the Arteries. The Stump being bound up, and committed to the Hands of two or three Servants, a less Number not being sufficient to hold it, by Reason such strong convulsive Motions purfued the Part on the Operation. I was very desirous to examine the Arteries of the amputated Leg, having before discovered the Cause of a Mortification of the Arm of a young Gentlewoman, who dy'd not long after an Amputation of the Part, tho the Gangreen d'd not appear to reach near the Place where the Abscission was made: (i. e. below the ending of the Musculus Deltoides.) In which Case, I found the Sides of the Trunk of the Artery of the Arm so thicken'd, that the Diameter of its Borg was contrasted to less than a third Part, and would scarce admit a common Probe to pass it, vid. Fig. G. H. I. When I had found the Ends of the Arteries in the Leg above-mention'd, I endeavour'd to pass my Probe into one of them, but meeting with some Opposition, I suspected I had mistaken the Veinfor the Artery, and that the Valves oppo-fed the passing of the Probe that Way: but on surther Diffection I clear'd the Trunks of both those Blood Vessels, and found the Veins in their natural State; but the Sides of the Arteries were grown Bony or Stony; having clear'd two of their Trunks, I left one of them at Salifbary, the other I brought to Town, and is here figur'd.

A. The upper Part of the Artery cut off in the

Amputation of the Leg; from A to
B. The Trunk of the Artery distended and dry'd to thew its Canal.

C. That Part of the Trunk of the Artery which was so contracted by the Putrefaction or Offification, that a Probe would not pass its Canal; from C to

D. The Trunk of the Artery opened and expanded.

E, E. The Putrefactions or Offifications in the Sides of the Artery.

F, F. Their Specks in the lower Part of the Artery, not so large as in the upper Part, and placed at greater Distances.

a, a, ege. The Branches arising from the Trunk of the Arrery.

G. A Proportion of the Trunk of the Artery of the Arm above mention'd.

H. The S des of the Artery very much thickned, whereby the Diameter of its Canalis was so much diminished that the Probe

I. Would not pass it.

The Offisications in the Coats of Arteries have been frequently observ'd, especially in their large I runks within the Cavities of the Thorace and Ab. domen; but I don't remember the like has been ma-D 2

ken notice of in the Limbs; or that such Impediments in their Canals have been found the Cause of Mortifications of particular Parts, as in the Instance above-mentioned; tho I doubt not, but the like has often happen'd in aged People, especially where we find the Progress of the Gangreen not very swift, and its Beginning from no external Cause; the Consequences of which are commonly found satal. When the Arteries of one Leg (or of any other Limb) are so affected, we may well suspect the like in those of other Parts; which probably happened in the Instance I now mention'd; for tho' no Gangreen came on the Stump, yet the other Foot and Toes began to mortify about fix Weeks after the Amputation, as did the Parts about the Hips, which were compress'd in lying or fitting before he expired.

FIG. 4.

R Epresents the Extremities of the Blood Vessels, as they appear while the Blood is passing them in the Omentum of a live Dog, view'd with a Microscope.

A, A, The Branches of Arteries, and B. B. the Veins which affociate, C C their leffer Branches where they pass from each other, and are united at their Extremities.

F I G. 5.

THE like appearing in the *Mesentery* of a Do3 when living.

D, D, The Area that are here viewed with the Microscope, as they appear to the naked Eye.

F I G. 6.

THE Trunks of the Vena Cava, with their Branches dissected from an adult human Body, done from the original Scheme in the Repository of

the Royal Society.

A, A, The Orifice of the Vena Cava, as it apocars when cut from the right Auricle of the

Heart.

a, The Orifice of the coronary Vein of the Heart.

B, A, The superior, or descending Trunk of the

Vena Cava. C, C, A, The inferior or ascending Trunk: so distinguished from the Motion of the Blood in their Trunks, which is contrary to their Position:

D, D, The Subclavian Veins.

† That Part of the left Subclavian Vein, where the Thoracick Dust enters it, and discharges it self of its Chyle and Lympha.

The Vena Azygos with its Branches going to the Ribs, e, e.

c, The superior Intercostal Veins.

d, d, The internal mammary Veins.

E, E, The right and left Iliack Branches.

F, F, The internal jugular Veins.

G, G, The external Jugulars.

H, H, The Veins which bring Blood from the lower Jaw and its Muscles.

I, I, The Trunks of the internal Jugulars cut off at the Basis of the Skull.

f, The Veins of the Thymus and Mediafti-

g, g, The Veins of the Thyroid Glands. h, The Vena Sacra.

The internal Iliack Branch.

k, The external-

K, K, The occiputal Veins. The right axillary Vein.

M, The Cephalick.

N, The Basilick.
O, The Median Vein.
P, The Trunk of the Veins of the Liver. Q. The Phrenick Vein of the left Side.

The right Phrenick Vein.
A large Vein from the left Glandula Renalis r, A large Vein and Parts adjacent.

S, The left emulgent Vein. T, The right emulgent. i T, The right emulgent, in this Subject very much lower than the left, which is not u-

V, V, The two Spermatick Veins.
X, X, Two communicant Branches between the ascending Trunk of the Vena Cava and Vena Azygos, by which the Wind passes into the de-scending Trunk of the Cava, when we blow into the ascending at A. P. C. tho' the Trunk at A. A. and C. is firmly tyed on the Blow-pipe.

* An uncommon Branch between the lower Trunk of the Vena Cava and the left emulgent

y; A Vein which brings Blood from the Mus-cles of the Abdomen into the external Iliack Branch.

z, The Epigastrick Vein of the right Side. I, The Vena Saphena.

The rest of the Branches here displayed commonly differ so much in various Subjects, that the particular Descriptions of them (which none but the Operator who diffected them could pretend to be Master of) would be perhaps as useless, as tedious to repeat: Wherefore I pass to those considerable venous Trunks which are wanting in this Scheme.

F I G. 7.

Some of the large Trunks of the Veins and their Sinus's within the Skull, with the Beginnings of the internal Jugular Veins, filled with Wax, and dried together with the Falz, 65c.

A, The Extremity of the Falz cut from the Cri-

sia Galli.

a, Its lower Limbus that touched the Corpus Callosum, as it divides the right Hemisphere of the

the Brain from the left; where the fifth Simis passes, which are here dried and disappears.

B, B, The second Process of the Dura Mater, which supported the hindermost Parts of the Lobes of the Brain, and defended the Cere-bellum from being press'd by those Parts of the Cere-

C, A Portion of the Dura Mater remaining to

the Longitudinal Sinus.

D, D, Several Trunks of the Veins of the Brain cut off before they enter the Longitudinal

E, E, The Longitudinal Sinus's. F, F, the two lateral Sinus's.

G, The fourth Sinus.

g, The Veins from the Plexus Choroides.

H, H, The Bulbi or Diverticuli at the Beginnings of the internal Jugular Veins.

I, I, The internal Jugular Veins. K, K, The Trunks of Veins, which bring Blood from the lower law and Parts adjacent.

FIG. 8.

HE Trunks of the Vena Porta dissected and displayed; done from the Original Scheme in the Repository of the Royal Society.

A, A, The Branches of the Vena Porta freed from the Liver.

The Umbilical Vein. B, The Splenick Branch.

C, C, The Mesenterick Branches which are continued from the Intestines.

b, The Trunk of the Vena Pancreatica, which receives Branches also from the Duodenum.

c, c, The Vena Gastrica dextra Coronaria Superior.

D, The Superior Coronary Vein of the Stomach of the left Side.

E, The inferior Coronary Branch of the Sto-

mach of the right Side, and

F, The same Coronary Vein of the lest Side removed from their proper Situations; from these two last are continued the Vena Epiplocia Superior dextra 1, and the sinistra 2, with the Media 3.
G, The Vein call'd Vas Breve.

H, The Vena Hemorrhoidalis arising from the Restum and Amus, in this Subject emptying it self into the left Mesenterick Branch; but in other Bodies (and particularly in a Preparation of these Veins, which I have now by me) I find this Trunk of the Hamorr boid Veinsending in the Ramus Sple-

The Length of the Trunk of this Hæmorrhoid Vein, and its Progress under the Intestines, renders it liable to be compress'd, and its refluent Blood retarded; whence its Branches in the Inteflinum Rectum and Anus, become distended with Blood, and cause the Hamorrhoides Caca and A. porta; which are frequently attended with Aposthumations in the Anus and Parts adjacent; which Disorders are the more incident, not only because these Hæmorrhoid Veins (like the rest of the Bran-

ches of the Vena Porta) are without Valves, and the Blood has an ascending Progress in them, as also that the long Trunk (H) is not only expo ed to the Compressions made by the Intestines in both Sexes: But particularly the Uterus in Women in time of Gestation, especially near the Birth, so compresses this Trunk, that 'tis no wonder we find Women more afflished with the Hamorrhoids at that time, than at any other. Nor are the lliack Veins and the Lympheduct that accompany them, without being exposed to the like Incumbrance in Women with Child, whence the Veins of Legs and Thighs become Varicose, and those Limbs are so frequently swoln, which in a late Instance I was acquainted with, when the Intumescence proved so great, that at Length the Ab-dominal Teguments were vasily extended; but the Gentlewoman recovered (beyond the Expectation of some) on the happy Delivery of two large Children.

ARTHROSIS, or Articulation; amongst the Writers of Anatomy is divided into (1) Diarthrosis or De-articulation, which is a more loose Articulation of the Bones where there is a manifest natural Motion of one Bone on the other; in which it differs from the (2) Synarthrofis or Coarticulation, which is a much closer Jundure, and where there is no fuch natural apparent Motion of one Joint on the other. (3) Ginglymus, where each Bone receives into its Sinus the Proc sus of the other; as in the Articulation of the Ulna, Tibia, Humerus, 55 Offa Femorum.

ARYTENOIDÆUS Minor, is a Muscle which

runs on the Surface of the Arytanoidus Major, arifing from that Part of one of the Cartilagines Arytanidai, next the Cricoides on one Side, and terminating in that Part of the other Arytanoideal Cartilage, which is farthest from the Cricoides on the other Side. Its Use is to assist the other Muscle of this Name in its Action, which is much strengthen'd by this manifest Decussation of the Fibres.

ASAPHATUM, is a Kind of Impetigo, Serpigo,

or running Itch.

ASHLAR, is the Work-Men's Term for common or free Stone, as it comes out of the Quar-

ASPECT Double, is a Term in painting, us'd for a fingle Figure representing two or more different Objects; which is caused either by a Change of the Polition of the Eye, or by angular Glasses,

ASSEMBLY, in the Military Art, is the second. Beat of a Drum before a March; on hearing this, the Soldiers strike their Tents, and roll them up; and then stand to their Arms. The third beating is called the March, as the first is called the General.

ASSISA magna, was a more folemn Trial by a Jury of 12 or more Knights, to give their Verdict in a Cause prosecuted per Brevs de Resto; i. e. where the Dispute lies not about the bare Possession, but of the Right and Property; in this distinguithed from the Assis a parva or minor, where the Question is only of Possession, in which the Jury were 12 ordinary Legal or Freemen return'd by the Sheriff.

ASSISÆ Judicium, is the Judgment of the Court given against the Plaintiff of Defendant for Default.

ASTROLABE, this Planisphere considered as a Projection of the Sphere is of two Kinds. The first is a Projection of the Sphere on the Plane of

the Equinoctial in the Stereographick Way, the Eye being supposed to be placed in the Pole of the World. The other Astrolabe is of Gemma Friaccounted from the Noon of one natural Day, or sus ; which supposes the Eye in the Point of the Interjection of the Equator and Horizon, projecting or Midnight of the next natural Day.



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A Table of Physical Parts to be added to, or taken from the Moon's mean Motion, according to the Sun's mean Anomaly.

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A Table of Reduction accommodated to the least Inclination of the Moon's Orbit, five Degrees, with the Excess of the greatest Declination, 5°, 18'.

A Table of the Moon's Horizontal Parallaxes, and of her Horizontal Semidiameters.

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A Table of the true Horary Motion of the Moon ins Eclipses, to the least and greatest Eccentricity; with the true Horary Motion of the Sun, and his Semidiameter.

21

A Table of the Angle, with the true Motion of the Moon from the Sun, makes with the Ecliptick, in the Syzygies.

Argum. Latitud.		The to	ue Ho	ary M	otion	of the	Moon !	from th	e Sun.		Argum. Latitud.
Sig. o	27'	28′	29'	30'	31,	321	33'	34'	35'	36'	Sig. 5
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3	5 46	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	27
4	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	26
5	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	25
6	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35	24
7	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35	23
8	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 .36	5 35	5 34	22
9	5 42	5 41	5 40	5 39	5 38	5 37	5 .36	5 35	5 34	5 33	21
IO	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 33	5 32	20
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12	5 39	5 38	5 37	5 36	5 35	5 34	5 33	1532	5 31	15 30	18

23

A Table of the Temporary Reduction between the true Syzygies of the Luminaries, and the greatest Approximation of their Centres.

Argum. Latitud.			ne of the true Solotion of the l			Argum. Latitud.
Sig. 0	27' 28'	29' 30'	31' 32'	33' 34'	35' 36'	Sig. 5
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4	2 20 2 15	2 10 2 05	2 00 I 56	I 53 I 49	1 45 1 42	26
6	2 55 2 48	2 41 2 36	2 30 2 25	2 21 2 16	2 12 2 08	25
	3 29 3 21	3 14 3 07	3 00 2 54	2 48 2 43	3 38 2 33	24
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_	4 38 4 27 5 II 4 59	4 17 4 08	3 59 3 51	3 43 3 36	3 09 3 23	22
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The Uses of the Astronomical Tables, in the Calculation of Eclipses, &c.

Before I shew you the Method of the Calculation of the exact Time of the Eclipses of the Sun and Moon, it will be proper to premise these Observations by way of Lemmata; as Mr. Whiston hath done in his Pralect. Astronom.

1. That there is this great Difference between an Eclipse of the Sun and of the Moon; Thata Lunar Eclipse is the same entirely, from what Part of the Earth soever it be look'd upon, and doth not receive any Alteration from the divers Polition of Places on the Surface of the Earth; for where there is a real Loss or Deprivation of Light, 'tis all one if you look upon it from the Equator, or from the Poles; for the Beginning, End, and Quantity of the Eclipse of the Moon depends on real Causes, and not only on the different Position of the Observer. But in the Sun the Case is quite otherwise: A So-lar Eclipse is not any real Deprivation or Loss of Light in him; 'tis only a local Interruption of the Sun's Light to some particular Places, occasioned by the Interposition of the Moon's Body. For in such Parts of the Earth as have the Centre of the Moon's Body interposed between them, and the Centre of the Sun, there may be had a Total Solar Eclipse; whereas in Regions lying at some Distance side-ways from thence, the Eclipse may be only Partial; and if they lye very remote, they may not see the Sun eclipsed at all. And therefore Lunar Eclipses are of the greatest Use in the finding the Longitude of Places, the Observation

of those of the Sun being useless for that Purpose.

2. There are, universally considered, more Solar than Lunar Eclipses, but there are more of the Moon in any one particular Place; for fince the Earth's Disk is much greater than the Disk of its Shadow feen at the Moon, it must needs be that the Penumbra of the Moon shall fall oftner into the broader Disk of the Earth while the Sun is eclipsed, than the narrower Moon can into the narrower Disk of the Earth's Shadow while she is eclipsed. But since the Eclipses of the Moon will be all observable in the same Place, as often as she is never so little above the Horizon of that Place; whereas such of the Sun only will be vifible any where, as happen when the Moon is interposed between that particular Place and the Sun: Tis easily seen, that in particular Places Lu-

nar Eclipses must be most frequent.
3. Total Eclipses of the Sun are very rare; so that if you consider them with regard to any particular Place, you will hardly have above two or three in the Compass of an hundred Years. The Reason of which is, that the Vertex or Point of the Conical Shadow of the Moon's Body doth fall beyond the Earth's Surface, and sometimes doth not quite reach it: Nor is that strange, when we take notice, that the Moon's apparent Diameter doth so little exceed that of the Sun, that it can't totally cover or obscure it, but only in some very Rare, Total, and Central Eclipses;

nor in every Central one neither; for if no Eclipse happen when the Sun is in his Perigaum, and the Moon in her Apogaum, the apparent Diameter of the Sun will exceed the Lunar one; and so the Eclipse will appear annular, or the Shadow of the Moon will be environed with a Ring of Light

4. The Moon is never eclipfed by the very Shadow of the Earth it felf, but only by that of the Earth's Atmosphere. This was a Proposition per-fectly unknown to the Ancients, but is sufficiently pparent and manifest from the Consideration of

lefraction.

For those Rays of Light which are next the Earth enter into its Atmosphere, and then go out of it again: But while they do thus pass out of a Rarer Medium into a Denser, they must by the known Laws of Refraction tend towards the Perpendicular; nor can it be otherwise when they go out of the Atmosphere again, for then they will recede from the Perpendicular; and as well in the former Case as in the latter, the Perpendicular being changed, they are inclined the same way; that is, towards the Axis. And from this double Refraction, when brought to Calculation, it appears that those Rays of the Sun, which pass near the Earth, are so inflected, as to concur in a Point long before they reach to the Distance the Moon is placed at.

5. In Lunar Eclipses, the Consideration of Parallaxes and Refractions hath no Place; but in Solar ones, tho' there be not much regard had to the latter, there must be the greatest to the former. The Reason whereof is, that with regard to Refraction and Parallax, the Shadow of the Earth, in the same Place of the Lunar Transit, is affected after the same manner as the Moon her felf would be in passing thro' it, and so produces no Difference in the Calculation. And in like manner in Solar Eclipses, the Refraction of either the Solar or Lunar Light, at the same Elevation above the Earth's Horizon, is still one and the same; (as by late Observation hath been ascertained) as if both Luminaries had been at the

same Distance from the Earth.

But with respect to the Parallax, the Case is to be deemed far otherwise: The Sun's Parallax, whether Horizontal, or in any Degree of Alti-tude, being much less than that of the Moon; and therefore must be accurately considered in the

Calculation of Solar Eclipses.
6. The middle Time of Eclipses is not the very Moment of the Full or New Moon, but in or near that Place, where a Perpendicular let fall from the Centre of the Sun, or of the Shadow of the Earth to the Lunar Orbit, doth intersect it. For since the Direction of the Lunar Orbit is diverse from the Direction of the Ecliptick, making with it an Angle of at least five Degrees; and al so since the exact Time of the full and new Moon's

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is, by Consent of all Astronomers, observed to be in a Plane, not Normal to the Moon's Orbit, but to the Ecliptick, the nearest Approach of the Centres, which is the very middle Moment of the Eclipse, can't happen in the exact New or Full Moon; but a little before or after, according to the Moon's Latitude, and the Position of the Nodes, and in a Plane Normal to the Plane of the Lunar Orbit, and not to that of the

Ecliptick.
7. The Investigation and Calculation of Solar Eclipses is much more difficult than that of the Lunar ones, because the Parallaxes of the Sun and Moon are so very different; and also that in the Time of a Solar Eclipse, according as the Altitude of the Luminaries above the Horizon is greater or less, they are very much changed; and during all the Time of the Eclipse, are mutable and variable. Besides the divers Positions of the Ecliptick in different Horizons, whether you consider the Places of the Luminaries, as to Latitude or Longitude, do every where occasion no small Inequalities.

These Things premised, I proceed to the Calculation of Eclipses, beginning with those of the Moon. And the first Work is, To find the Time of the mean and true Syzzies. Which is done

thus: 1. Out of the Table of the mean Motions of the Moon from the Sun, (which you will find amongst the other Astronomical Tables in this Vol.) write down the proper Numbers for their Time fought, from the Columns of the Radical Year, the Intermediate Year, Month, &c. and then add them all into one Sum, which Sum subtract from an entire Circle or 12 Signs; and the remaining Numbers, either by themselves, if you seek the Conjunction, or with the Addition of a Semicircle (or six Signs) if you desire the Time of the Opposition, being turned into Time, will give the exact middle Moment of the Conjunction or Opposition sought. That is, if you first sub-duct that Number which is next less than the given Number, and which is to be taken out of the Table of the mean Motions proper for Days, out of the said given Number, and then seek for the Remainder in the same Table for the Hours, and subtract the Number there next less out of it, repeating the same Process also for Minutes, Seconds, Esc Then will the Day, with its annexed Hours, Minutes, Seconds, &c. of the mean Time of the Syzygy fought, be most accurately determined. Unless indeed it be Leap-Year; for then the Day next less than it, with its proper Minutes, Seconds, &c. will be the exact Time of the Conjunction or Opposition required.

And having thus got the equable or mean Time of the mean Syzygies, both the middle and true Time of the true Syzygies may be thus found.

Time of the true Syzygies may be thus found.
2. The next Work is to find the Sun's Longitude, or his true Place in the Ecliptick for the

Time given. Which is done thus:

Seek the Time given in the left Hand Column of the Table of the Earth's mean Motions, and that not only for the Radical, but also for the Intermediate Years, with the Month, Day, Hour, Minute and Second: Write all these down in their Order, with the Tabular Numbers corresponding to them (which are called the mean Motion of the Earth and of the Perihelion) in a double Order, so that you may preserve distinctly, not

only the Signs, but also the Degrees and Minutes, and even the Seconds, as they shall occur.

Then add into one Sum, all the mean Motions of the Earth, of the Radix, of the Intermediate Years, of the Month, Day, Hour, Minute and Second, in order to obtain the Earth's mean Place, (or Sun's, if reckon'd in directly opposite Parts of the Ecliptick.) Then add the mean Motions of the Perihelion (taken from both the Tables) after the same manner together, that its middle Place also may be had for the Time given.

Next, subduct the Place or Longitude of the Perihelion before found, from the Earth's mean Place, and the Remainder will be the Earth's mean Anomaly; which is the Basis and Foundation of all the succeeding Operations.

Then you may next gain the Coequate Anomaly of the Earth, or the true Place of the Earth, with regard to the Centre of the Sun: Thus, from the Table of the Equations of the Earth's Orbit, in which the Difference between the True and Mean Motions of the Earth are always given, seek the middle Anomaly of the Earth above found, on the Left Hand, if it be within the first signs; but on the Right, if it be in the fix latter Signs; and find by the Rule of Proportion, the Quantity of the Equation answering thereunto; that is, not only that which the Table gives in whole Degrees, but also what corresponds to the Miuntes and Seconds of the mean Anomaly; as by the Rule of Three 'tis easy to do: Then will this entire Equation, deducted in the former fix Signs from the mean Motion of the Earth, and added to it in the latter six, give the Earth's true Place; and that most exactly, if the Time at first given were the mean Time: But if, as it is most usual, it were the Vulgar and Apparent, the Numbers found as above, must be corrected by the Equation of Time. Thus

of Time: Thus, Consult the first Table of the Equation of the apparent Time, (or that which is made for the Ecliptick Figure of the Earth's Orbit among these Tables, N. 1.) and there seek the Earth's mean Anomaly, either in the right or left Hand Column, (as above shewn) and write down thence the corresponding Temporary Equation, either to be added or subducted according as is there directed: Next go to the latter Table of Equation, or that which depends on the Inclination of the Equator and Ecliptick, and entring the Sun's Place in the Ediptick, either at the Top or Bottom; against it, you have that proper Equation, either to be added or subtracted as occasion requires. And thus having gotten these two Equations, if they are both to be added, or both subtracted, the absolute Equation will be their Sum; but if they are different, it will be their Difference: And this absolute Equation will help us to investigate the Sun's Place at any given apparent Time, tho' at present it is done only as to the middle Time. For if out of the Table of the Earth's Horary Motion, accounted with respect to the mean Anomaly, you find (by the Rule of Proportion) the Earth's Motion corresponding to this absolute Equation, and add it to, or subtract it from, as occasion requires from the Sun's true Place before found; what refults, will be the Sun's correct Place in the Ecliptick for the Time given. An Example will make all this plain.

Surpose

To find the Moon's true Place in the Heavens.

Suppose you would have the Sun's Place in the Ecliptick for October 25. at one Hour, five Minutes, and thirty Seconds Afternoon, in the Year

of Christ 1668 past.

Note 1. That the Radix's of the mean Motions in Elamstead's Tables, are accommodated to the Meridian of London, and deduced from the Noon of the Day immediately preceding the Kalands of January; and therefore, every Leap-Year, a Day must be added to the Time given; and since the Year before us in this Question was Leap-

Year, and the Month given October is at a diffrance from February, (and it will be the same in all Months after the last of February) you must reckon the Time, not the 25th but the 26th of October. Look then into the Table of the Earth's mean Motions for the Year 1661. (which is the next preceding Radix) where you find the Sun's Place to be 9 Signs, 20 Degrees, 25 Minutes, and 42 Seconds, and the Perihelion to be 35.70.6.50".

Make a little Table, and write all things down

thus:

What is the Sun's Place OEt. 25. 30. p. m. In the apparent Time A. D. 1668? Perihelion's Motion. Sun's Motion. 20 25 18 0 1661. 48 29 50 11 5 41 Biffed. 02. 26. 24 42 28 Hour 1. I 2 Min. 5. 42 31 Sum of all, and the Place of the Pe-Seconds 30 14 29 45 for 2 Circles. Sum of all Deduct For the Sun's mean Motion. Remains 29 Deduct 4I 31 Being the Place of the Perihelion. 48 Which is the mean Anomaly. Remains 14 7 Again from 45 I The mean Motion. 29 Subduct The proper Equation found as above. 32 The Sun's Place. Remains 12 57 44 Subtract again The proportionable Parts to be subtracted, as above shewn. For the Sun's corrected Place. 12 04

And thus may the Sun's Place be truly calculated for any Time affign'd.

To find the Moon's true Place in the Heavens.

IN order by these Tables to calculate truly the Place of the Moon, which is much more intricate and troublesome than the former; it will be proper previously to remember these Particulars about her Motion.

1. That her very mean Motion it self is subject to some Variation; and according to the various Distance of the Earth from the Sun, which is called its Anomaly, (and belongs to the Moon as well as the Earth) is sometimes compleated quicker and sometimes slower: So that her middle menstrual Motion is a little swifter in the Aphelia, and a little slower in the Peribelia.

2. Besides, the Motions of the Moon her self and of the Aposaum, (such as we had in the Sun) here is to be considered peculiarly, the Retrograde Motion of the Nodes of the Lunar Orbit; and this Motion is to be added, where the former Motions were to be subtracted from the Place of the Radix, and vice versā.

3. The very Motion it self of these Nodes is unequable; so that according to the different Position of the Line of the Nodes of the Moon's Orbit, with regard to the Sun, the Quantity of its Velocity is various and mutable, and therefore this Inequality must be equated before the Calculation can go on well.

4. The Eccentricity of the Moon's Orbit is subject to the greatest Inequality; for in the same Position of the monthly Lunation, when the Linea Apsidum is in the Syzygies, the Eccentricity is much greater than when its in the Quadratures: For the Moon doth not revolve in an Ellipse, whose Figure is given in Specie, but in one perpetually changing, and whose Form is much more oblong in the Syzygies than in the Quadratures, when she comes nearer to a circular Figure: And this Inequality or continual Variation of her Excentricity, and which can scarce be accurately determined.

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The Uses of the Astronomical Tables.

nar Calculations.

5. The Motion of the Apfis is as unequal, if not more so, than that of the Excentricity; sometimes Stationary, sometimes Progressive, and sometimes

Retrograde.

6. The Moon in every Month moves faster in the Syzygies, than she doth in her Quadratures; and this Variation also must be equated, before the Calculation of the Moon's Motions can fucceed well.

7. The Angle of Inclination of the Plane of her Orbit to that of the Ecliptick is also continually changing; and this too must be brought to an E-quation, before the Place of this every way variable Planet can be exactly calculated. See Sir Isaac

Newton's Theory of the Moon, in Vol. I.

The'e Things being premised, let us attempt to calculate the Moon's true Place in the Heavens for

any given Moment of Time.

1. First, the Sun's true Place, his mean Anomaby, both the proper Parts of their corresponding Equation, and the Absolute Equation thence arifing, must be found by the Method above described, without which the Lunar Calculations will not be exact: For the Lunar Inequalities depend chiefly upon the Sun's Place; and without his mean Anomaly, the mean Motions of the Moon, and her other compound and irregular Motions, cannot be adjusted. And indeed unless both these are had, the absolute Equation of Time can't be obtained; which yet is so very necessary to be known, that nothing can be done without it: For the given apparent Time must first, by Means of this Equation, be reduced to the mean Time; the mean Motions in the Tables being accommodated to that, and not to the apparent

2. From the Tables of the mean Motions of the Moon, of the Apogee, and of the Node, take out the mean Place of the Radixes in their several Columns; and then from the following Tables, write out also the mean Motions of the Moon and of the Apogee, for the proper Years elapsed from the Radix, and of the Month, Day, Hour, Minute and Second, placing them in Order, in two Columns (one for the Moon, another for the Apogee) and adding them up severally into one Sum, as you see in the Example annexed to these Directions. By which means you will gain the mean Place of both the Moon and the Apogee for the mean Time given. It was said before, that the Radical Place not only of the Moon and Apogee. but also of the Node, was to be placed in the first Series; but in the others, the intermediate mean Motions of the Node were designedly omitted: For altho' those intermediate mean Motions, answering to the Year's distance from the Radical, and to the Month, Days, Hours and Minutes, are to to be taken out as was done in the rest; and moreover to be collected into one Sum, as well as the Radical ones; yet because the Motion of the Nodes (contrary to all the rest) is always Retrograde, the intermediate Numbers are to be subducted from, not added to the Radical, in order by the Difference to find the true Place of the afcending Node at the Time given. And having thus gotten the mean Places of the Moon, Apogee and Node, the next Work is,

3. To find their true Places. In order to which, let the Numbers answering to the Sun's mean Ano-

mined, causes a very considerable Difficulty in Lu- maly before found, be taken out of the Table of the Physical Parts, to be added to, or taken from the Moon's mean Motion; and if the Anomaly be-less by fix Signs than the mean Motion of the Moon, let those Numbers be added to; but if it be greater by fix Signs, let them be subtracted from the mean Motion of the Moon, and then you will gain her correct mean Motion.

To gain the true Place of the Apogee, subtract its mean Motion or Place from the Sun's true Place the Remainder will be what they call the Annual Argument: Which thus found, you must take out of the Table of the Equation of the Moon's Apogee, &c. the Equation corresponding to this annual Argument; and this either added to, or subtracted from (according as the Table directs) the middle Place of the Apogee will, by the Sum or Difference accordingly, give the trus one for

the Time given. 4. Out of the same Table take the Excentricity of the Moon's Orbit for the Time given; and if it be less than the mean Excentricity (in the Head of the next Table) subtract it thence; if greater, take the mean Excentricity from it, re-ferving the Difference for other Astronomical

5. That you may gain the Moon's Place yet nearer to the true, subduct the true Place of the Apogee of the Lunar Orbit from the correct mean Motion of the Moon (found in Art. 3.) and note the remaining Numbers, for they will shew you the mean Anomaly of the Moon: Which as foon as you have obtained, carry to the Table of the Equations of the Moon's Centre, and thence making a Proportion when there is occasion for it) take out two Equations, as well that which belongs to the mean Excentricity, as that which answers to the greatest, if the Excentricity before found be one of the greater; or that which answers to the least, if the former Excentricity be one of the lesser; and find the Difference of these two Equations, by carefully subtracting the lesser from the greater. This being rightly done, you may by the Rule of Three thus find the Parts proportional. Say, as the Difference between the great-est or least Excentricity, and the mean one, is to the Difference of the two Equations last found:: So is the Difference between the mean and the true Excentricity, to the proportionable Parts sought. Which being thus found, if they are either added to, or subducted from, as occasion requires, the mean Equation; the Sum or Difference will give the true Equation of the Lunar Orbit, to be added to, or taken from the Moori's mean correct Place, according as the Title directs, and by this means you will obtain the Moon's equated Place. And yet with all this Pains, you have not gotten the Moon's Place ultimately correct; bue only such a Place-of her, as is supposed to be with-out the Business of Reflection or Variation, (and also setting aside the Consideration of Latitude) a Matter perfectly unknown to the Ancients both in Name and Nature. But you must go farther thus:

6. Subtract the Sun's true Place from this equated Place of the Moon, and the Difference will be the Distance of the Moon from the Sun, but yet not exactly true. Wherefore out of the Table of the Variation of the Moon, take the Numbers answering to this Difference or Distance between the Sun and Moon, and they will give the true Quantity of the Variation, as the last and consummate

Equation.

To find the Moon's true Place in the Heavens.

Which Equation if it be added to, Equation. or taken from the Moon's equated Place, according as Occasion requires, the Sum or Difference will give you what hath been so long sought, The true Place of the Moon in her proper Orbit. next thing to be done, is to gain her true Place, with Respect to the Ecliptick, both in Longitude and Latitude. In Order to which,

7. Substract the mean Place of the Node (which was before found) from the true Place of the Sun; the Remainder is the Sun's Distance from the Node, which having gotten out of the Table of the Equations of the Node, take the Equation proper to the Distance, which being added or substracted according to the Title of the Table, will give the true Place of the Node for the Time given. And because not only the Equation of the Node, but even the mutable Inclination of the Limit, or of the Plane of the Moon's Orbit to the Ecliptick, is Proportional to this Distance; take also from the same Table, the various Inclination of the Limit, or the Numbers expressing the Excess above the least Inclination (five Degrees) out of the proper Column; that so having gained the true Place of the Moon's Node, and the Equation of the Limit, you may the better obtain the Moon's Longitude

and Latitude for the Time given.
8. Take then this true Place of the Node, from the true Place of the Moon in her proper Orbit, before determined, the Remainder is what they call the Argument of Latitude: And out of the Table of the Reduction and Excess of the Inclination of the Orbit, take the proper Number correfponding to such Reduction or Excess: And fav by the Rule of Three, As the greatest Increment of the Limit (in Minutes of Degree) is to the Excess given; so is the present Increment of the Inclination of the Limit (viz. above five Degrees) to the Parts Proportional required; which Parts thus found, added to the simple Redustion, shall give a Redu-Etion true and perfest, which being after the Manner of an Equation, added to, or taken from the Moon's true Place in her proper Orbit; will give her Longitude, or her true Place in the Ecliptick.

o. And this Longitude of the Moon being ob-

tained, you must thus proceed to seek her Latitude.
From the Table of the Moon's Latitude, which not only stews her simple Latitude, (supposing the least Inclination to be of five Degrees only) but also the Parts Proportional to be added to it, when 'tis near a third of a Degree or 18 Minutes more, Out of this Table I say, take her simple Latitude answering to the Moon's Argument of

Latitude, with the Parts Proportional to be added to it, and then say by the Rule of Proportion, As the greatest Increment of these Minutes, is to the present Increment: : so is the Excess of the Inclination of the Orbit above the least Inclination before found, to the Parts Proportional; and those added to the *simple Latitude* of the Moon, will give her true Latitude from the Ecliptick.

And these Directions are sufficient for finding the Moon's true Place, both in her proper Orbit, and in the Ecliptick; and both as to Longitude and Latitude, at least according to Horrox's Theory. But there are yet behind some other Enquiries of no contemptible Consideration, which must be purfued to compleat the true Theory of this every way changeable Planet. As first, to find the Quantity of the Moon's Horizontal Parallax for any Time affigned. 2. Her apparent Diameter. 3. Her true Horary Motion in either Syzgy; and the Knowledge of these, is very necessary for the exact Calculation of the Eclipses of the Luminaries.

Wherefore let us next go on thus.

10. To find the true Horary Motion of the Moon in either of the Syzgies, out of the Table of the Moon's Horary Motions correspondent to the mean Anamoly, take out the proper Numbers when the Eccentricity is greatest and least, and note the Difference; then seek the true Eccentricity of the Moon's Orbit, in the very Moment of the Syzgy (according as directed in Number 5 above) and observe well the Difference between that, and the least Eccentricity of all; then work thus according to the Rule of Proportion. As the Difference between the greatest and the least Eccentricity, is to the Difference of the Horary Motions now found :: so is the Difference between the present and the least Eccentricity, to the Parts Proportional; which Parts so found, if added to the Horary Motion corresponding to the least Eccentricity, when it less than the Horary Motion belonging to the greater Eccentricity, or fubstracted when 'tis greater; will give the true Horary Motion of the Moon, both with regard to the Sun, and also to the Ecliptick, in the very Moment of the Syzgies. And from this, taking the Horary Motion of the Sun (above found) you will have the Horary Motion of the Moon from the Sun.

And when thus the Reason and Method of finding the Moon's Horary Motion is known, that of determining her Horizontal Parallaves, and apparent Diameters will be so too, the Reason of

both being one and the same.

The Calculation of Eclipses.

I N order to make the Nature of Eclipses, their several Phænomena, and the Calculation of the Times of their Appearances more clear and intelligible, it may be useful (with Mr. Whi-fon) to premise these following Preparatory Propositions.

1. That the Moon is a Body perfectly Opake, having no Manner of Light of her own, nor a Power of transmitting the Light she receives from

2. That the Earth and Moon are both Bodies very little, in Comparison with the Bulk of the Sun, as appears from their several Diameters: That of the Sun being about half a Degree; whereas that of the Earth is not above a Third of a Minute, and that of the Moon scarcely a Fourth of the Diameter of the Earth, if they were both to be seen from the Sun.

3. Wherefore the Figure of the Shadow in both a Solar and Lunar Eclipse must be conical, and ter-

minating in a Point.

The Mucro or Vertex of this Cone of Shadow in either Eclipse, falls short of any of the other

Planets; which therefore can never be concerned in these Desiciencies of Light.
5. Were the Plane of the Lunar Orbit coincident with that of the Ecliptick, there would be a total and central Eclipse of each Luminary in every Sudation; and the Lunar Eclipses would be vifible all over those Parts of the Earth, whose Horizon she is above: But the Solar Eclipse only to those Parts of the Earth directly opposite to the Sun and Moon at that Moment, which is the very Moment of the Syzgy: And consequently to determine these Eclipses then, we need only calcuculate that.

6. But because there is for the most Part, an Inclination, or Angle of a little more than five Degrees, made between those two Planes; it will be plain that Eclipses can only happen at those Full and New Moons, in which she is in or near the Nodes, or the Points of Intersection of the two Orbits: And this happens usually in every Lunation. Wherefore were the Lunar Nodes immoveable (with respect to the Sun) there would be even now, an Eclipse of each Luminary, in every Synodical Month.

7. And because for the producing an Eclipse, not only the Access of the Moon to the Nodes is necessary, but also such an Access as shall happen at the time of any of the Syzgies, or at either New or Full Moon, 'tis plain, that the Elcipses of the Luminaries can only happen at those Times of the Year, in which the Syzgies are in or near

the Nodes.

8. Wherefore there will be, for the most Part, four notable Eclipses, or such as shall be visible and conspicuous to some or other of the Inhabitants of the Earth, every Year. Two Solar, and two Lumar. For since for many Days together, the Sun's Place is once in every Year, but a little distant from the Northern Node: and then after about a Fortnight, (for the same Time) as near to the Southern Node of the Moon, there must happen (generally) two Syzgies, during each of these Accesses of the Sun to the Node, and consequently at each Syzgy, there must be an Eclipse.

Having thus in Part prepared the Way for the

Calculation of Eclipses by these Preliminary Considerations; the Work it self will follow by De-

grees. And first in Order,

To cal culate an Eclipse of the Moon.

Y O U must proceed thus, To find the Time of the mean and true Syzgies.

1. From the Table of the mean Motion of the Moon from the Sun, take out the proper Numbers for the radical Year, and the present Year, and Month, and writing them down, add them up into one Sum; which Sum take out from an entire Circle or 12 Signs: Then if you feek for the Conjunction, the remaining Numbers alone, or with the Addition of fix Signs or half a Circle if you want the Opposition, being turned into Time, will give you the mean Moment of the Conjunction or Opposition sought; that is, if first you deduct (out of the next Table of the mean Motion for Days) the Number which is next less than the given one, from that given Number; and so do also out of the Columns for Hours, Mimutes, Seconds, 69c. for then the Day with its Hours, Minutes, Seconds, 69c. fo found shall be the accurate mean Time of the mean Syzgies,

provided it be not Leap-Year: For if it be, you must take the Year that is next less with its Months, Days, Hours, Minutes, Seconds, & co. adjusted as before.

And thus having got the mean or equable Time of the mean Syzgy, you may by the following Method, find the mean and true Time of the true

2. First find the Longitude of the Sun in the Ecliptick, and of the Moon in her Orbit, as hath been before shewn: Then if the Places of the Sun and Moon agree in Longitude exactly, which very rarely happens; or if they are diametrically opposite, then both the mean and true Syzgies do both happen at the same Moment of Time: But if, as it will most Times happen, they be not the same, the Difference between them must be noted, and turned into Time, in order to find the true Syzgies, thus.

Write



To determine the Duration and the Time, &c.

3. Write down the true Horary Motion of the Sun, corresponding to the mean Anomaly (found above) and from the same Tables do the same by the Moon; then substract the Sun's Horary Motion from the Moon's, the remaining Numbers will shew the Horary Motion of the Moon from the Sun, or what she gains in one Hour. Then fay by the Rule of Three, As the Motion of one Hour, is to that one Hour, or to 6c Minures in Time:: so is the Difference of Longitudes, or the Distance of the Sun from the Moon, to the Interval or Space between the mean and true Syzygy; which Space of Time, if the Moon hath not yet overtaken the Sun, must be added to the mean time of the Syzygy; but if she be gone pass'd him, it must be taken from the mean Syzygy, and the Sum or Difference will be the true Syzygy, to a Moment.

But two Things must here be noted, that this Matter may be truly understood. (1.) That the Moon's mean Anomaly should not be entred in the Table of the Horary Motions, till 'tis first augmented by half its Distance from the Sun, if the Moon have not yet overtaken him; but if she hath, then the Anomaly must be lessen'd as much. For fince the Reason of bringing the Anomaly to that Table, is only to shew with what Velocity the Moon hath attained, or will attain her Distance from the Sun; 'tis plain her Horary Motion is to be taken neither in the Beginning nor End of that Interval, when it may be quicker or flower, but when 'tis at a mean in the middle. (2.) The Interval between the mean and true Syzygy, feldom exceeds 12 Hours, never 14, as by Aftronomical

Computations is apparent.

4. Having thus found the mean Time of the true Syzygy, the true Place of the Sun in the Ecliptick, and of the Moon in her Orbit, must be found to the sun in the Ecliptick and of the Moon in her Orbit, must be found to the sun of the Moon in her Orbit, must be found to the sun of t (as above directed) corresponding thereunto, to-gether with the Moon's true Latitude from the Ecliptick agreeable to the Moment of the true Sy-

2ygy, as hath been already shewn. Then
5. From the mean Time thus found, an Equation may be formed to find the Apparent thus; Get
(as is above shewn) the absolute Equation of Time, either adjectitious or ablatitious by help of the Sun's mean Anomaly; and contrary to its Title, add it to,

if it be ablatitious, or substract from, if adjestitious, the mean Time now found: By which means the apparent Time of the true Syzygies will be gained.

6. Having thus obtained the true Moment of apparent Time of the true Conjunction and Opposition, there are yet two things more to be done, before we can advance any farther; i.e. to know the Moment of the apparent Time, in which the Centres of the Luminaries are at their leaft Distance, and at what Moment of the same Time

the Syzygies happen in the Ecliptick.

There is usually a great Difference between the nearest Approach of their Centres, and the Moment of the full or new Moon, and therefore between those Moments of Time, and the Time of the true Syzygy in the Moon's Orbit, accounting from the Beginning of Aries. For the Time of the Ecliptical full or new Moon, in a Plane Normal to the Ecliptick: The Time of the nearest Approach of their Centres, in a Plane nearly Normal to the Lunar Orbit: The Apparent Time of the Syzygy in the Lunar Orbit, whiere the Arches drawn from the Beginning of Aries, to the Centres of the Sun and Moon, are equal, is observed to happen in a Plane Normal, neither to the Ecliptick, nor the Moon's Orbit, but in an intermediate one between both. The half therefore of the Excess or Defect of the least Distance of their Centres in the Ecliptical Syzygy, is nearly equal to the Difference between the Time of the full or new Moon in the Lunar Orbit, and that in the Ecliptical Orbit, and consequently to the least Disserence of their Centres, and this balf Difference is called the Reduction; which if taken from the Time of the true Syzygy, accounted from the Beginning of Aries, will give the Moment of the Ecliptical Syzygy; if added to it, the Moment of the nearest Approach of their Centres.

To get this Reduction by the Astronomical Tables, note the true Horary Motion of the Moon from the Sun (or Earth) in the Front of the Table, and in the Column under it, and over-against the Argument of Latitude placed in the Side, you will find the Reduction sought, to be used, as is just

now shewn.

To determine the Time and the Duration, and other Circumstances of the Eclipses of the Luminaries: The first and chief Thing to be done, is to find the least Distance of their Centres.

FOR whether there will be any Eclipse or not; and if one, what its Quantity, Duration, & c. will be, can only be known this Way.

Now this least Distance is always equal to the Moon's Latitude, in the apparent Time of the Syzygy, in her proper Orbit. This Latitude therefore, at the Time of the Opposition in a Lunar Eclipse must be first sought, as hath been above shewn: And then the next Work will be, to calculate the Magnitude or Semidiameter of Vol. 11.

the Earth's Shadow, in the Place of its Transit over the Moon.

Which being compared with the least Distance of their Centres, will account for the chief Phæ-

nomena of Lunar Eclipses. As for Instance,
1. If from the Sum of the Sun's and Moon's Horizontal Parallaxes, you take the apparent Semidiameter of the Sun; the Difference will be the apparent Semidiameter of the Earth's Shadow, in the Place of its Transit over the Moon, as is N 2 plain

The Uses of the Astronomical Tables.

Plain from the Diagram of Hipparchus (vid. Whifon Astronom, p. 62.) Wherefore the Horizontal Parallaxes of the Sun and Moon, for the several Degrees of the Anomaly, being given from the Astronomical Tables, and also the apparent Semidiameters; it will be easy to determine the Magnitude of the Earth's Shadow.

2. The apparent Semidiameter of the Shadow being thus found, add to it the apparent Semidia-meter of the Moon: If their Sum exceed the least Distance of the Centres before found, there will be at least a Partial Lunar Eclipse. But if it be less than the least Distance between the Centres, the Moon will not be at all obscured by the Ter-

restrial Shadow.

3. Next substract the apparent Semidiameter of the Moon, from that of the Shadow: And if the D fference be equal to the faid leaft Central Distance, there will be a total Eclipse of the Moon but fine mora, as they say, that is, the Moon will begin to emerge out of the Shadow, as soon as ever she is totally obscured. If this Difference be less than the Distance aforesaid, only some Parts of the Moon's Body will be covered: But if it be greater, the Eclipse will not only be total, but cum mora; that is, the Body of the Moon will remain perfectly covered for some time.

4. In order to find the Quantity of the Eclipse, especially in Partial ones, (which Quantity is commonly estimated by Digits and 60th Parts of Digits; for the Moors of Digits; for the Moors of Digits; for the Moors of Digits and to be desired to be a supposed to be desired. divided into 12 Parts or Digits, and each Digit into 60 equal Parts) From the Sum of the apparent Semidiameters of the Shadow, and of the Moon, substract the least Distance of the Centres, and then the Difference or Remainder, reduced to Digits by the Rule of Proportion, will give the Quantity of the Eclipse: Therefore say, As the Measure of the Lunar Semidiameter in Degrees and Parts is the Come in Digits we that is 60 so shall that Parts is the same in Digits: that is 60, so shall that Difference which answers to the Quantity of Obscuration in Degrees and Parts, be to the same, accounted in Digits and Parts.

5. To find the Angle of Incidence, proceed thus; As the Sum of the apparent Semidiameters of the Shadow, and of the Moon, is to Radius: : so is the least Distance between their Centres, to the Cosine of the Angle of Incidence, which there-

of the Exit. But fince in total Eclipses, not only these two Angles of Incidence and Exit, but also that of total Immersion and Emersion is to be considered, you must next proceed to find it. Which this Proportion gives,

6. As the Difference of the apparent Semidia-meters of the Shadow and of the Moon, is to Radius: so is the least Distance of the Centres to the Cosine of the Angle of Immersion. Wherefore the Quantity of the Eclip'e being known, you will have the Angle of Incidence and Immer-

7. To find the Mora or Time of the Duration of

a Lunar Eclipse.

Say, As Radius to the Sine of the Angle of Incidence: : so is the Sum of the apparent Semi-diameters of the Shadow and of the Moon, to the Semi-mera, or half the Duration of the Eclipse.

8. To find the Duration of the absolute Dark-ness in a total Lunar Eclipse.

Say, As Radius to the Sine of the Angle of Immersion:: so is the Difference of the apparent Semidiameters of the Shadow and Moon to the Motion of the Semi-mora, or the Duration of absolute Darkness. I say the Motion of the Semi-mora, because the Motion of the Moon during that Space of Time, or the Line that she describes during this Semi-mora, or half Space of Time in which the absolute Darkness continues, is rather meant, than the Mora or Space of Time it self. But if you would have it expressed in Time; fay, As the Horary Motion of the Moon from the Sun, is to an Hour or 60 Minutes in Time:: fo is the Motion of the Semi-mora in the absolute Darkness, to the half Time of its continuance: And thus the middle Moment of the Eclipse is found.

9. To find the Moment of the Beginning and End

of a Lunar Eclipfe.

From or to the middle Moment of the Eclipse, take or add the Semi-duration, and you must have the Reginning and End. And if from or to the middle Moment you take or add the Semi-mora of absolute Darkness, you will have the Beginning and End of that Darkness.

And thus have you a Calculation of a Lunar Eclipse, not very difficult, if compared with that of a Solar one, and free from the Trouble of Pafore will be found; as also, its Equal, the Angle I rallaxes and Refractions. An Example follows.

A Calcu-

A Calculation of the Moon's Place for April 5. 1707. at 1^h. 46^m. p. m.

	Mid. Motion (Ap	Apogzum.			Retrogr. Node:								
	s.	0		"	s. c	, ,	,,	s.	0	,	~			•	
Radix 1701 Years fince 6 April, Days 5 Hours 13	10 2 5 0	15 9 21 7	1 <i>9</i> 28 45	55 27	8 o 1	8 18 4 5 9 35.	20 44 2 37	0	27 26 5 0	24 I I	20 29 51	-			
Minutes 46	C	ć		ΙŚ		0 0	13		Ö	0	43 6				
Mean Motion Sum	6	24	7	41	7 2	3 2	56	4	ĭ	. 5		Take the	upper	г	
Sun mean Anomaly Parts Physical Subtr. Middle Place correct	9.06	17 0 23	43 10 56	41 53 48	O 2 Sun's	5 14 true Pl	57 ace.	o Sui	26 26 n's tri	19 14 ue Pl	57	Numb remai: Sun's 1	ns.		
Apogzum Subtr. Mean Anomaly Equation add Equated Place in the Orbit	7 11 c 6	14 9 2 26	42 14 21 17	23 25 0 48	Ánnu	3 12 al Argi	I um.	11 Sun	26 's Dif	14 fr. N	57 Vode	Sun's from t	Distai he N	nce ode.	
True Place of the Sun Moon's Distance from the Sun Variation add True Place in the Orbit	0	26 0 0	14 2 0	57 51] .	B 20 tion Su	33 btr.	Eq	o Juatio	o on ad	ld.	Equat	ion a		
Node Subtr. Argument of Latitude Reduction add True Place in the Ecliptick True North Latitude	6 0 5 0 6 0	26 26 29 0 26	17 19 58 0 17	53	The tr Inclina The gi	tion of	f the	Lin	nit	ogzu Nod	e o	14	42 19 18	23 16 0	
Former Equation add Latter Equation substract			7	 15 39		True Mean						131 2 37			
The Dif. is Equation now add	_		• •	24					ence	-	c•6	354	•		
Wherefore the apparent Tir will be thus	nes	of th	ie Ecl		1	ifferen the m greate	ean	etw and	the	,	116	513			
Beginning 11 42 Middle 13 40 End 15 37	42 9 36	}			The H	orary N		•	Of th	ie Su	n	the		2	,, 56 26 30

As. 1650". 60':: 172. 64. Wherefore the Difference of Time to be subducted, is 64.

And therefore the middle of the Eclipse will be 13 h. 39'. 45"

The Moon's Horizontal Parallax The Sun's add	54'• 48". IC
Sum	54 58
The Sun's Semidiameter Subtr.	16 01
Remains Semidiameter Shadow	38 57
Moon's Semidiameter	14 52
Sum	53 49

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To Calculate the Eclipse of the Sun.

this Eclipse of the Sun is improperly so call'd, and may with much more Justness take the Name which some of our Modern Astronomers have given it, when they call it an Eclipfe of the Earth; for so in reality it is, the Sun by no means being deprived of his Light, but only some Parts of our Earth lose theirs, by being within the Shadow of the Moon's Rody, when it happens to be interested. the Moon's Body, when it happens to be interposed between them and the Sun.

To illustrate this the better, let us suppose the Earth for a Time deprived of its diurnal Rotation round its Axis, while the Moon freely revolves round us. And suppose the Moon to be in the very Nodes, and so without any Latitude: Then 'tis plane of the Centre of the Moon, being in the Plane of the Ecliptick, directly inter-posed betwen the Centres of the Sun and Earth, will occasion a Central Eclipse of the Sun, to fuch People as inhabit the Earth's Equator; which will be total, if in that Place the apparent Diameter of the Moon exceed that of the Sun, but if it fall short of it, as is most usual, then the Eclipse will be annular.

2. But if at the Time of the Eclipse, the

Moon be not in the very Node, but a little Di- More's Mathematicks. Vol. I.

I N order to which, let it be premised, 1. That stance from it; then the Centre of the Moon's Shadow will not describe the Ecliptick, nor any

great Circle on the Earth, but a leffer Circle, or a Chord of a great Circle in the Plane of the Disk.

3. The Figure of the true Line or Path, which the Centre of the Penumbra and Shadow describes on the Spherical Surface of the Feather. scribes on the Spherical Surface of the Earth, is not exactly Circular, but a Portion of a Curve more or less regular, according to the Motion of the Earth and the obliquity of its In-

4. The Moon's true Parallax, to be estimated in a Vertical Circle, here puts on the form of other Parallaxes, and makes a Difference, not only in a Vertical Circle, but even in those of Longitude and Latitude; So that on this Account, the apparent Longitude and Latitude of the Moon, do very much vary, and render the exact Calculation of Solar Eclipses very difficult.

5. However there hath been a Geometrical Method found out by Sir Christopher Wren, Mr. Flam-sted and Mr. Halley, to avoid this tedious and precarious way of Parallactick Calculation, and of delineating a Solar Eelipse by Scale and Compass. See Flamsted's Dottrine of the Sphere, in Sir Jonas

To determine the Moment of the Beginning and Ending, and the Duration of a Solar Eclipse.

1. FROM the Moon's Horizontal Parallax, fubstract the Solar, the Remainder will be the Semidiameter of the Sun's Disk. Then collect into one Sum, the Horizontal Semidiameters of the Sun and Moon, which Sum will be equal to the Semidiameter of the whole Penumbra of the Moon, from whence a Solar Edication the Moon, from whence a Solar Eclipse

arifes,
2. To the Semidiameter of the Disk, add that of the *Penumbra*; and if the Moon's Latitude at the Moment of the true Conjunction in her proper Orbit be less than that Sum; there will be, somewhere on the Earth, an Eclipse of the Sun: But if it be greater; there will be no Eclipse at all. And if the Moon's Latitude be, alone, less than the Semidiameter of the Disk, then the Centre of the Shadow will fall upon the Earth, and so cause somewhere a Central Solar Eclipse, but if it be greater, there will be only a Partial one.

3. From the Semidiameter of the Earth's Disk, take that of the *Penumbra*, and Note the Remainder carefully; for if the Latitude of the Moon, in the Time of the Syzygy in her proper Orbit, be *lefs* than such Remainder; then will the whole *Penumbra*, at the middle Moment of the Eclipse, be confined within the Circumference of the Earth's Disk; but if otherwise, it will not be so. And if by Multiplication, you reduce all these Quantities to Seconds, you will have the Angles of Incidence as they are call'd; that is, the Distances of the Points where the Penumbra touches the Disk in its Ingress and Egress; and also the Point where, in the middle Time between both, the Centre of the Penumbra enters into, and goes our of the Disk.

For these Distances being given in Angles, from the Velocity of the Monthly Motion of the Moon from the Sun, there may, by the Rule of Three, be found the Space of Time proper to each Distance; that is, the whole Duration of the Eclipse will be given, and of the absolute Darkness, and also the Time of the Mora of the Penumbra within the Earth's Disk, as will appear

4. From the Latitude of the Moon at the Time of the Conjunction in her own Orbit (which, as hath been said above, is the same with the least Distance of the Centres so often mentioned) you

To determine the Moment of the Beginning and Ending of a Solar Eclipse.

may find these Angles of Incidence, of the Immersion and Emersion of the Centre, by these

As the Sum of the Semidiameters of the Terrestrial Disk, and of the Penumbra, is to Radius: so is the Moon's Latitude, or the least Distance of their Centres, to the Cosine of the Angle of Incidence: And then,

As the Semidiameter of the Earth's Disk is to Radius:: so is the Moon's Latitude, to the Cosine of the Angle of the Immersion of the Centre of

the Penumbra. And

As the Difference between the Semidiameters of the Terrestrial Disk, and of the Penumbra, is to Radius:: so is the Moon's Latirude, to the Cosine of the Angle of the total Immersion.

And fince in the Egress of the Penumbra, the Angles are equal to those in the Ingress, the same

Numbers will express both.

5. Having thus gained the Cosine of these Angles, and consequently, the Angles themselves; you must next investigate the Motion of the Moon corresponding to each of the Angles respectively. By saying,

As Radius is to the Sine of the Angle of Incidence:: so is the Sum of the Semidiameters of the Penumbra and the Earth's Disk, to the Motion of half the Duration of the whole Eclipse;

As Radius to the Sine of the Angle of Immerfion of the Centre :: so is the Semidiameter of the Disk, to the Motion of half the Duration of Cen-

tral Eclipses. And again,

As Radius to the Sine of the Angle of total Immersion:: so is the Difference between the Semidiameters of the Disk and Penumbra, to the Motion of half the Mora, or continuance of the Penumbra within the Disk.

6. And when the Motions are thus found, you may gain the corresponding Times by this Analogy: As the horary Motion of the Moon from the Sun, is to one Hour, or 60 Minutes: : so is the Motion of half the Duration, (whether belonging to the Angle of Incidence, to the Angle of the Immersion of the Centre, or to the Angle of the whole Immersion) to the Space of Time corresponding to each Motion respectively.

And having thus gained these Intervals of Time; if you add them to, or take them from, the mid-dle Moment of the Eclipse, you will obtain the Moment of Time, in which is the Beginning and End of the Eclipse Central or other; the Beginning and End of the Mora of the Centre of the Penumbra universally, for that Place where you are, or for the Meridian of that Place for which your Tables were calculated; which Time, by the Confideration of the Difference of Meridians or Longitudes of Places, may eafily be accommodated to any other Place.

And thus may the general *Phenomena* of Solar Eclipses be accounted for and calculated. Their more particular Affections may be obtained from the following Considerations, and Methods of Investigation. But let us premise,

1. That in that very Place, where the Penumbra first touches and enters the Earth's Disk, the Inhabitants will see the Beginning of the Eclipsc, in the uppermost Point of the Sun's vertical Diameter, or in the upper Extremity of the Limb. (2.) In that Place where the Centre of the Penumbra enters the Earth's Disk, the Spectators

will see a Central Eclipse of the Sun. (3:) But in that Place where the whole Penumbra is first received or contained within the Disk, there the End of the Eclipses will be observed, at the lower End of the Sun's vertical Diameter. (4.) Where the Path of the Centre of the Penumbra, in the Meridian Circle intersects the Earth's Axis; and where it intersects the Axis of the Ecliptick in the Nonogesimal Degree, or the Point that is most elevated above the Horizon, there a Central Eclipse will be visible. (5.) In that Place where the Penumbra begins to emerge out of the Earth's Disk, the Eclipse will begin in the Western Luminary, in the nadir Point of his vertical Diameter: (6.) In that Place where the Centre of the Penumbra goes out of the Limb, a total Eclipse will be visible in the Sun in the West.

7. But where the Centre of the Penumbra goes out of the Disk, there will be the perfect End of the Eclipse, which will go off in the Zenith Point

of the Sun's vertical Diameter.

These are the general Phenomena of Solar Eclipses; only you may observe, that by Reason the Menstrual Motion is swifter than the Diurnal, they will always begin from the West, and so will proceed on from West to East, during the whole Time of the Eclipse.

Before I quite leave this Affair, it will be pro-per and useful to acquaint the Reader briefly with Mr. Flamstede's late invented Method of representing Solar Eclipses by a Geometrical Construction, because 'tis free from all the Embarasment of Parallaxes, and in some Cases hath the Advantage of

Suppose then a Plane to touch the Moon's Orbit. and which shall be posited so as that it shall be at right Angles to the Line which corrects the Centres of the Sun and Moon; and that through this Plane, innumerable right Lines be drawn from the Centre of the Sun, to any Circles upon the Earth's Surface, then will these Lines so drawn, project the terrestrial Sphere, and its Circles on that Plane; fo that an Eye placed in the Sun, would observe the Earth and its Annual and Diurnal Motion, as if all were transacted in that Plane: Just as we who live on this Earth, observe the Sun and Moon, and their various Motions and Changes, as if performed in Circles of the Sphere projected on a Plane.

From such a Projection therefore of the Earth's Spherical Surface, there will arise in that Plane a Circle for a Base, which will be nearly equal to a great Circle on the Earth, and which is called the Earth's Disk, and will be every where Normal to the Plane of the Ecliptick. From its Centre, suppose a right Line drawn both ways, representing the Earth's Axis, and which according to the different Seasons of the Year, will be variously inclined to the Plane of the Ecliptick, which will be represented by one of the Diameters of the Disk; for the Parallelism of the Earth's Axis, by reason of its various Position to the aforcsaid Plane, will make three unequal Angles. Let there be imagined also in the same Plane, innumerable Eclipses to be described by the Diurnal Motion or Rotation of any Point on the Earth's Superficies, these will be the Elliptical Paths of the several Vertexes, as they are called; by each of these, the Situation of any particular Place is determined, and distinguished from all other in this given Plane. Whence, it will follow, that

The Uses of the Astronomical Tables.

if in Solar Eclipses, you can (within the Plane of this Disk) find the Lines and Paths which the Moon her self touches or describes; you may find also the very Places on our Earth which will be then eclipsed by the Interposition of the Moon's

Having then gained by the Precepts above given, the least Distance between the Centres of the Earth (or of the Disk) and of the Penumbra, and the Distance of this Line of the least Distance, from the Axis of the Ecliptick, described or drawn on the Plane aforesaid; let there be drawn thereto, in the Plane of the Disk a perpendicular from the Point of that least Distance, that Line will shew the Path of the Centre of the Penumbra, as it transits the Disk; of which you have a Calculation above given, with regard to the Angles of Incidence, of the Immersion of the Centre, and of the total Immersion. In this right Line, or in this Path of the Centre of the Penunbra, note the Hours of your Meridian, with the Quaras above by Calculation; and let the Hours, &c. also be noted in the Elliptick Path of your particular Place, which must be delineated in this Plane; so that each Hour, and each particular particular hours and each particular part of every Hour may determine the very part of every Hour, may determine the very Point where your Place described by that Ellipsis, is at that Moment of Time. And having thus given these Moments of Time in the Restilinear tellites of Jupiter, See Jupiter in Vol. II.

Path of the Centre of the Penumbra, and in the Elliptick Path of your particular Place, you may by Scale and Compass construct the Phænomena of the Eclipse, as they will appear in your particular Place; thus, Take from the same Scale of equal Parts, by which you drew all the rest, the Semi-diameter of the Penumbra, and moving one Point of the Compasses along the Path of the Penumbra, direct the other towards the Path of the Place. If you find it will not reach to it so as to touch it wou may conclude there will be no Eclipse of it, you may conclude there will be no Eclipse of the Sun in your particular Place; but if it doth either touch it, or reach over it, there will be an Eclipse; a Partial only, if it touch; a Total one, if it reach over the Elliptick Path; the beginning of which Eclipse will be at that Hour, or part of an Hour, where the Compasses Legs being carried along both Paths, do mark out the same Time in each Path: In like manner, the middle of the Eclipse will be found to be at that Moment of Time, which the Legs of the Compasses (being ters, Minutes, & c. (if there' be occasion) corresponding to the Phanomena of the Eclipse, found
Parallel to the Axis of the Ecliptick in your particular Place,) will be at that Moment of Time, which shall be markt out both in the Paths of the Penumbra, and in the Path of your particular Place. See farther in Mr. Flamstede's Dostrine of

A Table of the Latitudes of many of the most Eminent Places on the Earth; together with their Differences of Meridians in Time and of Longitude in Degrees, accounted from the Meridian of Her Majesty's Royal Observatory at Greenwich, near London.

Note, Those Places Markt thus * having been determined by Celestial Observations; the rest have been corrected by their help.

Places Names.	Latitude		Diff. of Merid.		Diff. of Longit.		
Places Names.	D.	M.	H.	M.	D.	M.	
A Capulco in Mexico — — — — —	17	30	7	05	106	15	W
A Agra the Mogul's Court —	28	30	5	33	83	15	E
* Aleppo in Syria	37	20	2	25	36	15	E
* Alexandria in Egypt ——————	31	٥7	2	12	33	CO	E
* Amiens in France	49	54	0	09	2	15	E
* Amsterdam	-52	2 I	O	19	4	45	E
* Antwerp —————	5 I	10	0	17	4	15	
* Avignon —	43	51	0	18	4	30	E
Babylon — — — — —	34	30	3	14	48	30	E
Barbadoes —————————	13	30	. 3	53	58	15	W
Barcelona — — — — — — — — — — — — — — — — — — —	·4I	26	0	10	2 .	30	E
* Batavia — ,		S 15	6	43	Ico	45	E
* Bayon ————	43	29	0	06	I	30	W
Bengal ———————	21	56	6	2 I	95	15	E
Bergen in Nerway	61	00	. 0	32	8	co	E
* Bononia in Italy ——————	44	30	0	47	II	45	E
* Boston in New-England -	42	25	4	42 ½	70	37	W
1						<u> </u>	[reft

A Table of Latitudes and Longitudes, &c.

•	• •	Latitude 1	Diff. of	Diff. of	1
	Places Names.		Merid.	Lougit.	}
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¥	Bourdeaux	44 50	0 02	4 30	11.
•	Cadiz in Spain	36 16		0 30	w
¥	Calis in France	1 -	o. 30	7 30	1
	Camboia in India	1 ' 1	0 07	. 1 45	E
¥	Canea in Crete	10 20	7 12	108 00	E
	Candia	35 29	I 36 ±	24 07	E
¥	Cape Bon Esperance	35 18	I 41	.25 15	E
¥	Cape Commission	34 S 15	1 19	19 45	E
×	Cape Comerin	8 00	513	78 15	E
×	Cape Vir de at the Isle of Goree -	14 43	I 09	17 51	W
- J.	Cayenne West-Indies	4 56	3 26	17 30	W
т	Cayro	30 04	2 17	34 15	E
•	Ceylon — — — —	7 50 }	5 33	83 15	E
*	Cheusan China — — — — — —	30 co	8 06	121 30	E
	Cochin East-Indies — — — —	9 25	5 03	75 45	E
	Conimbra Portugal — — — — —	40 30	0 39	9 45	W
¥	Constantinople	41 07	2 .07	31 45	E
*	Copenhagen Denmark—	55 40	0 50	12 30	Ē.
	Corvo Irfula	40 03	2 06	31 30	W
	Cracow Poland	50 10	1 18		E
	Cusco in l'ern	12 S. 25	·		W
*	Dantzick in Poland	54 22	4 55 I	73 45	
¥	Diep in Normandy	49 56	- 7	. 19 . 00	E
¥	Dublin in Ireland	53 12	0 28	I 00 .	E
×	Dunkirk Flanders			7 co	W.
•	Durazzo in Dalmatia	51 OI 41 58	0 09	2 15	E
*	Edinborough in Scotland		I 21	20 15	E
¥	Embden—	- /	O. I2	3 00	W
	Fero Insula		0 30	7 30	E
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· •	Frankford on the Main—	43 41	9 47	11 45	\mathbf{E}
:	Geneva —	50 04	0 33	<u>8</u> 45	E
	Genoa	46 22	o 26	. 6. 3a	\mathbf{E}
*	Ghent	44 27	0 39.	9 45	E
	Greenwich at the Observatory	51 01	0 15	3 45	E
٠.	Goa in India — — — —	51 28±	0 00	0 00	
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T .	Lions France — — —	45 45	0.20		\mathbf{E} .
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V	ol. II.			Madi	<i>i.</i>]
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A Table of the Latitudes and Longitudes, &c.

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	Latitud.	Dift. of	Diff. of	
Places Names.		Merid.	Longit.	
Places Maines.	\overline{D} . \overline{M} .	\overline{H} . \overline{M} .	\overline{D} . \overline{M} .	•
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Madrid Spain	40 10	0 13	3 15 (W
	39 35	0 10	2 30	E
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* Malacca India —				
* Martinico Island —	14 44	4 04		W.
* Marfeiles • — — —	43 20	0 21 1	5 .22	E
Messina in Sicily	38 21	I 06	16 30	E
* Mexico	20 06	6 49	102 10	W
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Munchen Bavaria — — — — —				
* Montpelier — — —	43 36	0 15		Ē
* Muscow — — — —	55 34	2 35		E
* Namur — — — —	50 25	0 20	5 60	E
Nangasack Japan — — —	32 53	8 31	127 45	Ē E
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Naples	41 05	1 03	15 45	E E
* Narbon — —	43 15	0 09	2 15	E
Narfinga — — —	18 15	5 34	83 30	E
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* Oxford —	51 44±	9 05	1 15	W
Ozaca Japan —	35 05	8 52	133 00	E
* Padua —	45 31	0 45	11 15	\mathbf{E}
* Paris — — — — — — — — — — — — — — — — — — —	48 50	0 09	2 15	Ē
	39 55	7 51	117 45	Ē
* Pekin China — — — —			80 15	Ē
* Poudicherri		1 1		E
* Prague Bohemia — —	50 40	0 58	14 30	E
* Ratisbon — — —	48 59	0 49	12 15	E
Reggio in Italy — — — —	42 15	0 55	13 45	E
* Rbodes	36 42	2 12	33 00	E
* Rochel —	46 10	0 05	1 20	W
	41 51	0 52	13 00	E.
Rome —		1		E
* Roftock —	1 - 1		1	
* Roterdam —	51 55	0 17	4 15	E
Salamanca Spain — — — — —	41 12	0 16	4 00	W
* Sevil — — —	37 36	0 26	6 30	W
* Siam in India —	14 18	6 43	100 45	E
* Smirna in Ionia	38 28	i 49	27 15	Ē
C. L. D. C.	36 14	4 20	65 00	Ē
Spahan Persia – – – –	58 50	1 10	17 30	Ē
Stockholm Sweden -			1 ' '	
Syracusa Sicily — — — —	37 04	1 01	15 15	E
Tangier — — —	35 55	0 25	6 15	W
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Toledo Spain— — — —	39 46	0 14	3 30	W
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* Vienna	48 22	1 09	17 15	E
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* Uraniburg —		1		Ē
* Utrecht —	52 05		5 00	E
* Wirtemberg Saxony — —	51 53	0 52	13 80	E
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Note, That those Places against which the S is placed in the Column of Latitudes, are South of the Equator; and all the other North.

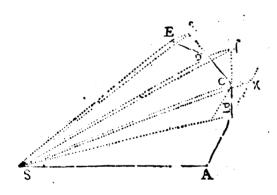
ASTRO-

ASTRONOMY, in order to prepare the Way for the right understanding of this noble Science, as it now stands in the Writings of the modern Astronomers, who have revived and demonstrated the Ancient Pythagorean System of the World: And besides those necessary Precognita of the Doctrine of the Sphere, its Projection in Plano, and the Spherick Trigonometry (which every one ought to know that will pursue this Study;) I shall here (from Mr. Hayes's Fluxions, p. 291, &&c.) give you such Physical and M chanical Propositions, as will qualify you to obtain a sufficient Knowledge of the Doctrine contained in the present Books of Astronomy.

PROP. I.

The Area's which Bodies (suppose any Planets or Comets) revolving about an immoveable Center, (as suppose the Sun in S) describe by the Rays drawn to the same, are Proportional to the Times of Description, and are all in the same immoveble Plain.

Let the Time be divided into equal Parts, and suppose in one of them, a Body describes the Space AB (by a Power which it has to move in the right Line Ax from A towards x) in the next Moment of Time, if nothing hindred, it would move from B to x, describing the Line Bx equal to AB, so



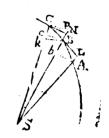
that drawing the Rays AS, BS, xS to the immoveable Center S, the Areas ASB and BSx described, would be equal: But when the Body comes to B, let a Force in S attract the fame, and by one fingle but strong Impulse, make the Body deviate from the right Line Bx, and move in the right Line BC; draw x C Parallel to BS, interfecting B C in C, then at the End of the second Moment of Time, the Body will be found in C, in the same Plain with the Triangle A S B; join SC and the Triangle SBC, because of the Patallels SB and Cx, will be equal to the Triangle SBx, and consequently it will also be equal to the Triangle SAB: In like Manner, if the Central Force (or Vis Centripeta) act successively in C, D, &c. and make the Body in successive Moments of Time describe the Lines CD, DE, &c. they will be in the same Plain, and the Triangle SCD will be equal to the Triangle SBC, and SDE will be equal to SCD = SBC. Whence it is manifest that the Body revolving about an immoveable Center in an immoveable Plain, describes equal Areas in equal Times; and by Composition, the Area SACS is to the Area SAES, as the Time which the Body takes to describe that, is to the Time it takes to describe this. Vol. II.

Let the Number of the Triangles be increased and their Breadth diminished in infinitum, then the Perimeter ABCDE will be a Curve Line, and consequently the Vis Centripeta which perpetually draws back the Body from off the Tangenr of this Curve, acts continually; and the Areas SACS, SAES Proportional to the Times of their Description, will also in this Case be Proportional to the same Times. Q. E. D.

CON ECTARY I.

If a Body or Planet revolving in the Curve ABC, be attracted by a Central Force in , or gravitate to-

wards the Sun there; and if the Body describe the infinitely little Portions of the Curve AB and BC in equal Times, then the infinite little Triangles ASB, BSC will be equal; and if on the Center S, and with the Radii SA, SB, the little Arches Ab, Bc, be described, then the Triangle SAB or $SAb = \frac{1}{1}SA \times Ab$, and the Triangle SBC is =



 $\frac{1}{1}SB \times Bc$; therefore it is, $\frac{1}{2}SA$: $\frac{1}{2}SB$:: SA: SB:: SB

DEFINITION I.

The Center of Attraction is that Point to which the revolving or moving Body is attracted or impelled by the Force or Impetus of Gravity; thus the Sun is such in the respect of the primary Planets, and the Earth in respect of the Moon.

DEF. II.

Paracentric Motion of Impetus is so much as the revolving Body approaches nearer to, or recedes farther from the Center of Attraction; thus if S be the Center of Attraction, and if a Body in A move to B, then SB - SA = Bb, is called the Paracentric Motion of that Body.

DEF. III.

Circular Velocity of a Body is measured by the Arch of a Circle; thus if a Body in \mathcal{A} move to B_i or b_i its Circular Velocity is measured by the Arch of the Circle \mathcal{A} b describe on the Center of Attraction, and the Circular Velocity of a Body moving from B to C is measured by the Circular Arch B C.

DEF. IV.

Conatus Excussorius is measured by a Line let fall from a Point infinitely near to another Point, Perpendicular to a Line drawn to touch the Curve in that other Point: whence it is manifest that the Conatus Excussorius Circulationis, or Conatus Centrisqus may be expressed by BN the versed Sine of the Angle of Circulation CSN (or by ck, because the Difference between the Radii SC, SB is incomparably little) for the versed Sine is equal to a Tangent drawn to the other End of the Arch.

O 2

DEF.

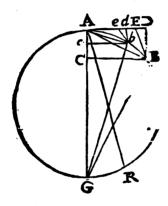
DEFIN. V.

Solicitatio Paracentrica Gravitatis vel Levitatis, or the Paracentric Solicitation of Gravity or Levity, is express'd by the right Line A L, drawn from the Point A, Parallel to the Ray SB (infinitely near S A) until it intersect the Tangent B L.

LEMMA L

The versed Sines of infinitely little Arches are in a duplicate Ratio of the Chords of the said Arches.

Let the right Line AD touch the Circle AB G in A, then D A B is the Angle of Contact; Let In A, then D A B is the Angle or Contact; Let AB be an infinitely little Arch, AB the Chord, and AC the versed Sign thereof, I say AC or BD is as the Square of AB; that is, if another infinitely little Arch Ab be taken, then the versed Sine Ac (or bd): Versed Sine AC (or BD):: Abq: ABq.



Draw the Diameter AG, and draw the Lines GB, Gb; then by the Property of the Circle, we have $ABq = AC \times AG$ and $Abq = AG \times AC$; whence it is, $ABq:Abq:AC \times AG:AC \times A$

to the Arches AB, Ab, and consequently the Verto the Arches AB, Ab, and consequently the ver-fed Sines AC, Ac, or the Subtenses of the Angle of Contact BD, bd, are in a duplicate Ratio of the conterminal Arches AB, Ab. And if the Lines BE, be, subtend the Angle of Contact DAB, and be Parallel to any Line (less than the Disperses AC) draws wishing the Circle

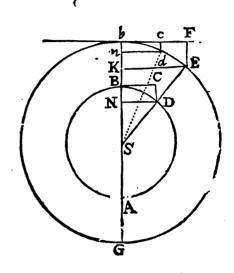
than the Diameter AG) drawn within the Circle, as AR, then the Lines BE, be, will be as the Squares of the conterminal Arches AB, Ab, for BD: bd:: BE: be:: ABq: Abq.

COROLLARY.

The Subtenses of the Angles of Contact of Curves, whose Curvature in the Point of Contact Difference between them is incomparably little) are as the Arches, therefore the Conatus Centri-are in a duplicate Ratio of the conterminal Arches. fugi are in a duplicate Ratio of the Velocities.

LEMMA II.

In unequal Circles ABD, GbE, if the infininitely little Arches BD, bd be equal, then the versed Sines BN, bn of these Arches will be reciprocally Proportional to the Radii SB, Sb.



Produce SD unto E, and draw E F Parallel to Sb, and draw the Lines DN, EK, dn perpendicular to SB.

Then it is, b K: B N: :Sb:SB. And bn:bK::bdq:bEq.

But $b E = \frac{Sb}{SB}BD$.

Therefore, $bn:BN::Sb \times BDq:\frac{Sbq}{SR}BDq$.

That is, $b n : B N :: \frac{b d q}{S b} : \frac{B D q}{S B}$

And fup- bd = BD

We have bn: BN:: SB: Sb. Q. E. D.

PROP. II.

The Conatus Centrifugi (or Vires Centripetz) of Bodies revolving in equal Circles, with an equable Motion, are in a duplicate Ratio of their Velocities.

The Conatus Centrifugus is equal to the versed Sine of the Angle of Circulation, and the versed Sines of Arches infinitely little are in a duplicate Ratio of the Chords of those Arches; that is, in a duplicate Ratio of the Arches themselves, and is the same with that of some Circle (or when the the Velocities (the times being supposed equal)

CONSECTARY I.

If two Bodies B, b, revolve in unequal Circles, ABD, GbE, and describe the Areas SBD, Sbd; then the Conatus Contrifugi (or Vires Contripeta) DC, dc, will be in a Ratio compounded of the duplicate Ratio of the Velocities directly, and the simple Ratio of the Radii inversely.

For if the Radii be equal, the Conatus Centrifugi are as the Squares of the Velocities; and if the Velocities be equal, the Conatus Centrifugi are reciprocally as the Radii; therefore if neither the Radii nor the Velocities be equal, the Conatus Contrifugi are in a Ratio compounded of the Rationes of the Squares of the Velocities directly, and of the Radii inversely.

This Corollary is demonstrated more universally, in one of the Steps of the Second Lemma; for it is there, $bn:BN::\frac{bdq}{Sb}:\frac{BDq}{SB}$

CONSECTARY II.

And if the Bodies B, b, describe the equal Areas BSD and bSd in equal times (that is, if $SB \times BD = Sb \times bd$, then bd:BD::SB:Sd) then the Velocities BD and bd will be reciprocally as the Radii, and the Squares of the Velocities will be as the Squares of the Radii inversely, whence the proportion $bn:BN::\frac{bd}{Sb}:\frac{dq}{Sb}:\frac{BD}{SB}:\frac{BD}{SB}:\frac{SB}{$

CONSECTARY III.

If the Velocities be directly as the Radii, then the periodic Times will be equal, and the Analogy $bn:BN::\frac{bdq}{Sb}:\frac{BDq}{SB}$ will become bn:BN::Sb:SB; that is, the Conatus Centrifugi are proportional to the Radii.

CONSECTARY IV.

If the Bodies B, b, describe the Arches B D, b d in equal Times, then the periodic Time of b will be to the periodic Time of B, as $\frac{S}{b}\frac{b}{d}$ is to $\frac{S}{B}\frac{B}{D}$; because the Times are directly as the Spaces and reciprocally as the Velocities; and because b n: B N (:: d c: D C): $\frac{b}{S}\frac{d}{D}\frac{q}{d}$: $\frac{B}{S}\frac{D}{D}\frac{q}{d}$: $\frac{S}{B}\frac{D}{D}\frac{q}{q}$: (Multiplying by S B \times S b) $\frac{S}{B}\frac{B}{D}\frac{S}{Q}$: $\frac{S}{B}\frac{B}{D}\frac{S}{Q}$: $\frac{S}{B}\frac{B}{D}\frac{S}{Q}$. Therefore the Vires Centripeta are in a Ratio compounded of the Rationes of the Radii directly, and the Spaces of the periodic Times inversely.

CONSECTARY V.

And if the Squares of the periodic Times be as

the Radii, that is, if $\frac{Sbq}{bdb}$: $\frac{SBq}{BDq}$:: Sb:SB, then it will be $b\pi:BN::\frac{Sb\times SBq}{BDq}:\frac{SB\times Sbq}{bdq}$:: (by substitution) $Sb\times SB:Sb\times SB$; that is, the Vires Contripota are equal; and because $\frac{Sb}{bdq}$ = $\frac{SB}{BDq}$, therefore $\sqrt{Sb}:\sqrt{SB::bd:BD}$; that is, the Velocities are in a Subduplicate Ratio of the Radii. Et vice versa.

CONSECTARY VI.

And if the Squares of the periodic Times be as the Squares of the Radii, that is, if $\begin{array}{c} Sb \ q \\ b \ d \end{array}$: $\begin{array}{c} SBq \\ BDq \end{array}$: $\begin{array}{c} Sbq : SBq \\ BDq \end{array}$: $\begin{array}{c} Sbq : SBq \\ Sbq : SBq \end{array}$ then it will be $\begin{array}{c} Sbq : Sbq : SBq \\ BDq \end{array}$: $\begin{array}{c} Sbq : Sbq \\ BDq \end{array}$: (by substitution) $\begin{array}{c} Sbq : S$

CONSECTARY VII.

SCHOLIUM.

And because it is found by Observation, that the Squares of the periodic Times of Planets, are as the Cubes of their Distance from the Sun; and that in equal Times they describe equal Areas about the Sun: Therefore it is manifest, that the Sun is the Centre of all the Planetary Motions; and that the Vis Centripeta (or Force of Gravity) of one Planet, is to the Vis Centripeta of another Planet, as the Square of this Planet's Distance from the Sun, is to the Square of that Planet's Distance from the Sun.

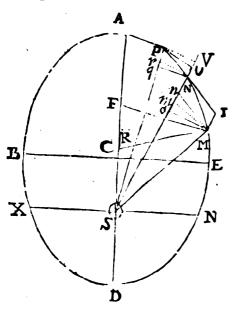
It is also evident that those Planets which are nearest the Sun move swiftest, for the Velocity of one Planet is to the Velocity of another Planet, as the Distance of this Planet from the Sun is to a mean Proportional between the Distances of this and that Planet from the Sun.

PROP.

PROP. III.

If the Area which a Body, revolving about an immoveable Center, describes by Rays drawn to the said Centre, be proportional to the Times of Description, the Elementum or infinitely little Increment or Decrement of the Paracentric Impetus is equal to the Difference or Sum of the Paracentric Solicitation (Solicitation of Gravity, or the Impression made by the Astion of Gravity or Levity, or any such like Cause) and twice the Conatus Centrifugus, viz. to the Sum, if it be the Solicitation of Levity; or to the Difference, if the Paracentric Solicitation arise from the Astion of Gravity.

From the Points P and M, draw the Lines P v, Mo perpendicular to SN; then because the Triangles P S N, N S M are equal, (the times being supposed equal) therefore (because



the Base S N is common to both) the Altitudes Pv, Mo are equal; take Nn = LM, and draw Mn parallel to LN; then the Triangles PN v, M no will be equal and fimilar, and PN = M n, and N v = o n; again in the Right Line SN (produced if need be) take SV = SP, and Sm=SM, then is NV the Difference between the Radii SP, and SN, and Mm is the Difference between the Radii SN and SM; now NV is = $(Nv) \cdot no + Vv$; and Nm is = Nn + no = om, therefore NV - Nm = Vv + mo - Nn = to the differentio-differential differential diffe tial, or infinitely little Increment or Decrement of the Paracentric Velocity, = 2 m o - N n (because V v and m o, the versed Sines of two Angles and Radii, whose Difference is incomparably little, are equal.) Now the Difference between the Radii SP, SN, and SN, SM, expresses the Paracentric Velocity, and their Difference again is the infinitely little Increment or Decrement of the said Paracentric Velocity; and mo or Vv is equal to the Conatus Centrifugus Circulationis, and Nn is = to the Solicitation of Gravity; therefore the Elementum of the Paracentric Velocity is equal to the Difference between twice the Conatus Centrifugus (2 mo) and the simple Solicitation of Gravity (Nn) or (which may be proved in like manner) to the Sum of twice the Conatus Centrifugus, and the simple Solicitation of Levity.

CONSECTARY I.

Hence it appears, that if the Solicitation of Gravity prevail, then NV-Nm will be Negative, that is, Nm will be greater than NV, and the descensive Paracentric Velocity increases, and the ascensive decreases. But if twice the Conatus Centrifugus prevail, then NV-Nm will be positive, and the ascensive Paracentric Velocity increases, and the descensive decreases.

CONSECTARY II.

If the Elementum, or infinitely little Increment or Decrement of the Paracentric Velocity be given, the Solicitation of Gravity or Levity may be found; for the Conatus Centrifugus is always given, (by Conf. 2. Prop. 2.) it being constantly in a triplicate Reciprocal Ratio of the Radii.

PROP. IV.

The Angles which a Planet describes about the Sun, in equal Times, are reciprocally in a duplicate Ratio of the Radii.

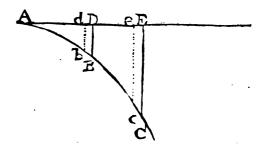
The Circular Velocities are in a Ratio compounded of the Rationes of the Angles and Radii, jointly; therefore the Angles are in a Ration compounded of the direct Ratio of the Circular Velocities, and the reciprocal Ratio of the Radii: But because in equal Times the Areas are equal, (Conf. 2. Prop. 2.) therefore the Circular Velocities are reciprocally as the Radii, and confequently the Angles are reciprocally in a duplicate Ratio of the Radii.

And such are the apparent Diurnal Motions of the Planets observed from the Sun (for Days, in such Cases, are Parts of Time little enough, especially in Planets more remote from the Sun) which are almost reciprocally as the Squares of their Distances from the Sun; so that a Planet, in a given Element of Time, describes but the fourth Part of that Angle, which it would describe at half its present Distance from the Sun.

LEMMA III.

The Spaces which a Body describes in the beginning of its Descent, are in a duplicate Ratio of the Times.

Let the Right Line A E be divided into an infinite Number of equal Parts d D, e E, & c. representing equal Moments of Time; and draw



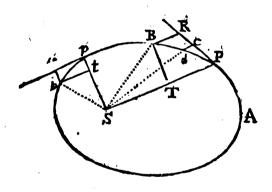
the Ordinates BD, EC, &c. proportional to the Velocities of the heavy Body, at the end of the Times represented by AD, and AE, and describe the Curve ABC. Now because the Space which a Body describes, is proportional to the Time of Description, and the Velocity jointly;

Body describes in the Moment of Time Dd, is proportional to the Restangle Db; and the Space which the same heavy Body describes in the Moment of Time Ee, is proportional to the Restangle Ee: Whence the Space which the Body describes in the Time AD, is to the Space it describes in the Time AD, is to the Space it describes in the Time AE, as the Curvilineal Space ADB, is to the Curvilineal Space AEC, but when the Body begins to descend, the Ordinates DB, EC are indefinitely near the Point A; in which Case the trilineal Figures ADB, AEB become restilineal similar Triangles, the indefinitely little Portions AB, BC being in the same streight Line. Now the Areas of similar Triangles are in a duplicate Ratio of the Homologous Sides; that is, the Area ABD: Area AEC: ADG: AEG therefore the Spaces which a heavy Body describes in the Beginning of its Descent, are in a duplicate Ratio of the Times. AEC:

PROP. V. Problem I.

If a heavy Body revolving in the Periphery of a Curve, about an immoveable Centre, describe Areas proportional to the Times; 'tis required to find the Law of the Vis Centripeta tending to the said Centre.

Suppose a Body P to be projected in the Line P R from P towards R, and let the Body at the same Time be attracted by a Force in S, so



that by a Motion compounded of the projectile and attractive Forces, it describe the Curve A P p; and let the Line P R touch the said Curve in P; draw S P, and assume any Point B in the Curve indefinitely near P; and draw B R parallel to S P, and B T perpendicular to S P; assume another Point p in the Curve; and draw S p, the Tangent p r and r b parallel, and b t perpendicular to S b, and suppose the Body describes the Arches P d; p b in equal Times; and draw d c parallel to S P: Then the Ratio of the Lineola Nascens B R to the Lineola Nascens b r, is compounded of the Rationes of B R to d c, and of d c to b r: But (Lem. 1. and Cor.) B R is to d c, as the Square of the Arch PB, is to the Square of the Arch P d; and because the Arches P B, P d are indefinitely little, they are proportional to the Triangles PSB, PSd; (Lemma 2.) that is, they are proportional to the Times the Body takes to describe them, or to the Times which the Body takes to describe the Arches P B, p b, and consequently B R is to d c, as the Square of the Time which the Body takes to describe the Arches P B, is to the Square of the Time it takes to describe the Arch P b;

again, because Pd and pb are supposed to be described in equal Times, therefore dc is to br, as the Vis Contripcta in P is to the Vis Contripcta in p; whence it is evident that B R is to br in a Ratio compounded of the Rationes of the Squares of the Times in which the Arches PB, pb are described, and of the Vis Contripcta in P to the Vis Contripcta in p; that is, (because the Times of describing the Arches PB, pb, are proportional to the Triangles PSB, pSb, or to the Rectangles $SP \times BT$, $Sp \times bt$.)

BR: br::V × SPq × BTq: v × Spq × btql

And by division BR

SPq × BTq: Spq × btq

V:v.

Or Spq × btq : SPq × BTq ::V:v:

That is, the Vis Contripeta in P is as the Solid SPq × BTq

BR

hriefly demonstrated

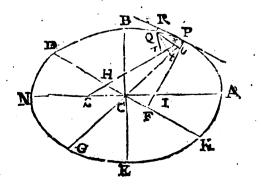
This may be more briefly demonstrated thus: If the Times be equal, B R is as the Vis Centripeta; and if the Vis Centripeta be given, then BR (Prop. 1. Lem. 3.) is as the Square of the Times; and if neither the Times nor the Vis Centripeta be equal, then BR is (supposing $V \stackrel{.}{=}$ to the Vis Centripeta in P, and T = to the Time of Description) as VT, therefore V is as $\frac{BR}{T}$; and because the Time is as the Area PSB, or as the Rectangle $SP \times BT$, therefore V is as $\frac{BR}{SPq \times BTq}$ directly, or as $\frac{SPq \times BTq}{BR}$ inversely. Q. E. D:

COROLL ART.

Hence if any Figure, as A P p, be given, and the Point S, to which the Vis Contripeta tends; then the Value of the Solid $\frac{S P q \times B T q}{B R}$ may be determined from the Nature of the Figure; and consequently the Law of the Vis Contripeta, which is reciprocally as the said Solid, may be found.

PROP. VI. Problem II.

If a Body revolve in the Periphery of an Ellipsis; its required to find the Law of the Vis Centripeta, tending to the Focus of the Ellipsis.



Let ABD be the Elipsis, and S the Focus to which the Vis Centripeta tends. Draw the Axis

AN; and AN, the Conjugate Diameter BE; draw the Line PR touching the Curve in any Point (P) and draw the Diameter P G, the Conjugate Diameter DK, PF perpendicular to DK, and Qv parallel to PR: Draw SP intersecting DK in H, and intersecting Qv in x; and draw QR parallel to SP. Then (Hayes, Art. 51.) PH = AC; draw QT perpendicular to SP; and suppose the Parameter of the Axis $\left(\frac{2 B C}{A C}\right)^{q}$

 $L \times QR: L \times Pv:: QR: Pv:: Px: Pv:: PH: PC:: AC: PC.$

 $L \times Pv :: Gv \times Pv :: L : Gv.$

 $Gv \times Pv : Qvq : : CPq : CDq$

And because Qv q is = Qx q, when Q is infinitely near P. Therefore, Qxq(=Qvq):QTq:: (by fimilar Triangles) <math>HPq(=ACq):PFq:: (Hayes, Art. 6c.) CDq:CBq.And multiplying the respective Terms of these Analogies into one another there will arise this:

Analogies into one another, there will arise this; L X & R: QTq :: L X AC X CP q: Gv X CBq X CP Viz. $L \times QR: QTq: :2 BCq \times CPq: Gv \times BQC \times CP$. $L \times QR : QTq :: 2 PC : Gv.$

But when the Point Q is indefinitely near P, then 2PC = Gv

Whence $L \times Q R = Q T q$.

And multiplying both fides of the Equation by S $\frac{Pq}{QR}$, we shall have $L \times SPq = \frac{SPq \times QTq}{QR}$.

(Cor. Prop. V.) Therefore the Vis Centripeta is reciprocally as $L \times SPq$; and because L is a determinate Quantity, therefore the Vis Centripetais reciprocally as the Square of (S P) the Distance of the Body in P from the Centre of Attraction S. Q. E. I.

GOROLLARY I.

The Parament of the Axis (L) is equal to. Q7 q QR

COROLLARY II.

If the Centre of Attraction S, and the adjacent Vertex N, be suppos'd immovable, and if the other Foci I approach nearer and nearer to S, and at last coincide with the same, then the Body will revolve in the Periphery of a Circle, and the Law of the Vis Centripeta will be the same as in the Ellipsis.

COROLLARY III.

If the Vertex's A and N be given, and if the Focus I coincide with A, and the Focus S coincide with N, then the Ellipsis A PN will become a fireight Line coinciding with the Diameter AN, and the Body will move in the fame, without any Attraction from without the Line.

. COROLLARY IV.

If the Vertex N, and the Focus of the Ellip-fis, or Centre of Attraction S be given; and if the other Focus I be at an infinite Distance from S, then the Ellipsis NPA will degenerate into a Ī.,

Parabola, and the Vis Centripeta in P will be as the Square of the Distance NP inversively.

COROLLARY V.

The same things being suppos'd, if the Focus 1 be at more than an infinite Distance from S; that is, if it full on the contrary Side of N in respect of S, then the Body will move in the Curve of an Hyperbola, and the Vis Centripeta will be reciprocally as the Square of the Distance from the Focus S.

COROLLARY VI.

If the Focus I and the Vertex A be given; and if the Centre of Attraction S be suppos'd at an infinite Distance from 1, then the Curve AP will be a Parabola, and the Vis Centripeta will be the same in every Point of the Curve; and contrarily, if a Body moving at first in a streight Line, be attracted to a Centre at an infinite Distance from the same, then that Body will move in the Curve of a Parabola, and the Centre of Attraction will be in the Axis of the Parabola, at an infinite Distance from the Vertex.

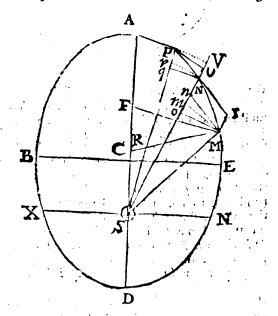
SCHOLIUM.

It may be observ'd that the Paracentric Solicitation of Gravity, and the Vis Centripeta, are Terms signifying the same thing.

PROP. VII.

The Solicitation of Gravity, or Vis Centripeta of a Planet, is to the Conatus Centrifugus of the same Planet, as its present Distance from the Sun is to 1 the Parameter of the Planetary Ellipsis.

Suppose S M = D, and L = to the Parameter of the Axis; and let $t \times L$ be a constant Plane equal to twice the Elementary Triangle



MSN: Then the Arch Mm is $=\frac{t \times L}{D}$, and $M m q \text{ is} = \frac{t^2 \times L^2}{D^2}$, and $m o = \frac{M m q}{2 S M} = \frac{1}{2 S M}$ - = to the Conatus Centrifugus.

Again,

Agair, the Solicitation of Gravity is as D_2 inversely, or as \overline{Mm} , or $\frac{t^2 \times L^2}{D^2}$ directly, or as (dividing by the invariable Quantity $\frac{1}{2}$ L) $\frac{2 \times t^2 \times L}{D^2}$ directly. Whence 'tis evident that the Solicitation of Gravity is in the Conatus Centrifugus, as $\frac{2 \times t^2 \times L}{D^2}$ is to $\frac{t}{2} \times \frac{L^2}{D^3}$, or as D is to $\frac{t}{4}D$; and because 'L is an invariable Quantity, the Rationes of the Solicitation of Gravity to the Conatus Contrifugus are proportionable to the Distances of the Planet from the Sun.

PROP. VIII.

The greatest Ascensive or Decensive paracentrick Velocity of a Planet, is when the Distance of the Planet from the Sun is equal to \(\frac{1}{2}\) of the Parameter of the Axis of the Ellipsis.

Draw S W perpendicular to the Axis AD, I say the greatest Paracentrick Velocity is in W or X. For the Solicitation of Gravity is to the Conatus Contribugus, as D is to $\frac{1}{4}$ L; and the Solicitation of Gravity is to twice the Conatus Contribugus, as D is to $\frac{1}{2}$ L; and because SW = D is $= \frac{1}{2}$ L, therefore in the Point W(or X) the Solicitation of Gravity, is equal to twice the Conatus Contribugus and (by Prop. 3.) consequently the Fluxion of the Paracentrick Velocity is = 0: Whence it is evident, that if on S as a Centre, a Circle be describ'd with a Radius $= \frac{1}{2}$ the Parameter of the Axis, it will cut the Orbit of the Planet in two Points W and X, in which the greatest Paracentrick Velocity happens.

COROLLART

The Conatus Centrifugus of receding from the Sun, is always less than the Solicitation of Gravity; for the Solicitation of Gravity is always to the Conatus Centrifugus, as the Distance of the Planet from the Focus is to ‡ part of the Parameter of the Axis; and in the Ellipsis, the Distance of a Planet from the Focus, is always greater than ‡ part of the Parameter of the Axis. Therefore, 50c.

PROP. IX.

The Impetus which a Planet acquires (during the whole time of its Motion) by the continued Attraction of the Sun, are proportional to the Angles of Circulation; that is, as the Angles of apparent Motion from the Sun.

I say, That Impetus which a Planet acquires, as it moves from A to P, is to the Impetus which it acquires, moving from A to M, as the Angle ASP is to the Angle ASM: For the Increments of those Angles (Prop. 4.) are reciprocally as the Squares of the Radii or Distances; that is (Cor. Prop. 5.) as the Solicitations or Impressions of Gravity: Therefore the Sum of these is proportional to the Sum of those; that is, the Sum of all the Impetus or Impressions of Gravity acquir'd from A to P, is to the Sum of all the Impressions of Gravity acquir'd from A to M, as the Angle at ASP is to the Angle ASM.

Vol. II.

GOROLLARY.

Hence in the Point W (in which an Ordinate to the Axis drawn through the Focus S, inter east the Ellipsis) the *Impetus* which a Planet hath acquired fince it descended from the Aphelion, is equal to half the *Impetus* acquir'd from the Aphelion to the Perihelion; and in the said Point W, the Distance of the Planet from the Sun is $=\frac{1}{2}$, the Parameter of the Axis of the Figure.

And the Impetus which a Planer, describing any Arch of its Orbit, acquires, is to the Impetus acquired in a Semi-revolution, as the Angle of apparent Motion is to two right Angles; the Impetus here meant is that impressed by Gravity or Attraction, simply considered by themselves, the contrary Impetus arising from the Conatus Centrifugus not being considered.

PROP. X.

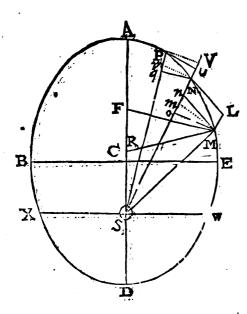
To explain the Motion of a Planet through the whole Revolution; and to show how a Planet approaches to, and again recedes from the Sun, Alternis Vicibus.

If a Planet be at its greatest Digression from the Sun, or in the Aphelion A, the Conatus Centrifugus and the Solicitation of Gravity, are less than if it were nearer to the Sun. But at that Diffance, viz. in the Aphelion A, the Solicitation of Gra-vity is greater than twice the Conatus Centrifugui, (because S A, the Distance of the Aphelion from the Sun, is greater than $\frac{1}{2}$ the Parameter S(W) therefore the Planet will descend towards the Sun in the Curve Line APMD, and (Prop. 3.) the descensive Impetus will continually increase, as in heavy accelerated Bodies, so long as the Solicitation of Gravity is stronger than twice the Conatus Centrifugus: For the descensive Paracentrick Motion increases, as long as the Solicitation of Gravity is greater than twice the Conatus Centuifugus; and therefore the descensive Paracentrick Motion will increase (although the infinitely little Increment of the Paracentrick Motion decrease at the same time) until the Planet arrive at W, in which Point the Solicitation of Gravity is equal to twice the Conatus Centrifugus; and consequently the Paracentrick Velocity is greatest at W, when the Distance of the Planet from the Sun is equal to 1 the Parameter of the Orbit: Afterwards, although the Planet continues to approach nearer and nearer to the Sun, until it come to D, yet the Paracentrick Velocity decreases; for the Solicitation of Gravity is to twice the Conatus Centrifugus, as the Distance of the Planet from the Sun, is to ! the Parameter of the Orbit; and consequently, all the while the Planet is in describing the Portion of the Orbit WD X, twice the Conatus Centrifugus is greater than the Solicitation of Gravity; and from W to D the Paracentrick Velocity decreases; which it continues to do, until the Centrifugal Impressions collected into one, from the Aphelion A, preci ely destroy all the Impressions of Gravity collected into one, from the Aphelion A, or until the Centrifugal Impetus be equal to the Centripetite Impetus. Now this happens in the Perihelion D, where the Paracentrick Velocity vanishes, and in which the Conatus Centrifugus and Solicitation of Gravity are equal and contrary, so that the Planet cannot approach nearer the Sun than it is in this Point D.

Afterwards, the Motion being continu'd: As the Planet hath hitherto approached to, so now it begins to recede from the Sun in the Focus S, and endeavours to move from D by X rowards A. For twice the Conatus Centrifugus, which began to exceed the Solicitation of Gravity in W, continues to prevail from D to X; and therefore, seeing the Planet begins to move (as it were anew) from D to X, the former contrary Impetus (mutually de-flroying each other) the Centrifugal Paracentrick Velocity increases from D to X, but the increment thereof, or the impression decreases, until the Planet arrive in X, where the Solicitation of Gravity is equal to twice the Conatus Centrifugus; therefore the greatest Centrifugal Paracentrick Velocity is in X; from X to A, the Solicitation of Gravity prevails above twice the Conatus Centrifugus; and consequently, the Centrifugal Paracentrick Velocity decreases, until the Planet arrive in the Aphelion A, in which point the Conatus Centrifugus and Solicitation of Gravity become equal and contrary, and confequently mutually destroy each other: And thus the Planet returns to A, from whence it departed, and begins and finishes new Revolutions succesfively, and without Interruption.

CONSECTARY L

Hence we have fix remarkable Points in the Elliptic Orbit of a Planet, viz. four obvious, A the Aphelion, D the Perihelion; E and B the mean Distances (for SB or SE is $=\frac{1}{2}$ the transverse Axis AD, and consequently an Arithmetical Mean between S A and S D, the greatest and least Di-



gression of a Planet from the Sun) and two more, viz. W and X, being the Extremities of the Parameter of the Orbit applied to the Axis in the Focus S, which Points happen in the greatest ascensive or descensive Paracentrick Velocity.

CONSECTARY IL

The Impetus which a Planet acquires by the Action of Gravity from A to W is equal to half the Impetus which it acquires in its descent from meter of the Axis of the Figure L (Prop. 6. Cor. 1.)

A to D, and the Impetus acquir'd from A to Wis = to that acquir'd from W to D; for the Impetus are proportional to the Angles of apparent Motion, and the Angles A S W and WSD are right An-

CONSECTARY III.

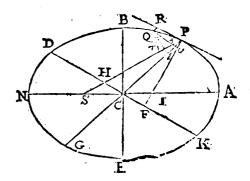
Hence to determine the Species of the Planetary Ellipsis; the Focus of the Ellipsis S is given; and the Point A where the Planet is when the Sun begins to attract it, being supposed at the greatest Distance of the Planet from the Sun, the remoter Vertex of the Ellipsis is also given, and the proportion between the Solicitation of Gravity, or Force of Gravity, wherewith the Sun begins to attract the Planet in A, and the Conatus Centrifugus in the fame Point A being known; the principal Parameter of the Orbit WX, or an Ordinate applied to the Axis in the Focus S, may be found. For SA (given) is to SW ($=\frac{1}{2}$ the Parameter of the Orbit) as the Force of Attraction in A is to a surface of the Orbit) as the Force of Attraction in A is to a surface of the Orbit). Orbit) as the Force of Attraction in A is to twice the Conatus Centrifugus, and if the Parameter be substracted from S A, the greatest Distance of the Planet from the Sun, the remainder will be to S.A. as S A is to SD; therefore AD the transverse Axis of the Ellipsis is also given: Whence the Planetary Ellipsis may be describ'd.

CONSECTARY IV.

A Planet will describe a Circle when the Solicitation of Gravity, and twice the Conatus Centrifugus are equal at the Beginning of the Attraction; for in that Case they will remain equal, there being no Cause to make the Planet approach neares to, or recede farther from the Centre of Attraction about which it revolves; but when in the Beginning the Force of Attraction and twice the Conatus Centrifugus are unequal (provided the simple Conatus Centrifugus be always less than the Attra-ction) then the said Planet will describe an Ellipsis; and if the Force of Attraction prevail, the Point where the Motion begins, is the Aphelion; or if twice the Conatus Centrifugus prevail, then the faid Point is the Perihelion.

PROP. XI.

If several Bodies rovolve round a common Centre, and if the Vires Centripetæ be reciprocally as the Squares of their Distances from that Centre, then in Ellipses, the Squares of the periodic Times will be as the Cubes of the transverse Axes of the Ellipses.



Reassume the Symbols in Prop. 6. then the Para-

 $=\frac{QTq}{QR}$, when the Point Q is infinitely near

P, and if the Times be equal, then Q R is directly as the Vis Contripeta, or reciprocally as (the Square of the Distance) SPq; therefore L is as $QTq \times SPq$; that is, the Latus Rossum (L) is as the Square of the Area $QT \times SP$; and the Area $QT \times SP$, or $\frac{1}{2}QT \times SP$ is in the subduplicate Ratio of the Parameter (L)And if the periodic Times be equal, the Areas of the Ellipses, are in a subduplicate Ratio of the

of the Ellipses, are in a subduplicate Ratio of the Parameters; and if the Parameters be equal, the Areas are proportional to the periodic Times; and if neither the Parameters nor the periodic Times be equal, then the Areas of the Ellipses are in a Ratio compounded of a subduplicate Ratio of the Parameters, and the simple Ratio of the periodic Times; therefore the periodic Times are in a Ratio compounded of the direct Ratio of the Areas, and the reciprocal subduplicate Ratio of the Parameters. Now the Areas of unequal Ellipses, are (Art. 105. Hayes No 4.) in a subduplicate Ratio of the Parameters, and the subduplicate Ratio of the Cubes of the transverse Axis jointly. Therefore the periodic Times are in a Ratio compounded of the subduplicate Ratio of the Parameters directly, the subduplicate Ratio of the Cubes of the transverse Axes directly, and the subduplicate Ratio of the Parameters inversely; that is, the periodic Times are in a subduplicate Ratio of the Cubes of the transverse Axes, and consequently the Squares of the periodic Times are proportional to the Cubes of the transverse Axes. Q. E. D.

COROLLARY.

The Squares of the periodic Times of Bodies revolving in Ellipses, are as the Cubes of their Distances from the (Focus of the Figure or) Centre of Attraction.

Rooks on this Subject of Astronomy of moreimmediate and necessary Use are such as these,

Gregory's Astronomy Lat. in Fol.
Flamstede's Doctrine of the Sphere at the end of Sir Jonas Moor's I Vol. of Mathem.

N. Mercator's Aftronomy, Lat. Land. 1676.8vo. Gassendus's Astronomy.

Bishop Ward's Astronomy

Tacquet's Astronomy, in his Opera Math.

Halley's Catalogue of the Southern Stars. Ox-

on in 4to.

An Essay concerning the Causes of the Celestial Motions, in the Leipsick Acts of Feb. 1689. by G. G. Leibnitz.

Kepleri Epitome Astronomia Copernicana.

Wing's Harmonicon Calefte. Street's Astronomia Carolina.

Fer. Horrocci Op. Postbuma.

Bayeri Uranometria.

Rullialdi Afronom. Philolaica. Higenii Syftem, Saturnianum,

Whiston's Prale iones Astronomica.

ATHENATORIUM, in Chymistry, is a thick Glass Cover (or Head) fixt to a Cucurbite in some Kinds of Sublimations

ATMOSPHERE. From what hath been shewn in Vol. 1. under this Word, it appears to be plainly impossible to account for so great a Rarefaction and Conderfation as is discovered to be in the Atmospherical Ait, without the Supposition of the Parricles of Matter being endued with a Rep. U.ng Vol. II.

or Levitating Force, whereby they mutually avoid one another, till they come within the Distance where the attractive Force begins. See Attraction. For as the Learned Mr. Halley observes, at the close of his Proposition about the Heights of the mercurial Cylinder, at any Elevation above the Earthy Surface. See Phil. Trans. N. 187. It seems a very bard Question, that the Texture or Composition of Parts can be capable of so great an Expansion and Contraction as is found to be in the Air, and can scarce be accounted for, from comparing it to Wooll,

or such like Spungy Bodies.
ATTAINTED, in the common Law is used particularly for fuch as are found guilty of some Crime or Offence, especially Felony or Trea on !
But a Man is also said to be attainted of Diffeism. West. 1. c. 24. and 36. and 3. Ed. 1. A Man is attainted two Ways; by Appearants or by Process. Attainder by Appearance, is either by Confession, Battel, or by Verdict. Attainder by Confession is when a Man pleads Guilty, and doth not put him-felf upon his Country for Tryal. A Man is attainted by Battel, when being appealed by another, and chusing the Combat rather than the Jury, he is vanquisht; and he is attainted by Verdict when he is found Guilty by a Jury.

ATTAINDER by Process, is otherwise called Attainder by Default or Vilary, and is where a Person slieth and is not found, after he hath been three Times publickly called in the Country, and

at last is Outlawed by Default.

ATTENDANT, in Law is used in this Sense, for one that oweth a Duty or Service to another; or after a fort dependeth upon another. v. gr. There is a Lord, Meine and Tenant. The Tenant holdeth of the Meine by a Penny, the Meine holdeth over by two Pence. The Meine releaseth to the Tenant like Printe he hash in the Lord and the Tenant all the Right he hath in the Land, and the Tenant dies: Then shall his Wife be endowed of the Land, and be Axendant to the Heir of the third part of the Penny, and the third part of the two Pence, for she shall be endued of the best part of the Possession of her Husband. They say also, that where the Wife is endowed by the Guardian she shall be Attendant to her Heir at his full Age

ATTITUDES, in Painting or Sculpture, are the proper Postures that the Figure should be placed in, so as agreeably to answer the Defign of the

Piece.

ATTRACTION. Sir Isaac Newton at the end of the Latin Edition of his excellent Book of Opticks, Qu. 22. shews that of those Bodies which are of the same Nature, Kind, and Virtue, by how much less any Body is than another, the greater is its attractive Force, in proportion to its Magnitude. Thus 'tis found that the Magnetick A traction is stronger in a small Loadstone, in proportion to its Weight, than in a larger: For the Particles of fmall Magnets, being nearer one to another, can more easily combine or join their Forces into one. Wherefore the Rays of Light, being the least of all Bodies that we know, must needs have the greatest and strongest attractive Force; and how very strongly those Particles do attract, may be collected by the following Calculation. The Attra-Elion of a Ray of Light, with regard to the Quantity of its Matter, is to the Gravity which any projected Body hath, in proportion to the Quantity of Matter in that Body :: in a Ratio compounded of the Velocity of a Ray of Light, to the Velocity of that projected Body, and of the Flex-

ure or Curvature of the Line which the Ray deferibes in the place of its Refraction, to the Curvature or Flexure of the Line which the faid projected Body describes. That is, supposing the Inclination of the Ray, to the refracting Surface be the fame with that of the Horizon. And from this Proposition he Calculates that the Attraction than the Force of Gravity on the Earth's Surface, according to the Quantity of matter in each; and supposing Light to come from the Sun thither in about seven or eight Minutes. And in the very roint of Contact of the Rays, their attracting Force may be yet much greater.

Now such a prodigious Force of Attraction in the Rays of Light cannot but have wonderful Effects in those Particles of Matter, with which they are joyned in the Composition of Bodies; and must cause that those Particles attract one another, and that they are moved variously among them-

Tis very probable therefore that the fmall Particles of Bodies have certain Virtues, Powers or Forces, by which at a small Distance they may act not only on the Rays of Light to Refract, Reflect or Inflect them, but also mutually on one another, in order to produe most of the Phanomena in Nature. 'Tis very well known that some Bodies do thus act on one another by the Attractions of Gravity, Magnetisim and Electricity: And these Examples shew what the Reason and Order of Nature is, and make it very probable that there may be yet some other Attractions, for Nature is very uniform and agreeable to it self.

Now the Attractions of Gravity, Magnetismand Electricity, extend themselves to considerable Distances, and therefore are commonly observed and taken notice of by every one. But 'tis very possible that there may be many others also, which are contain'd in such narrow Limits, and performed within such a little Distance, as yet to have escaped

all our Observations.

For when Salt of Tartar runs per deliquium or, dissolves into an Oil as the Chymists call it, 'tis very probable that it is occasion'd by some Attraction which is mutual between the Particles of the Salt, and those of Water, which rove up and down in the Air in the Form of Vapour; and the Reason why common Salt, Nitre and Vitriol, don't run thus per deliquium, is because they are without any fuch Attractions; and when Salt of Tartar hath drawn as much Water out of the Air as its Quantity will bear, it draws no more, because when it's Saturated, the Attraction is at end. It must be also from its attractive Force, that the Water thus imbibed by the Salt, cannot be separated from it in Distillation, but by a very violent Heat; whereas, Water will usually distill off with a very easy Hear, from other things. 'Tis much the same thing with Oil of Vitriol, which till it is Saturated with it, attrass the Moissure of the Air in very considerable Quantity, and afterwards parts with it with great Difficulty. And when Oyl of Vitriol and Water being mingled together in the same Vessel, grow so hor, as it is known they will do, it appears plainly by that Heat, that a very great Motion is excited in the Particles of the two Liquors; and from that Motion it appears that their Particles in mingling Coalesce with a great Force and Impetulioty, and consequently attrast or gravitate towards one another with an accelerated Motion. Thus

also when Aqua fortis, Spirit of Vitriol or Nitre, or any other corrofive Menstruum dissolves Filings of Iron or any other Metal with Heat and Ebullition; 'tis plain that the Acid Particles of the Menstruum attract and rush upon those of the Metal with a very great Force, enter into their Pores with violence, and disjoyn or separate the small Corpuscles of which the Metal is composed, one from another; tho' the Particles of the Acid Menstruum are drawn off at first when they are made by a moderate Heat, yet after their Union they with the Parts of the Metal, cannot be drawn off as yet by Distillation, but by a most intense and violent Heat.

When Spirit of Vitriol poured upon common Salt or Nitre, makes an Ebullition and Coalesces with the Salt; and when after this, if the Compost be distilled, a Spirit of Salt or Nitre will be drawn off much easier than without such a Mixture; it shews plainly that the Fixt Alkali of the Salt Attracts the Acid Spirit of the Vitriol much more strongly than it doth its own Spirit, and because it cannot detain them both, it parts with its own Spirit freely. When Oil of Vitriol is distill'd from an freely. When Oil of Vitriol is distill'd from an equal Weight of Nitre, and from both is drawn off a Compound Spirit of Nitre, and that Spirit is poured upon half its Weight of Oil of Cloves, of Caraway-Seed, or any ponderous Oil distill'd from vegetable or animal Bodies, or upon Oil of Turpentine, mix'd with a little Balfam of Sulphur to thicken it; when in any of these Mixtures an actual Flame will be produc'd, 'tis apparent that the Particles of the Spirit and Oil must rush towards one another with a strong accelerated Motion, and struggle and fight with a most violent Force and Impetus. 'Tis the same thing when that compound Spirit is poured upon well rectified Spirit of Wins, for a Flame will immediately arise on their Mixture. The Pulvis fulminans, as they call it, which is compos'd of Sulphur, Nitre and Salt of Tartar, goes off with a more quick and violent Explosion then even Gun-powder it self. The Acid Spirits of the Sulphur and the Nitre rushing together with such Violence, that all the Parts of the Powder are rarified, as it were, at once and all together.

Thus also common crude and impure Brimftone it self, if it be powder'd and mingled with an equal Weight of Filings of Iron or Steel, and with a little Water be made up into thick Paste, like Dough, the Sulphur will act so upon the Iron, that in five or fix Hours time, the Mass will grow so hot as not to bear handling, and at last will plainly burn and emit a Flame. Now from all these Experiments, and from the Consideration of the great Quantity of Sulphur that there is in the Earth, and of the great Heat of the inner Parts of it, from the hot Springs, the burning Volcanos, the Fire Damps and burning Exhalations that are found in the Bowels of the Earth; from the Considerations of Earthquakes, Whirlwinds, and the wonderful Convulsions that the Sea is sometimes put into; we may understand, That the Particles of Bodies, before at Rost (and 'tis the same thing also in all Fermentations, & (5)c.) may be and are pur into most violent Motions, by some Principle of very great Force and Activity, which yet doth not difcover it self till the Parts approach and come very near one another; but that they do then attract one another with great Force and Rapidity, and thereby produce their wonderful Effects.

Again, when Oil of Tartar per deliquium is poured upon the Solution of any Metal, there is a Precipitation of the Metalline Particles produc'd,

which all fall down to the Bottom of the Vessel; From whence it appears, That the Particles of the Liquor are more strongly attracted by those of the Oil of Tartar than by those of the Metal, and by that Attraction are precipitated down from the Liquor: So also when a Solution of Iron in Aqua Fortis will dissolve Cadmia, and precipitate its Iron; or when a Solution of Copper will dissolve Iron, and let gothe Copper (fee depart) &c. this seems to prove plainly, that the Acid Particles are more strongly attracted by those of the Metal that they dissolve, than by those of that which is let go. When we find that those Menal which is let go. struums which will dissolve one Kind of Metal or mix'd Body, won't touch another, it must be attributed to the Attraction that there is between the Particles in some Cases, and there being no such in the other. And in the general it is owing to this Principle, that Heat, according to Aristotle's Definition of it, doth congregate or gather together homogeneous Things, and separate those which are of a different Nature: After this he shews how on this Principle, and by the Help of Chymical Analyses, to come to the Knowledge of what Kind of Parts natural Bodies are composed.

The Reason why Drops of Water, or other li-

quid Body usually put on a spherical Form, he saith, is also from the mutual Attraction of their Parts; after the same Manner as the Earth and Seas make one round Body by the mutual Attracti-

on or Gravitati n of their Parts.

And because when Metals are dissolv'd in Acids, they attract but a small Portion of the Menstruum to them, therefore he concludes, that their Force of Attraction extends but a very little Way. And as in Algebra, when affirmative Quantities vanish and terminate, their negative begin: So in Me-chanicks, where Attrastion ceases to exert it self, a Kind of repelling Force should succeed; and that there is in Nature such a Force, seems to follow from the Reflection and Inflection of the Rays of Light; for in both these Cases, the Rays are repelled from Bodies without the immediate Contact of the reflecting or infletting Body. And the same Thing seems concludable from the Emission of Light; for a Ray of it, as soon as it is shaken out of the lucent Body by the vibrating Motion of its Parts, and is got without the Sphere of its Attraction, is propelled with a very great Degree of Velocity; and the same Force which in Reslection serves to repel the Ray, now serves to emit

The Production of Air and Vapours doth also shew, that there is a repelling Force; for those Particles which are forced out of the Bodies by Heat or Fermentation, as foon as ever they are out of the Sphere of the Attraction of these Bodies, do immediately recede from it, and from another with a great Force, and do avoid coming together again; so that sometimes they take up above a Million of Times the Space which they did before, when they were in the Form of a Dense Body, which is so very great a Contraction and Expansion as is hardly conceivable, if the Particles of the Air be only elaftical, ramose and coiled up one within another, like the Tendrels of Vines, or Springs of Watches, as some have imagin'd: Nor indeed, will any other Hypothesis account for this wonderful Phænomenon, but this of their being endu'd with a repelling Force, by which they mutually avoid one another, as well as the Bodies from whence they at first came.

ATTRIBUTIVE Justice: See Justice. AVERCORN, was anciently a referred Rent in Corn paid to Religious Houles by their Tenants or

Farmers.

AVOIR DU POIS, in French fignifies to be of just Weight; but in Law 'tis taken in two Senses, for a peculiar Kind of Weight of sixteen Ounces to the Pound, and thereby distinguish'd from Troy. Weight, whose Pound hath but twelve Ounces: And also such Merchandize and Goods as are weighed by this Weight, and not by Troy Weight, as Pitch, Tarr, Rosin, Wax, Flesh, Tallow, Cheese, Soap, Hemp, Flax, Coppper, Tin, Lead, Steel, Iron, &c. Mr. Ward saith, he found that I Pound Avoir du pois was exactly 14 Ounces, 11 Peny-Weights, 15 + Grains Troy: And he faith; he can find no Law for the Introduction of this Weight, nor at what Time it came into Uses which it feems to have done only by Custom.
See Weights in Vol. I.

AURELIA, is a Term used by the Natural Historians for the first apparent Change of the Eruca of any Insect: Tis the same with what

some Writers call Nympha.

AURISCALPIÚM' is an Instrument to clean

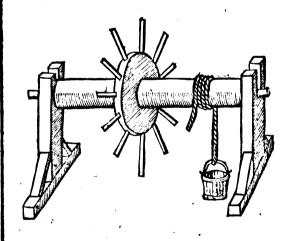
AURORA Borealis is a white Pyramidal Glade of Light, which Dr. Childry, Mr. Cassini and Mr. Derham have mentioned as appearing like the Tail of a Comet in the Northern Hemisphere of the fix'd Stars.

AUXILIUM ad filium Militem faciendum & ad filiam maritandam, was a Writ formerly directed to every County, where the King or other Lord had Tenants, to levy of them a reasonable Aid to-wards the knighting of his Son, and Marriage of his Daughter; but this is now utterly taken away by a Statute made 12 Car. 2. c. 24.

AXIS in Peritrochio. See its Desc

See its Description in

Vol. L



In this Instrument, and all such like, (as all Crane-wheels, Mill-wheels, &c. the Vis Matrix, which is to sustain or lift up any Weight, need only be to such Weight as the Perimeter of the Axis A B is to that of the Tympanum or Peritrochium C D; and then there will be an Aquilibrium.

From the Fabrick of the Engine, 'tis plain, that the Weight Wis at every Revolution of the Axis rais'd so much, as is the Girt of the Axis; and consequently the larger the Axis, the quicker rises the Weight (with a Proportionable Power) but yet the harder: and the less the Axis is, the slower rises the Weight, but the easier.

Whetefote

Wherefore if the Weight be to the Power, as the Perimeter of the Peritrochium is to the Perimeter of the Axis, then will the Velocity of the Power to that of the Weight, be as the Weight to the Power; and consequently the Moment of the Power will be equal to that of the Weight. Wherefore 'tis plain, that the greater the Perimeter or outermost Wall, the longer the Stick or Lever DC: Or on the other, the lesser the Diameter of the Axis, the easier will the same Force move the Weight assigned.

AYDE, in Law, is where a particular Proprietor is impleaded, and not being able to defend the Thing for which he is so impleaded, he prayeth syde of some better able: which is done two Ways, 1. In a Plea real, and Tenens petit auxilium de A B sine quo respondere non potest. 2. In a Plea personal, and then the Defendant, petit auxilium

ad manutenendum Exitum.

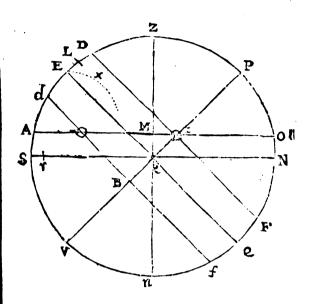
AYEL is a Writ which lies where the Grand-father (called by our common Lawyers Besayel, it should be Besayeul) was seized in his Demesne, as of Fee of any Lands and Tenements in Fee Simple, the Day that he died, and a Stranger abaseth and entereth the same Day, and dispossesseth the

ASIAMENTA, Easements, in Grants of Conveyance and Demise did include any Liberty of Passage, Hich-way, Water-course, or other customary Benefit for the Ease and Accommodation of the Owners or Inhabitants of any House, or the

Tenants of any Land. Kennet's Glossary.

AZIMUTH of the Sun. To find it-readily by projecting Part of the Analemma, having the Latitude of the Place, and the Sun's Declination and Altitude: With 60 of the Chords draw the Circle PEZ for the Solstitial Colure or Meridian of their Place, and cross it in the Center with the 2 Lines Z n and S N, at right Angles to another for the Azimuth of E and N, and for the Horizon of the Place. Set the Latitude from N to P, fo shall P be the Pole of the World: and fet it also from the Zenith in Z to E, and draw E CQ for the Equinoctial, draw also P U for its Axis. Then

to D, and from Q to F, if it be North Declination; or from E to d, and from Q to f, if it be South, and draw the respective Parallel to the Equinoctial DF, or df: Then set the Sun's Altitude from S to A, and from N to O, and draw



the Parallel to the Horizon, A O, where this Interfects, the Parallel of Declination will be the Reprcfentation of the Sun's Place, as at 1 in Summer, or @ 2 in Summer. Fit then the Sector to the Radius AM, and MO, or M o 1, or M o 2 thall be to that Radius, the Sine of the Sun's Azimuth from the East or West Southwards, according to the Time of either Before or Afternoon.

If no Sector be at Hand, you may measure the Azimuth on the Chords to the Radius of the Diagram thus; Set M A from the Center C to r in CS, on which Point r, as a Center, with the Extent MO 2 strike above the Arch x; for then a Ruler laid from C the Center, just to touch the Convexity of the Arch x, will cut the Limb in L, and then L S measur'd on the Chords, will from the Chords set the Sun's Declinitian from E I give you the Degrees of the Azimuth.



BAR

ABYLONISH Hours. The Babylonians, Persians, and Syrians, 500, accounted their 24 Hours of the natural Day to begin from Sun-rising, and to continue till the Sun tetting of the next Day. Wherefore Hours thus accounted, and thus put in (as is column) among the Furniture of Dials, are in Dialling called the Babylanish Hours.

BACK and Bottom Nails, are such as are made with flat Shanks that they may hold fast, and yet not open the Grain of the Wood. They are used for nailing Boards together for Coolers, for Gutters to fave Water under the Eaves of a House, or for any Vessel made with Planks or Boards, and

design'd to hold the Liquors.

BALDACHIN, in Architecture, is a Building in Form of a Canopy or Crown supported by Pillars, often serving for the Covering of an Altar. Some also call the Shell over a Door by this Name and pronounce it Baldaquin.

BALLISTERS, are a Row of small Pillars which support a Rail. They are sometimes called Bannisters, and are placed on Stairs, and in the Front of Galleries, Balconies, &c.

BANK, is a Carpenter's Term for a Piece of Firwood unflit from 4 to 10 Inches Square, and of

any Length.

BANNERET, was anciently a Knight made in the Field with the Ceremony of cutting off the Point of his Standard, and making it as it were a Banner. And this was accounted so Honourable a Knighthood, that they were allowed to display their Arms in the Field in the King's Presence as Barons do. They were next to Barons in Dignity. Henry VIIth made divers Bannerets upon the Cornish Rebellion, A.D. 1495: See Selden's Titles of Honour, Camden's Britannia, Sir Tho. Smith, Lib. de Rep. Angl. c. 18. BARBICAN, is a Term in Architecture taken

from the French, and signifies any Outwork be-

longing to a great Building.

BARCO-Longo, is a small, low, long, sharp built Vessel without a Deck, going with Oars and

Sails; much used in Spain.

BARGAIN and Sale, in Law, is a Contract made of Mannors, Lands, Tenements, Hereditaments, and other things, transferring the Property thereof from the Bargainer to the Bargainee. The Author of the new Terms of the Law faith, it ought to be for Money, &c. and that the Fee-simple passeth thereby, though it be not said in the Deed, To have and to hold, the Land to him and his Hoirs; and though there be no Livery & Seifm made by the Vender, so it be by Deed, indorsed, fealed, and enrolled either in the County where the Land lies, or within one of the Courts of Record at Westminster, and this within 6 Months after the Date of the Deed: According to 27 H.8. c. 16.

BARK, or Barque, is a Vessel with 3 Masts, viz. Main-mast, Fore-mast, and Mizen-mast, and carrying usually about 200 Tuns.

BAROMETER. In Phil. Tran. N. 292. there is a pretty Experiment of Mr. Hawksbee, to shew the Cause of the Descent of the Mercury in the Barometer in Storms, to be the collateral Pressure or Current of Wind on the Surface of the stagnant

Mercury in the Ciffern, which abates the Force of the Perpendicular Pressure, or the usual Gravity of the erect Column of Air, equal in Base to the Orisice of the Tube.

BAROMETER Portable, is one that can be fasely and conveniently carried about from Place to Place, without the Danger of spilling the Mercury out of the Cistern, or letting the Air get in at the Bottom of the Tube, or of the Mercury included in the Tube, breaking the Top of it off by the Motion it will be put into by being carried from one Place to another. You may prevent the two former Inconveniencies by tying fome gentle Leather fast over the Brim of the Cistern, which must be of Glass or close grained Wood; and must have a Neck or Hollow round the Outlide of the Brim to tie on the Cover of Leather. And the last may be remedied, by either a way to screw or squeeze the included Mercury quite up to the Top of the Tube, so that the Tubein its Carriage from Place to Place shall be always full; or else by pinching the Head of the Tube at about an Inch from the Top, so as to make it there have a very narrow Neck, not so big as a Straw: By which Means the Force of the Mercury striking against the Top, will be very much bridled, and there-fore the Tube secured from having its Top broken

BARON hath divers Significations: First, 'Tis used for a Degree of Nobility next to a Viscount. Some of our Historians say, that soon after the Conquest, all Barons came to Parliament, and sat as Peers in the upper House of course; but they being then very numerous, it grew an Order and a Custom, that none should come, but such as the King thought fit to Call by Writ, which Writ ran then, pro hac vice tantum. But this State of the Nobility being very precarious, and depending sole-ly on the Prince's Pleasure, they at length got a surer hold, and obtained of the King Letters Patents; and these were called Barons by Patent or Creation, whose Posterity are now Lords of Parliament. And Cowel saith, there are nevertheless Barons by Writ, as well as by Letters Patents; and that those are distinguished from these by having their own Sirnames annexed to the Title of Lord: whereas Barons by Patent are named by their Baronies. The Original of Barons by Writ, Cam-den refers to Henry 2. and Barons by Patent or Creation commenced in the Time of Rich 2. To these Segar (Norroy) adds a third Kind of Baron, which he calls Baron by Tenure; and fuch are the Lords the Bishops, who, by virtue of Baronies annexed to their Bishopricks, sit in the upper House and are called Lords Spiritual.

BARON is also an Officer; as Baron of the Exchequer, of which the Principal is called Lord Chief Baron, and three others in that Court are

his Assistants.

There are also Barons of the Cinque Ports, which are two Members of the House of Commons chofen at each Port, and at the two Ancient Towns of Winchelfea and Rye.

BARON is also used for the Husband in Relation to the Wife; which two in Law, are called

Baron and Fine.

The



The Chief Magistrates also of the City of London, before they had a Lord Mayor, were called

Ever fince the Reign of William the Conqueror, the Bishops hold their Temporaries per Baroniam; and by that are obliged to attend the King in Parliament.

Sir W. Temple, in his Essay on Heroick Virtue, says, that Baronies were originally the larger Shares of the Lands of conquer'd Countries, which the Northern Invaders (such as the Goths, & c.) used to divide among their Generals and Chief Commanders; as the smaller Shares divided amongst the Soldiers were called Feuda or Fees; and he guesses the Word Baron to be of Northern Original.

BASIL is the floping Edge of a Chiffel, or of the Iron of a Plane used in Joinery.

BATCHELOURS, i. e. Basse Chevaliers, were Anciently a lower or inferior Sort of Knights, as distinguished from Barons and Bannerets, which then were reckoned the Chief or Superior Knights. And now our lower Order of Knights which are inferior to Baronets, are called Knights Batche-lours. And so in our Universities, there is an Academical Degree of Batchelours, (who have the Title of Sir) and which is inferior to that of Masters and Doctors.

BATTEN is the Workmens Name for a scantling of wooden Stuff from two or four Inches broad, and about an Inch thick; the Length is pretty considerable, but undetermined as to Num-

bers

BEAD, in Architecture, is a Moulding which in the Corinthian and Roman Orders is cut and carved into short Embossements, which look like Beads born in Necklaces: And sometimes an

Aftragal is thus carved.

A Bead plain is sometimes set also on the Edge of each Fascia of an Architrane. Its Convexity is usually about a Quarter of a Circle, and differs from a *Boultine* only in not being fo large. Bead is often placed on the lining Board of a Door-Case, and on the upper Edges of skirting Boards.

BEAM, in any Building, is a Piece of Timber lying across it, and into which the Feet of the principal Rafters are framed. No Building hath less than two of these Beams, viz. one at each Head; and into these Beams the Girders of the Garret Floor are framed; and if it be a Timber Building, into them the *Teazle Tenons* of the Posts are also framed. These *Teazle Tennons* stand at right-Angles to those which are made on the Posts to go into the Raisons, and the Relish or Cheats of these Teazle Tennons stand up within an 1. Inch of the Top of the Raison; and then the Beam is cauked down (which is all one as Dove-tailing across) till the Cheeks of the Mortices in the Beam conjoin with those of the Teazle Tennon on the Pofts

BEARER, in Architecture, is a Post or Brick Wall, which is trimmed up between the two Ends of a Piece of Timber to shorten its bearing, or to prevent its bearing with the whole Weight at the Ends only

BEAUPLEADER is, in common Law, a Writ upon the Statute of Malridge for not fair Pleading ; and this lies where the Sheriff, or other Bay-lift in his Court, will take a Fine of the Party, Plaintiff or Defendant, for that he pleaded not fairly.

BEDMOULDING, in Architecture, is a Term used by the Workmen for those Members in a Cornish, which are placed below the Coronet or Crown; and now-a-days a Bedmoulding usually consists of these 4 Members, 1. an O-----G. 2. a List, 3. a large Boultine, and 4thly, under the Coronet another List.

BEDRIP, Bedrepe, was the Customary Service which inferior Tenants formerly paid to their Lords, in cutting down their Corn, or doing any

Work or Labour in the Field.

BENDS, in a Ship, are the same with the Wailes or Wales, which are the outmost Timbers of a Ship on which the Men fet their Feet in climbing up: They are reckoned from the Water the first, second, and third Bend or Wail. They help much to strengthen the Ship, and have the Beams Knees and Foot hooks bolted into them.

BENEPED: They say at Sea a Ship is benepped, when it being a Nepe-Tide, the Water doth not flow high enough to bring her off from the Ground,

out of the Dock, over the Bar, &c.
BENEFICES. All Church Preferments, except Bishopricks, are by some called Benefices: Vid. Godolph. c. 18. And all Benefices are by the Canonists sometimes called Dignities. But we now apply the Word Dignity to Bishopricks, Deaneries and Archdeaconries, and as some will have it to Prebends.

BENEFICES are either Parsonages, Vicarages,

Parsonages, are Churches endowed with Glebe, Manse, Tythes, and all other Duties payable by the Parishioners.

Vicarages, are Benefices which were created for the Maintenance of such Clergymen as served in Churches, where some or all the Tythes were impropriated. At first the Vicar was a meer Curate; but by Degrees some of them got a settled Maintenance distinct from the Impropriator, which consisted of a Manse and Glebe, and some Portions of Tythes usually; but in some Places only a Pension from the Impropriator. And these are what the Law calls perpetual Vicars, or Vicars endowed.

Donatives, are such as being exempt from the

lurisdiction of the Ordinary are visitable only of the King or other Secular Patron, who puts his Clerk into Possession of the Benefice, by Virtue of an Instrument under Hand and Seal, without any Inflitution or Induction, and without any Examina-tion by the Ordinary. But the Clerk is obliged to subscribe the *Declarations*, and to take the Oaths enjoined by 14. c. 2. and 1. W. and M. the former before the Bishop in whose Diocess the Donative lies, and the latter before the Patron, faith Watfon. And if it be a Benefice with Cure, he is also bound to subscribe the 39 Articles before the Bishop, to read the Common-Prayer, and to make the same Declaration as other Incumbents do.

BENEFICIO primo Ecclesiastico habendo, is z. Writ drected from the Queen to the Chancellor or Lord Keeper, to bestow the Benefit that first shall fall in the Queen's Gift, above or under such Value, on this or that particular Man.

BENÉVOLENCE is used both in our Statutes

and Chronicles, for a voluntary Gratuity given by

the Subjects to the Sovereign.

BESANTINE was a Piece of Money coined by the Western Emperors at Byzantium or Constantinople, and was of two Sorts, Gold and Silver, formerly both Current in England: The Silver Bejantine was the Value of two Shillings, and the Gold



was of the Weight of a Ducket, as Chaucer seems

Kennek's Glossary. to represent.

BENEFICIUM Cedendarum Astionum, is the Right which one Surety hath who is fued for the whole Debt, to force the Creditor by Exception to assign over his Assign against the rest of the Sureties, or else he shall not force that one to pay the Debt.

BENEFICIUM Divisionis, in the Civil Law, is a Right by which the Creditor shall be forced, by way of Exception, to fue each Surety for their Share and Proportion, especially when the rest of the Sureties are under the Jurisdiction of the same

Judge, and able to pay.

BENEFICIUM Ordinis sive Excussionis, in the Civil Law, is a Right by which the Surety can by way of Exception force the Creditor to sue the principal Debtor, before he shall recover against him as the Surety, except the Surety was given judicially in a Cause depending.

BIRDS, are either Land-fowl or Water-fowl: Of Land fowl, some have crooked Beaks and Talons; and of these some are Carniverous and Rapacious, being call'd Birds of Prey; some Frugiverous, and these are called by the general Name of Parrots. Of Birds of Prey some are Diurnal, preying in the Day Time; and of these they reckon a greater and lesser Sort: The greater are either of a more bold and generous Nature, as the Eagle Kind; or of a more cowardly and fluggish, as the Vulture: The lesser Diurnal Birds of Prey, in Latin are called Accipitres, the Hawk Kind; and these are either of a more bold and generous Nature, and are wont to be reclaimed and manned for fowling, and are called Hawks; which our Falconers distinguish into Long-winged, as the Falcon, Lanner, Esc. whose Wings reach almost as far as the End of their Train; and short-winged, as the Goshawk and Sparrow Hawk, whose Wings, when closed, fall much thort of the End of their Trains. Those of the Hawk Kind which are of a Nature more cowardly and fluggish, or else indocile, are neglected by our Fakoners, and so live at large; and of these also there is a greater Sort, as the Buzzard Kind, and a lesser, as the Butcher-Bird or Shrike (about as big as a Black-bird, and found in England). The Bird of Paradife, which is exotick.

Of Birds of Prey with crooked Beak and Talons, some are Nocturnal, as the Owl kind, which fly and prey by Night; and these are either horned or eared, as the Eagle-Owl and Horn-Owl, &c. or without Horns, as the Brown Owl, Grey-Owl, &c.

There is a fort of Land-Birds with crooked Beak and Talons which is called Frugiverous, because though they do sometime eat Flesh, and so are of the Carnivorous and Rapacious Kind, yet they eat Fruits too; and these are known by the general Name of Parrots, and are distinguished into three Sorts according to their bigness, the greatest Size being called Maccaws; the middle fized, and most common, Parrots and Popinjays; and the least fort Parrakeets; and all this Kind make use of their Beak in climbing, and move the upper

Land-Birds that have their Bill and Claws more Arait, are distinguished into three Sizes. The greatest Kind are such as by reason of the Bulk of their Bodies, and smallness of their Wings cannot fly at all; these are Exotick Birds of a singular Nature, such as the Offrich, the Coffinary, and the Dodo. The middle sized Kind are divided by their Bills into such as have large, thick, strong, and

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long ones; some of which feed promiscuously on Fleth, Insects, and Fruits, as the Crow Kind, which are wholly black; and the Pie Kind, which are party coloured: Some feed on Fish only, as the King's-fisher; and some on Insects only, as the Wood-pecker. And into such as have a smaller and a shorter Bill, whose Flesh is either white, as the Poultry Kind; or blackish, as the Pigeon and Thrush Kind. The least siz'd Kind of Land-Birds with straight Bills and Claws, are called small Birds; and these are of two kinds, viz. soft beaked, which have slender, straight, and pretty longish Bills most of them, and feed chiefly upon Infects; or bard beaked, which have thick and hard Bills, and feed mostly on Seeds,

Water fowl, are either such as frequent Waters and watry Places to feek their Food; and these are all cloven-footed, and generally havelong Legs, and those naked or bare of Feathers for a good way above the Knees, that they may the more conveniently wade in Waters. Of these they reckon two Kinds; a greater, as the Crane, Jabiru, &c. and a lesfer which are either Pisciporous, feeding on Fish, as the Horon, Spoon-bill, Stork, &c. or Mulfuckers and Infectivorous: Of which some have very long Bills, which are sometimes crooked, as in the Curlew and Whimbrell; and sometimes straight, as in the Woodcock and Godwitt. Others have middle siz'd Bills, as the Sea-pie and Red Ibank, &c. and a third fort have short Bills, as the Lapwing and Ploner. Those are reckoned short Bills which exceed not an Inch and $\frac{1}{2}$; middle fiz'd are between two Inches $\frac{1}{3}$ and $\frac{1}{2}$; and long Bills above two Inches $\frac{1}{2}$

There is another Kind of Water-fowl which swim in the Water; some of which, as the Moor-hen and Coot, &c. are cloven fucted, but most are whole footed: And of these some few havevery long Legs, as the Flammant, the Avosetta, and Corrira, (see Willoughby, Part 2. & 2) but mostly they are /hort leg'd: Of which some few have but three Toes on each Foot, as the Penguin, Razor-bill, &cc. but generally they have four Toes on each Foot; and these either all connected together by intervening Membranes, as in the Pelican, Soland Goofe, &c. or more usually with the back Toe loofe: And this Kind are either narrow bill'd, or broad bill'd; those with narrow Bills have them either blunt and hooked at the Tip, of which fort some are ferrate, as in the Diver-kind, and some not toothed, as in the Puffin; or sharp pointed or straighter, of which fort some have long Wings, as the Gull Kind; and some shorter, as those Diving Birds called Donckers. Those with broad Bills may be divided into the Goofe Kind, which are larger, and the Duck Kind which are smaller; and these latter into She Ducks, or River or Plash Ducks. Most Water-Fowls have a fhort Tail; and none of this Kind have their Feet disposed like Parrots and Woodpeckers, that have two Toes forward and two backward, none having more than one back Toe, and some none at all.

BINDING Joysts, in Architecture, are those Joysts in any Floor into which the Trimmers of the Stair-Cases and Chimney-Ways are framed; and these should be stronger than common

Joysts.

BISHOP. The whole Process of the Creation of a Bithop, according to the English Law, is thus. On the Vacancy of any See, the Dean and Chapter are to certify the King thereof in Chancery, and to request his Leave to chuse another Bishop. The King, when he pleases, sends his Conge de Estires

Estire, or Leave to elect to the Dean and Chapter, nominating the Perion whom he thinks fit to have The Dean and Chapter are obliged within twenty Days after the Receipt of this Conge de Estire to make the Election, which being accepted by the Ferson elected, is certified both to the King and the Archbishop of the Province. On this the King grants his Royal Assent under the Great Seal, directed to the Archbishop, together with a Mandate to Confirm and Confecrate him. The Archbithop gives a Commission to his Vicar General to proceed to Confirmation, which is a long formal Process, of which the most observable Parts are two, viz. a Citation of all such as have any Objections against the Rishop Elect, to appear before them and offer them; and then a Deduction of all that has past in relation to the Election and the Royal Assent; the Particulars whereof are exhibited by the Proctor of the Dean and Chapter to the Vicar General. After this the Oaths of Supremacy, Simony, and Canonical Obedience are taken by the Bithop Elest; on which Sentence is read, and subscribed by the Vicar General, whereby the Election is ratified and decreed to be good. Next to this follows the Confectation, which is performed by the Archbishop and two other Bishops: Then the Archbishop sends a Mandate to his own Archdeacon, to install the Bishop in that Cathedral Church which belongs to his See; and this is oftnest done by Proxy. And the publick Notary there present, records the whole Process in an Authentick Instrument to be kept to Posterity; and after this the new Bishop is introduced to the King to do Homage. On his Confecration the Bishop hath a Right to his Temporaltics, but he cannot sue for them till his Consecration be certified by the Archbithop; but the King may grant the Bithop his Temporalties immediately after his Confirmation. By his Confirmation he is instated in the Jurisdiction of his Diocese, so as to excommunicate and certify it; and therefore the Power of the Guardian of the Spiritualties ceases from that Time forward. Clergyman's Vade Mecum.

BISSEXTILE. To prevent all Ambiguity which may arise on the Account of the Intercalation of a Day every fourth Year, 'tis appointed by the Statute de Anno Bissextili, 21. H. 3. that the Day increasing in the Leap-Year, and that next before,

shall be accounted but as one Day.

BLACKNESS. The Incomparable Sir Iface Newton in his Opticks, shews, That for the Production of Black Colours, the Corpuscles must be Less than any of those which exhibit other Colours, because at greater Sizes of the component Partieles, there is too much Light reflected to constitute this Colour; but if they be a little less than is requisite to reflect the White and very faint Blue of the first Order: (Vid. Book 2. Obj. 4.17, and 18.) they will reflect so little Light as to appear intensely Bluck, and yet may perhaps reflect it variously to and fro within them so long, till it happen to be stiffed and lost: by which means they will appear Black in all Positions of the Eye without any Transparency.

And from hence it appears why Fire, and that yet more subtle Dissolver Patrefaction, by dividing the Particles of Substances, turn them Black: Why small Quantities of black Substances impart their Colour very freely and intenfely to other Substances to which they are applied; the minute Particles of these, by reason of their very great Number, easily over spreading the gross Particles | Glossary.

of others. Hence also it appears, why Glass ground very elaborately with Sand on a Copper: Plate, till it beswell polithed, makes the Sand, together with what by rubbing is worn off from the Glass and Copper, become very black: And why black Substances do soonest of all others become hot in the Sun's Light, and burn; (which Effect may proceed partly from the Multitude of Refractions in a little Room, and partly from the easy Commotions of so very small Particles:) And also why Blacks are usually a little inclined to a bluish Colour; for that they are so, may be seen by illuminating white Paper by Light reflected from black Substances, where the Paper will usually appear of a bluish White; and the Reason is, that Black borders on the obscure Blue of the first Order of Colours describ'd in the above-mention'd 18th Obfervation, and therefore reflects more Rays of that Colour than of any other.

Tis necessary also to the Production of Blackness in any Bodies, that the Rays be stopt, retain'd, and lost in them; and these conceive Heat (by means of a burning Glass, &c.) more easily than other Bodies, because the Light which falls upon them is not reslected outwards, but enters the Bodies, and is often reflected and refracted in them

till it be stifled and lost.

BLOOD-RED Heat, is the last Degree of Heat given by Smiths to their Iron in the Forge, and is used only when Iron hath already its Form and Size, but wants a little Hammering to smooth it; and that is done with the Face of the Hand-Hammer with light flat Blows.

BLOOM, in the Iron Works, is a four-square Miss of Iron about two Foot long, brought from a Loop into that Form at the Fintry, and under

the Hammer: See Iron.

BLOWING Houses, in the Tin Miner's Language are the Furnaces where the Tin Ore (after it hath passed the Stamping Mill, and is throughly washed and separated from the Parts not Metalline, which they call the Causalty; and after it hath been again dry, and hath passed the Cruzing Mill) is melted and then cast.

BOMBARDEERS are Men employ'd to fire Bombs or Shells out of Mortars. They drive the Fusee, fix the Shell, load and fire. They work also with the Fire-workers on all sorts of Fire-

BOMB-KETCH is a small Vessel built and strengthned with large Beams for the use of Mortars at Sea.

BONNY, the Miner's Term for a distinct Bed of Ore that communicates with no Vein. See

Squat and Tin.

BORDAGE and Board-half-penny is a Fee or Duty paid in Markets and Fairs for Boards and

Tables, Booths and Standings.

BORDARII are often mention'd in the Doomsday Book, and were distinct from the Servi and Villany, and seems to have been of a less Servile Condition: For these had a Bord, i. e. a Cottage with a small Parcel of Land allowed them, on Condition they should supply the Lord with Poultry and Eggs, 650. Hence, BORDLODE was the Farm or Quantity of Food

which they paid by this Tenure: And the small

Estates so held, called

BORDI.ANDS, which therefore are such Demeasines as Lords kept in their Hands, for the Maintenance of the Board or Table. Kennet's

BOTANY,

B()TANY or Botanicks. Books on this Subject; Mr. Ray's Historia Plantar. 2 Vol. Fol. His Synopsis Stirpium Anglican. in 8vo. Basis Botanica. Auth. D. Christ. Ludovico Welschio, Lips. 1697. 12°. Morison's Praludia Botanica, Lond. 1669. His Universal Herbal. Dr. Plukenet's Phytographia, Tournesort's Method of Plants, 2 Vol. 4to. both in French and Latin.

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Jac. Breyneit Exotic. & minus Cognitar. Plantar. Centuria.

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2 Vol. 4to.

Hortus Indicus Malabaricus.

1. Boccone Icones & Descriptiones Plantar. Italia Gallia, &c.

BOTTOMRY is borrowing or lending Money on the Credit of a Ship or Vessel's safe Voyage.

BOULTINE in Architecture is the Workmens Term for a Convex Moulding, whose Convexity is just 4 of a Circle: Tis plac'd next below the Plints, in the Tuscan and Doric Capital.

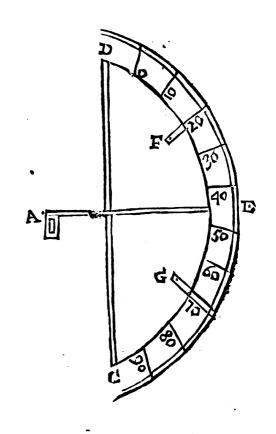
BOW is an Instrument which hath been sometimes used at Sea, consisting of only one large Arch of 90 Degrees, well and truly graduated, Three Vanes, and a Shank or Staff, as you see in

the Figure annexed:

Where DEC is the Arch, AE the Staff or Shank passing the Arch at 45 Degrees inmost, but in some in 50° or 55°. F is the Shade Vane, G the Sight Vane, and AB the Horizon Vane.

To take the Sun's Altitude by it.

By the Handle C hold the Bow upright, and move the Sight Vane G up and down, still looking through the Sight till you see the Shade of the



upper Part of the Shade Vane upon the Slit of the Horizon Vane; and that at the same Time you see also the Horizon through the Slit of the Horizon Vane: In doing of which, if you see the Sky and not the Horizon, then draw the Sight Vane a little lower down towards C, but if you see the Sea and not the Horizon, then slide it a little upwards.

If it be the Meridian Altitude that is to be obferved, you must wait and make Observation as
oft as you think sit, till at last you begin to see
the Sea instead of the Horizon. Then desist; and
the Differences between the Degrees and Minutes
cut by the Sight Vane, and those cut by the upper
Edge of the Shade Vane, is the Distance of the
Sun's upper Limb from the Horizon, from which
if you substract 16 Minutes, which is the Sun's
Semi-diameter, the Remainder will be the Distance of the Sun's Centre from the Horizon, allowing for the Refraction: And you need not
substract above 8 or 10 instead of 16 Minutes for
the Sun's Semi-diameter, when a Ship-board, since
you must allow for the Height of your Eye above
the Level of the Water.

To observe the Height of a Star.

Place the Sight Vane at A, and the Horizon Vane at G, and looking through the Sight Vane at A, move the Vane F higher or lower, till you can see the Star at the Horizon, through the Horizon Vane at G: So shall the Degrees and Minutes between the two Vanes F and G be the Altitude of the Star fought.

To take the Distance between two Stars.

Place the Sight Vane at A, and the Horizon Vane at G, as in the last Practice, and look through the Vane at A, moving the Vane F still to and fro, till you can see the one Star through the Vane G, and the other by the Vane F, for then will the Distance between those 2 Vanes F and G, be the Distance in Degrees and Minutes of the 2 Stars requered.

BOWGE, or rather Bouch, of Court, was formerly an Allowance of Diet or Belly, Provision, from the King or Superior Lords to their Knights, Esquires and other Retinue, that attended them in

any Expedition. Kennet's Glossary.
BOWLING BRIDLES in a Ship, are the Ropes by which the Bow-lines are fastned to the Leech of the Sail.

BOW-SPRIT-LADDERS, are Ladders in a Ship made fast at the Beak Head over the Bowsprit, to get upon it when there is Occasion.

BRACE in Architecture, is a Piece of Timber framed in with Bevil Joynts, and is used to keep, the Building from swerving either Way: When a Brace is framed into the Kinglesses or principal

Rafters, 'tis called by some a Strut.

BRACKETS in Gunnery are the Cheeks of the Carriage of a Mortar: They are made of strong Planks of Wood, of near a Semi-circular Form, and bound round with thick Iron Plates; they are fix'd to the Bed by four Bolts, which are called Bed bolts; they rife up on each Side of the Mortar, and ferve to keep her at an Elevation, by the Means of some strong Iron Bolts (called Bracket-bolts) which go through these Cheeks or Brackets.

BRADS, are Nails used in Building, having no spreading Heads as other Nails have: Of these fome are called foyners Brads, and are for hard Wainscot; others Batten Brads, and are for soft Wainscot; aud some Bill Brads or Quarter Heads, which are us'd when a Floor is laid in haft, or for shallow Joysts which are Subject to warp.

BRAKE in a Ship, is the Term for the Handle

of a Pump.

BRASS is a Metal made out of a Mixture of Copper and Lapis Calaminaris (which is usually called Calamine). This Stone is dug out of several Mines in the West of England (as about Mendipp, &c.) about 20 Foot deep. It is burnt or calcined in an Oven or Kiln made red hot, then ground to Powder, and sifted as fine as Flour; then mix'd with ground Charcoal, because the Calamine is apt to be clammy, to clod, and so is not cassly incorporable. Then they put about 7 st of Calamine into a melting Pot, holding about a Galland and management of the case of the c lon, and uppermost about 5 th of Copper. The Calamine must be mix'd with as many Coals as will fill the Pot. This is let down with Tongs into a wind Furnace 8 Foot deep, and remains there 11 Hours; for they cast not off above twice in 24 Hours. One Furnace holds 8 Pots. After melting

it is cast into Plates or Lumps. 45 th of Coude Calamine produces 30 lb burnt or calcined. They use Brass Sbruff sometimes instead of so much Copper; but that cannot always be procured in Quantities, being only a Collection of Pieces of old Brass.

The best Brass Guns are made of malleable Metal, and cannot be made of pure Copper or Brass; but it is necessary to put in courser Metals to make it run close and sounder, such as Lead and Pot-metal. Bell-metal being Copper and Tin, and Pot-metal Copper and Lead. About 20 tt of Lead is usually put into 100 to of Pot-Metal, but about 6 it is sufficient to put into a 100 to of Gun Metal.

The Calamine Stones were hereto ore fetch'd from Poland, but are now exported from us by the Dutch.

The Manusacture of Brass was privately kept in Germany for many hundreds of Years, wherein many thousands are employ'd, and all were maintain'd, some having thereby rais'd themselves

to great Estates. Phil. Trans. N. 200 and 200. BRAZING is a Kind of soldering of Iron, when the Work is so thin that it will not bear Welding, they lay small Pieces of Brass on the Places that are to be brazed, and strew a little Powder of Glass upon it to make the Brass run, and give it an Heat in the Forge till they find that the Brass is run, and then they take it out and let it cool.

BREASTS, in Women and other Females, are of a Substance confisting of a great Number of oval Glands, lying in a great Quantity of Fat: Their excretory Ducts approach the Nipple, join and unite together, till at last they form seven, eight, or more small Pipes call'd Tubuli Lastiferi, which have seven cross Canals, by which they communicate with one another, that if any of them be stopp'd, the Milk which was brought to it might not stagnate, but pass through by the other Pipes, which all terminate in the Extremity of the Nipple.

The Nipple is a spongeous Substance, made of two Orders of Fibres: the smallest make a fine Net-work within the largest Spaces of the Network of the bigger Fibres. Through it pass the Tubuli Lastiferi, which grow smaller and smaller to their Extremities, that the Milk might not run out, but when the Breasts are full, or upon Suction; It has an exquisite Sense, and a small Erection

when it is handled.

The Arteries and Veins of the Breasts are Branches of the Subclavian and Intercostal. They have Nerves from the Vertebral Pairs, and from the fixth Pair of the Brain.

The Use of the Breasts is to separate the Milk for the Nourishment of the Fatus. The Arteries which terminate in the Glands, which compose the Substance of the Breasts, bring the Blood pregnate with a Child which has received its last Perfection by its Circulation through the Lungs; this Chyle being separated by the Glands of the Breasts, runs through the Tabuli Lastiferi upon the Suction of the Child.

The Breasts in Men are very small; they are chiefly for Ornament. I have seen some Men

who have had milk in them. Keil.

BREDEWITE was anciently a Fine, Penalty or Amercement in Default in the due Assize of Bread: And K. Henry Il. granted, among other Things, to the Tenants of the Honour of Walling-

ford, Oxon, That they should be Quieti de Brede-

BREST is a Term in Architecture, used by some for that Member or Column which is called the

Thorus or Tore.

BREST Summers, in a Timber Building, are the Pieces in the outward Parts of any Building, and in the middle Floors, (not in the Garret, nor in the Ground Floor) into which the Girders are

framed.

BRICKS. The several Kinds of Bricks used in Architecture are these: 1. Compass, Bricks, which are of a Circular Form, and are used in steyning of Wells. 2. Concave or hollow Bricks, being on one Side flat like a common Brick, but on the other hallowed: They are used to convey Water. 3. Cogging Bricks are used to make the indented Work under the Coping of Walls built of great Bricks. 4. Coping Bricks, which are formed on Purpose for coping of Walls. 5. Dutch or Flemish Bricks, used to pave Yards and Stables, and for Soap-Boylers Fatts, and for Cisterns. 6. Clinkers are such Bricks which are glazed by the Heat of the Fire in the making. 7. Feather-edg'd Bricks are like the common Statute Bricks, only they are thinner on one Edge than on the other, and are used to pen up the Brick Pannels in Timber Buildings. 8. Didoron, was a Brick used by the Ancients of 1 ½ Foot, or two Spans long, (whence the Name) and one Foot broad. This was the smallest Sort of Bricks used by the Greeks in their private Houses, for there was a large Sort in Use in their publick Edifices, which they called, 9. Pentadoron, which was 3 Foot 9 Inches long, and 1 Foot broad. 10. Samel or Sandal Bricks, are such as lie outmost in a Kiln or Clamp, and consequently are soft and useless, as not being thoroughly burnt. 11. Great Bricks are 12 Inches long, 6 broad, and 3 thick. The Weight of one about of them 15000 Pound. Their Use is to build Fence Walls, together with, 12. Pilaster or Buttress Bricks, which are of the same Dimensions with them, only they have a Norch at one End of half the Breadth of the Brick. Their Use is to bind the Work at the Pilasters of Fence Walls, which are built of great Bricks. 13. Paving Bricks or Tiles, these are of several Sizes in seve-13. Paving ral Counties or Places. 14. Place Bricks are fuch as are made in a Place made on Purpose for them near the Building they are to be used in. Statute or small common Bricks: These ought to be 9 Inches long, 4½ broad, and 2½ thick; 100 of these usually usighs about 550 Pound, and consequently 1000, 5500 Pound, and about 407 in Number are a Tun Weight. These are commonly used in paving of Cellars, Hearths, Sinks, \$50. 30 or 32, if true Measure, will pave a Yard Square, and 330 will pave a Square of 100 Foot, laid in 12 but if laid edge-wise, they must be double in Number.

Bricks are burnt either in a Kiln or a Clamp: Those that are burnt in a Kiln, are first set or placed in it, and then the Kiln being covered with Pieces of Bricks, they first put in some great or cord Wood to dry the Ware with a gentle Fire, which is continued till the Ware is pretty dry which they know by the Colour of the Smoaks turning from a whitish dark to a black transparent Smoak: then they put in no more Wood, but proceed to burn the Bricks with Bush, Rurze Straw, Heath, Brake or Fern Faggots, having sirst

damm'd up the Mouth of the Kiln with their Shinlog as they call it (which is Pieces of Bricks piled up one on another, and then closed up with wet Brick Earth instead of Mortar) only leaving just Room to put in a Faggot. They then continue to put in more and more Faggots, till they make the Kiln and its Arches look white with Heat, and that the Fire begins to appear at the Top of the Kiln. Then they begin to slacken the Fire for about half an Hour or an Hour, and so let all cool by Degrees. The Ware will be burnit usually in about 48 Hours. But now-a-days about London, they usually burn Bricks in Clamps, which are built of the Bricks to be burnt, fomething after the Manner of the Arches in Kilns, viz. with a Vacancy between each Brick's Breadth, &c. for the Fire to play through; but with this Duference that instead of arching, they truss or span it over, by making the Bricks project one over another on both Sides the Place for the Wood and Coals to lie in, till they meet, and are bonded by the Bricks, at the Top which closes all up. The Place for the Fuel is carried up strait on both Sides, till about 3 Foot high, then they fill it almost with Wood, and over that lay a Covering of Sca-coal; and then they over-span the Arch: But they strew Sea-coal also over at the Clamp, betwixt all the Rows of Bricks, then they fire the Wood, and then the Coal, and when all is burnt out, they conclude the Bricks burnt enough. Builder's Dicti-

BRIDGE of Communication, is a Bridge made over a River, by which two Armies or Forts which are separated by that River, have a free Commu-

nication one with another.

BRIGADE Major, is an Officer appointed by the Brigadeer to affift him in the Management and Ordering of his Brigade, and he there acts as a Major General does in an Army.

BRINGERS up, in a Battalion, are the whole last Rank of Men in it, or the last Man in every

File.

BUDDLE, is the Word in the Works for dreffing Tin Ore, for a Tye of Boards or Slate about 4
Foot deep, 6 long, and 3 over, wherein stands a
Man with a Shovel in his Hand (called a Trambling
Shovel, as this is also called the Trambling Buddle)
bare-footed, to cast up the Ore about an Inch
thick, on a long square Board placed just before
him, and as high as his Middle, which is called the
Buddle Board: There are several of these Buddles
in which the Ore is still trambled over again and
again, till it be at last so well wash'd, as to become
what they call black Tin, which is compleatly ready for the blowing House.

BUILDING. There are some good Rules and

Directions about Building which are given in Moxon's Mechanick Exercises, and other Books of that kind, which 'tis very proper every Gentleman shou'd be acquained with, that he may not be cheated or imposed upon by his Workmen: And those are such as these; First with Respect to the Foundation, Care ought to be taken, that after the Cellars are dug, if there be any, or if none, after the Trenches are dug, in which the Walls are to stand, to try all the Foundations either by a Crow, a Rammer, or which is best, with a Borer, such as Well Diggers, Miners, &c. use, whether they are throughly sound, and are sit to bear the Weight

that is to be laid upon them. If the Foundation

be not very loose, it may be cured by ramming in

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great Stones with an heavy Rammer, the Stones being placed close together, about a Foot wider on each Side of the Trench than the Breadth of the Wall is to be; but if it be so loose that this will not do, you must get good Pieces of Oak, whose Length must be the Breadth of the Trench, or about 2 Foot longer than the Breadth of the Wall, and these should be laid a cross the Foundation, about a Foot asunder, and being well ramm'd down, lay long Planks upon them, which must be pinn'd down to them: and if this be not sufficient, Piles of a much greater Length must be driven down so deep, till they touch good Ground, and then strong Planks pinn'd down to their Tops, EGC. If the Foundation be faulty only in Patches, there may Arches be turned over the insufficient Places, which will take off the Weight from bearing upon them. And sometimes it may be proper to use inverted Arches.

The Foundation being well secured, the next Care is to see that the Walls be all made of the same Thickness as they are in the Design; for which Purpose there should be Numbers to ex-

press their Thickness in the Draught.

The Walls also must be well wrought aud bounded as they call it: In order to which the Mortar must be well made of good well burnt Lime and sharp Sand; the usual Proportion is a Load of Sand of 36 Bushels to a Hundred of Lime of 25 Bushels, or a Bushel of Lime to one and an half of Sand; but when the Sand is not very sharp, there must be a greater Proportion of it to the Lime.

In flacking of Lime, Care should be taken, that though it be wetted every where a little, yet it be not over-wetted; and every Layer or Bed of Lime should be covered with Sand to keep in the Steam, that it may not sly away, but be forced to mix it self with the Sand; and this will make the Mortar much stronger. The Mortar also must be well beaten with a Beater three or four times over before it is used, that the Knots of the Lime may be all broken, and the Lime and Sand mingled very well together: And it will be still better, if after the first beating, it be let lie three or four Days, audthen let it be beat well over again when 'tis used.

If the Bricks are laid in very hot dry Weather, and it be some small Piece of Work which you would have very strong, it will be worth while to dip every Brick as 'tis laid in a Pan of Water; and it will be of good Use in great Work to throw Water on the Walls, after the Bricks are laid, by a Wirtenburgh Syphon, or some such Way. And the Walls also should be covered in Summer Time, to keep them from drying too hastily, as well as in Winter Time from Rain, Snow, or Frost, which last is a great Enemy to all Kinds of Mortar, especially to that which hath been newly wetted.

Let the Workmen also in doing up the Walls, not carry any one above three Foot high, before the next adjoining Wall is brought up equal with it, that so they may join together, and make good

Bond in the Work.

In the middle of Walls, Care should be taken that Joint is not laid on Joint, at least as seldom as may be, that good Bond may be made there as well as on the Outsides.

When Timber is laid on Brick-Work, as Torfels for Mantle Trees, or Lintels for Windows, Templets for Girders, Egc. let it be always laid in Loan, for that is a great Preserver of Timber, which Mortar will eat and corrode: The same thing should be done with the Ends of Joists and

Girders, some Workmen dawb their End with Pirch, to preserve them from the Mortar.

BULL, perhaps from Brain Confilium, is an Infrument so called, granted by the Bishop of Rome, and sealed with a Seal of Lead, containing in it his Arbitrary Decrees, Command, or other Astions. By the Statute of 28. H.8. c. 16. it was enacted, that all Bulls, Briefs, Faculties, and Dispensations, of whatever Name or Nature, had or obtained from Rome, should be woid. Matt. Paris, A. D.: 1237. describes the Seal of the Bull to be a Cross in the middle, with St. Paul on the Righr, and St. Peter on the lest Hand.

BURNING Glasses. In Philos. Transat. N. 40. there is an Account of one S. Setalla at Millan who was causing a burning Glass to be made of 7 Foot in Diameter, and he pretends to make it burn at

the Distance of 50 Palm or 33 Foot.

And in N. 188. there is mention of a burning Concave which was made at Lusace in Germany of near 3 Leipsick Ells in Diameter, which exceeds the great one at Paris by 3 of an Ell. This was made of a Copper Plate, scarce twice so thick as the Back of a common Knife, and so may easily be moved from Place to Place, and ordered for Use; and the Workmanship of it may, by the Contrivances I have invented (saith the German) be easily, and in a little Time, performed by one Man. The Polish hereof is very good, and represents by distinct Reslexions, all those Appearances which arise from the Concave Figure thereof.

The Force of this Speculum is incredible: For. 1.a Piece of Wood put in the Focus (which is 2 Ells off) Flames in a Moment, so as a fresh Wind can hardly put it out. Water applied in an Earthen Vessel presently boils. 3. A Piece of Lead or Tin 3 Inches thick melts away in Drops, and in 2 or Minutes time will be melted quite through. 4. A Plate of Iron or Steel is presently red hot, and foon after hath a Hole burnt through it. I have made 3 such Holes in a Plate in 6 Minutes time. 5. Copper and Silver, and the like, applied to the Focus melt; I tried with a Rix Dollar: And the Iron aforesaid will run in 5 or 6 Minutes. 6. Slate at first is red hot, but in a few Minutes turns into a fine fort of black Glass, of which, if any Part be taken in the Tongs, and drawn out, it runs into Glass Threads. 7. Tiles and Earthen Pot-shreads, in a little time melt into Glass, as also doth Pumica Stone into a very white one: A Piece of a very strong Crucible runs into Glass in 8 Minutes. I have seen Bones turn into Glass of an Opaque Kind, and a Clod of Earth into Greenish Glass. These Experiments were made in Argust and Sep-

Dr. Hook proposed to the Society, that one might be made after this Manner, of many Feet in Diameter for a small Price; being hammered out of a Copper Plate, and tinn'd over with a Mixture of Tin, Lead, and Tin-glass, which is found to bear a very good Polish.

The Uses of such a Speculum would be very many, and perhaps its Effects wonderful, there being no other Heat in the World any thing like that of the Sun's Rays, whose Weight and Fineness are not possible to be equalled by any common Fire; yet the Moon's Rays, though the Light was augmented by the Glass, gave no Manner of Heat.

augmented by the Glass, gave no Manner of Heat.
Mr. Tichirnhaus is said to have made Convex
Burning Glasses of 3 or 4 Foot Diameter, and
whose Focus is 12 Feet distant, and of 1½ Inch in
Diameter; and to make this Focus yet stronger,

he contracts it by a second Lens, placed parallel to, and at a due Distance from the first, and then the Focus is but of 8 Lines in Diameter. This Glass in a Moment vitrifies Tiles, Slates, Pumice Stones, Dutch Ware, and Talk. It melts Sulphur, Pitch, and all Rosins under Water; any Metal exposed to it in little Lumps upon a Coal, melts in a Moment, and Iron sparkles as in a Smith's Forge. All Metals vitrify on a Piece of China Plate, if it be not so thin as to melt it self; and Gold in vitrifying receives a Purple Colour: Histoire de l' Aca-

The Linum Vivum or Asbestos would be vitrissed by this Glass, even in January, in about 10 Minutes Time: Vid. Ast. Erud. Leips. April. 1688.

The Incomparable Sir Isaac Newton presented a Burning Glass to the Royal Society of London.

whereof he is the most worthy President, consist-ing of seven Concave Glasses, and so placed, as that all their Foci join in one Physical Point. Each

Glass is about 11 ½ Inches in Diameter; six of them are placed round the seventh, to which they are all contiguous, and they compose a kind of Segment of a Sphere, whose Subtense is about 34 ½ Inches. The Central Glass lies about an Inch lower or farther in than the rest. The common Focus is about 22 ½ Inches distant, and of about an Inch in Diameter. It vitrifies Brick or Tile in a Moment, and in about half a Minute melts Gold.

If another round of Concaves were added about these seven, perhaps it would outdo any thing we

have an Account of.

BUTMENTS, in Architecture, are the Mason and Bricklayer's Term for those Supports or Props, on or against which the Feet of Arches rest. Also little Places taken out of the Yard of the Ground-Plot of a House, for a Buttery, Scullery, & are sometimes called Butments.



NADE, in the Book of Rates is us'd for a certain determinate Number of some kinds of Fith; as a Cade of Herrings is 500, of Sprats is 1000

CALCAGE, Calcagium, was a Tax or Contribution formerly paid by the neighbouring Inhabitants, towards the making and repairing of com-mon High-ways, Cause-ways and Roads; as

CALCEARUM Operationes, were the Work and Labour of this Kind done by the inferior fervile Tenants; and from this it was a Privilege to be free.

CALCULUS differentialis; J. Barnoulli in the Leipsick Acts for Jan. 1691. owns that our famous Dr. Barrow had given some Specimens of this Method above 10 Years before that Date in his Geometrical Leaures, and of which, all his Apparatus of Propositions there contain'd are so many Examples. He acknowledges also, that Mr. Leibnitz's Method of this Calculus differentialis is founded on Dr. Barrow's, and differs from it only in Notation and some compendious Abridgments. And in this Discourse Mr. Bernoulli gives some Specimens of the Use of this Calculus, in the Dimension of the Parabolick Spiral, and of the Flexures and Evolutions of Curves in general.

See on this Subject Mr. L' Hospital, Mr. Nei-

wintis's Analysis Infinitor.

CAMBER Beam, in Architecture, is a Beam or Piece of Timber cut hollow or arching in the Middle: They are us'd in Plat-forms, Church Leads, 60°c. and are very proper where ever is oc-casion for long Beams, being much bringer than flat Beams of the same size; for being laid with the hollow Side downwards, and having good Butments at the Ends, they ferve for a kind of Arch.

CANON, in the Ecclesiastical Law, was originally a Book wherein the Religious of every Convent had a fair Transcript of the Rules of their Order: These were often read over to them as the r Local Statutes, and therefrom were called Regula,

and Canon their Rule.

CANON in Musick; Ptolemy rejecting the Aristoxenian Way of measuring the Intervals in Mufick by the Magnitude of a Tone (which they suppose to be formed by the Difference between a Diapente and Diatesfaron) thought that Musical Intervals should be distinguish'd according to the Ratio's or Proportions which the Sounds terminating those Intervals bare one to another, when consider'd according to their Degree of being Acute or Grave, which was also before Aristoxenus, the old Pythagorick Way. Ptolenny there ore made the Diapason to consist in a double Ratio, the Diapente in a Sesquialteral, the Diatessaron in a Sequitertion, and the Tone it self (by which the Diapente and Diatessaron differ) in a Sesquioctave; and all the other Intervals according to the Proportion of the Sounds that terminate them. Wherefore taking as Canon (as 'tis call'd) a determinate Line of any Length, he show this Canon is to be cut accordingly, so that it may represent the respective Intervals; and this Method answers exactly to Experiment in the different Lengths of Musical Chords. And from this Canon, Ptolenry and his Matter of his second Element.

Followers have been called Canonici, as those of Aristozenus were called Musici.

There is a Tract called Sectio Canonis attributed. but falfly, to Exclid; and which you will find at the End of his Works, in the Oxford Edition.

CANTALIVERS, in Architecture, are a Kind of Modilions, only those are plain, but these are carved. They are much the same with Cartouzes, and are set as Modilions are, under the Corona of

the Cornish of a Building.

CAPIAS Conductos ad Proficisendum, is a Writ that lies for taking up such Men as having receiv'd Presi-money to serve the King, slink away, and come not in time. 'Tis an original Writ directed to the Serjeant at Arms, having included a Clause of Assistance.

CARACT is not any certain Weight or Quantity, but the 1 Part of any Quantity of Weight. And the Minters and Goldsmiths divide it into 4 Parts, which they call Grains of a Caract; and one of these they subdivide in Halves and Quarters.

CARKE feems formerly to have been the Word for a certain Quantity of Wool, whereof Thirty

made a Sarpler, 27. H. 8.c. 2. CAPSULATE Plants are such as have a Tetrapetalous regular Flower confisting of four distinct Petala in each Flower, and which bear their Seeds in short Capfula; by which they are distinguish'd from the Siliquesa, which bear their Seed in long Cases or Capsula Seminales, and are the other Branch of this Genus of Plants.

CAPSQUARES, in Gunnery, are those strong Plates of Iron which come over the Trunnions of a Gun, and keep her in the Carriage. They are fastned by Hinges to the Prize Plate, that it may lift up and down; it forms a Part of an Arch in the Middle, to receive a third Part of the Thick-ness of the Trunnions, for $\frac{1}{2}$ of them are let into the Carriage, and the other End is sastened by two Iron Wedges, which are called the Fore-locks

and Keys.
CAPTION, when a Commission is executed, the Commissioners Names subscribed and return'd,

that is called a Caption.

CARCASE of a House, in Architesture, are the Partitions, Floors, Rafters, &c. made by the Carpenter.

CARTESIAN System of the World.

Mr. Des Cartes, in order to account for the Celestial Appearances, supposes the Matter of the World to have been at first divided by Almighty God, into innumerable little equal Parts, each endow'd with an equal Degree of Motion, both about its own Centre and separately, so as that this Matter constituted a Fluid. He suppos'd also that several Collections of this Matter, were en-dow'd with a Motion about different Points, as common Centres, which Points were placed at equal Distances: so as that the Mitter round them compos'd different Vertices, as he calls them. He supposes also, that the first Particles of Matter by those intestine Motions were rendred or ground of a spherical Figure, and so did compose Globules of several Magnitudes: And there he calls the

But

But the very small Particles which, by the aforesaid Motions, were ground and rubb'd off from the first Particles of Matter, and driven vi-olently many different Ways, made up a new Matter, which he calls his first Element. And seeing that there would be more of this first Element, than was sufficient to fill the Vacuities between the Globules of the fecond Element, he supposes that the remaining Part would be driven towards the Centre by the circular Motion of these Globules, which did for that Reason recede from it; and this Matter being there amassed into a Sphere, would in the Centre of every Vortex produce a Body like the Sun: which Sun being thus form'd, and moving about its own Axis with the common Matter of the Vortex, would necessarily throw out some Parts of its Matter, through the Vacuities of the Globules of the second Element constituting the Vortex, and this especially at such Places as are farthest from its Poles, receiving at the same Time in by these Poles as much as it loses in its Equatorial Parts, or about the Equator: And by this Means it would be able to carry round with it those Globules that are nearest, with the greater Velocity, and the remoter with less. And by this Means those Globules which are nearest the Centre of the Sun must be least; because were they greater or equal, they would by Reason of their Velocity have a greater centrifugal Force and recede from the Centre. And if it should happen that any of these Sun-like Bodies in the Centres of the several Vortices, should be so incrustated and weakened, as to be carried about in the Vortex of the true Sun; if it were of less Solidity, or less Motion than the Globules towards the Extremity of the Solar Vortex, then it would descend towards the Sun, till it met with Globules of the same Solidity, and capable of the same Degree of Motion with it self; and then being fix'd there, it would be for ever after carried about by the Motion of the Vortex, without either approaching any nearer to, or receding from the Sun, and so become a Planet.

Supposing then all this, we are next to imagine that our Siftem was at first divided into several Vortices, in the Centre of each of which was a lucid Spherical Body; and that some of these being gradually incrustated, were swallowed up by others which were larger and more powerful, till at last they were all destroyed and swallowed up by the biggest Solar Vortex, except some few which were thrown off in right Lines from one Vortex to another, and so became Comets. from hence it appears, that those Planets which are nearest the Sun are less solid: That is also Des Cartes's Reason why we see always the same Face of the Moon; because the Hemisphere which is opposite to the Sun and the Earth is somewhat more solid than the other: Because also the Matter of the first Element which makes up the Body of the Sun, moves with greater Velocity the Parts of the Vortex, and the Bodies swimming in it, than those that are remoter: Therefore those Planets which are nearer to the Sun, must finish their Periods Cooner than those which are more remote from him. And the Reason why the Planets revolve round their Axis, is, because according to this Hypothesis, they were lucid, Sun-like, and revolving Bodies before.

But notwithstanding all this fine Romance, it is (First,) certain that a Vorten produced by the Revolution of a Sphere about ite Axis, must be propagated in infinitum, if nothing hinder it: And that Fluid, for of themselves they would describe a Curve-line, are moved by Vol. II.

therefore, fince there must be as many Vortices as there are fix'd Stars, one Vortex would certainly run into another, and every Particle would be acted by a Motion compounded of the Motion of all the central Spheres; which is abfurd and contrary to that Constancy, Limitation and Unifor-mity which is observed in the *Phanomena* of the Heavenly Bodies.

2. Since the Motion and Parts of the Vortices nearest the Centre, is swifter than that of the more remote, they must press upon the exterior Parts, and thereby perpetually impart some Part of their Motion to them; and therefore those interior Parts of the Vortex will be continually leffening fome Part of their Motion, which never being reflored, these Parts must still move slower and slower by Degrees, till at last all the Motion will be quite destroyed.

. According to this Hypothesis, each Planet is of the same Density with the Parts of the Vortex in which it swims, being govern'd by the same Laws of Motions, and is, as it were, only some concreted Parts of the Vortex. But the Times of the Periodical Motion of Bodies carried about by a Vortex, are in a duplicate Ratio of their Distances from their Centre; as the incomparable Sir Isaac Newton hath demonstrated in Sect. IX. of his Whereas the Squares of the Times of the Periodical Revolutions of the Planets are as the Cubes of their mean Distance from the Centre, or from the Sun: Wherefore the Planets cannot be carried about by a Vortex.

4. If a Vortex run out in Infinitum, then would a Body carried round by it certainly describe a perfect Circle, unless something solid did hinder it; and therefore the greater Distance there were between those folid Bounds, or the larger the Bason be which contains the Vortex, in respect of the Orbit of the Body carried about in it, the nearer would this Orbit be to a Circle; that is, the Excentricity of the Planets nearest the Sun, would be less than that of those which are more remote: But the direct contrary to this is true in Fact, the Eccentricity of Mercury being greater

than that of Saturn,

5. A Body carried about in a Vortex of the same Density with it, would necessarily describe a Circle, to whose Plane the Axis of the central Body producing the Circulation of the Fluid, would be perpendicular: And yet there is not one Planet to the Plane of whose Orbit the Sun's Axis is perpendicular.

6. The Comets have their Orbits, not only oblique to, but sometimes at right Angles, with the Plane of the Ecliptick; sometimes the Course of these Comets is diametrically opposite to that of the Sun: They persevere in their Motion without any Change: By Lines drawn from them to the Sun, they describe equal Areas in equal Times; and sometimes they enter into the Vortex of the Sun. All which is impossible, if the Solar Vortex moved round forcibly enough to carry these vast Bodies of the Planets along with it

Mr. Leibnitz hath indeed a little altered and mended this Hypothesis of Des Cartes; he hath accommodated it better to the Celestial Phænomena, and made it more agreeable to the Rules of Geometry

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scribe right Lines, and nothing (hesaith) but the Fluid concurs to turn them out of the Way.

Secondly, He endeavours to shew, that every Planet is carried about by a Motion compounded of two other Motions; viz. the Harmonical Circulation of the deferent Fluid, and the Paracentrical Motion of Access to, or Recess from the Sun.

The Planets by a Radius from the Sun describe Areas proportional to their Times; now the Fluid that carries the Planets, must of Necessity circulate so as to produce this Effect; which cannot be done otherwise than by supposing innumerable concentrical Orbits of exceeding Thinness to make up the Vortex; every one of which, hath its own proper Way of Circulation, viz. Those Orbs which are nearest the Sun move fastest, and the Velocities of the Circulations are every where reciprocally proportional to the Distances of the respective Orbs from the Sun, which will necesfarily make the Planet to describe equal Areas in equal Times, let it be in any Part of the Vortex. For these Areas are in a compounded Ratio of their Radii or Distances from the Sun, and in a reciprocal one of the Arches or Lengths of the Circulation, which in this Case will make a Proportion of Equality: And this Law of Circulation of the Vortex, he calls Harmonical.

The Paracentrick Motion is compounded of two others, that is, the Excussory Impression of the Harmonick Circulation, whereby all Bodies moving in a Curve, endeavour to recede from the Centre by the Tangent; and the Attraction of the Sun, or the Planets Gravitation towards him. And this, Mr. Leibnitz is of Opinion, arises from an Impulse communicated by the circulating Fluid. Now fince the Planets move in Ellipses, in one of whose Foci the Sun is placed, and by Lines drawn from him do describe equal Areas in equal Times, which no other Law of a circulating Fluid, but the Harmonick Circulation can account for, we must find out a Law for the Paracentrick Motion that may make the Orbits elliptical. The excuffory Impression of the circulating Fluid, would throw off the Planet from the Centre by the Tangent, wherefore the Attraction of the Sun or the Gravitation of the Planets towards it, must be sufficient to destroy that Effect; and besides, to make them move in elliptick Orbits, which cannot be brought about, unless this Attraction or Gravitation be reciprocally as the Squares of the Distances from the Focus: And this is the Sum of Mr. Leibnitz's Improvement of this Hypothe-

But this Account must be false for these Reasons; First, Because the Comets, as hath been said before, have their Orbits, some of them very oblique too; nay, sometimes at right Angles with the Plane or the Ecliptick, and their Courses are sometimes quite contrary to those of the Planets. Now these Comets describing about the Sun Areas proportionable to the Times, must also according to their Motion be carried about by an harmonically circulating Fluid: But then we shall have Vortices moving contrary to Vortices, which is very absurd.

2. In equable Motions, the Times are always directly as the Spaces, and reciprocally as the Velocities, but in a circular Motion, the Spaces in one Revolution are as the Radii; and in an harmonical Circulation, the Velocities are reciprocally as the Radii, and therefore the Periodical Times of

a Fluid circulating harmonically are in a duplicate Proportion of the Radii: whereas the Periodical Times of the Planets are in sesquiplate Proportion of their Distances from the Centre, or of their Radii, and consequently the Planets cannot be carried by an harmonically circulating Fluid.

It may, perhaps, be alledged here, that this harmonical Circulationis not continued from Mercury to Saturn, but isinterrupted, and reaches only from the Perihelian of Mercury to his Aphelian, and is there again interrupted, and so on through the whole System of the Planets; but this would produce a Deformity, which is very unlike the simple uniform Measures of Nature every where else. And besides, the Comets moving forward in the Zodiack, pass through all these imaginary Chasins and Interstices, and yet move in the same Manner as if they were carried by a Fluid circulating harmonically, according to some uniform Law; neither do their Appearances give any Ground to suspect such Interruptions as these. Vid Dr. Cheyne Phil. Prin. of Natural Religion.

CARTILAGO Scutiformis, is one of the 5 Cartilages of the Larynx; tis called in Greek Supondice because of its Figure. It makes that Protuberance in the fore-part of the Larynx called Pomum Adami. It is about one Inch broad, but not so long, being Concave within, and Convex without. Its four Angles have each a small Production; the two upper, which are longer, are tied to the Horns of the Os Hyoides; and the two lower to the second Cartilage, which is called Cricoides or Annularis, from its being like a Ring.

CARTONS, in Painting, are the most perfect Sort of Drawings on Paper, which are subservent to great Works, that must be throughly finished; all Sketches, Drawings, Models, and all other Works being Preparatory only, and to be reduced to Cartons. This Way was practifed by Michael Angelo and Raphael Urbin, Soc. the Cartons at Hampton Court being the Work of Raphael.

They are sometimes made by measuring the Heighth and Breadth of the Place where the Painting is design'd to stand; and then by dividing that Space into Squares, and one afterwards of the same Dimensions on Paper; they draw on the latter the Subject of their Story or Design, transferring it afterward from the Carton to the Wall, by painting it there in Oil, 60°c.

ing it there in Oil, 63c.

But some great and experienc'd Masters will be able to do all this without the Help of the Grate, as they call it; that is, the Division of the Space or Table into Squares, tho, after all, 'tis a good se-

CARTOUCH, is a Case of Wood about 3 Inches thick at the Bottom, girt round about with Marlin, and holding about 48 Musket Balls, besides 6 or 8 Iron Balls of a Pound Weight. Tis fired out of a Hobit, as they call it, that is, a small Mortar; and is very proper for defending a Pass.

CARTOUZES, in Architecture, are much the fame with *Modilions*, only these are set under the Cornish in Wainscotting, and those under the Cornish at the Eves of a House. Some Workmen call them *Dentils* or Teeth.

call them Dentils or Teeth.

CARUCATE, from Caruca, and the French Carui, a Plough, was the Ancient Plough Land; and fignified as much Arable Land as could be tilled with one Plough in a Year. This in Rich. 1. Reign, was computed at 60 Acres, but 'twas afterwards varied; and the Measure of a Carucate was different according to Time and Place.

CASE-

CASE HARDENING, is a Way of making the Outfide of Iron hard. And 'tis used sometimes by File-Cutters, when they make Course Files for Cheapness; and formerly most Rasps were Case-bardened. Gunsmiths also use it to harden the Barrels of Guns; and for Tobacco Boxes, Cane Heads, Buttons, &c. 'Tis done thus: They take Hoofs or Horns of Kine, dry them in an Oven, and powder them, then put an equal Quantity of Bay Salt to it, and mingle both together with stale Urine or Whitewine Vinegar. Some of this Mixture they lay upon Loam, and wrap it about the Iron, putting also more Loam over all. Then lay it upon the Hearth of the Forge to dry and harden; and when 'tis dry and hard they put it into the Fire, and blow till they give the whole Lump a blood red Heat, but no greater. Then 'tis taken out and quenched, and at last the Case-hardened Iron is taken out of the Case.

CASEMENT, the same with Cavetto, in Architecture, is a hollow Moulding; some say 1/4, some

of a Circle in Compass.

CASSINE, in the Military Language, is a Farm House, where a Number of Soldies have posted themselves, in order to make a Stand against

the Approaches of an Enemy.

CASTELLORUM Operatio, was formerly Service of Work and Labour to be done by inferior Tenants for the Repair or Building of Castles. To this some came in Person, and others contributed, and it was one of the three necessary Taxes from which few Persons were exempted.

CASTING of Drapery, is a Term in Painting, fignifying a free, easy, genteel, negligent way of cloathing any Figure: and when the Drapery is so

managed, they say 'tis well Cast. CAVAZON, in Architecture, is the digging or hallowing away of the Earth from the Foundation of a Building. Palladio faith it ought to be 1 of the whole Height of the whole Building

CAVETTO, in Architecture, is a hollow Moulding of about or of a Circle in Compass.

CAUKING, in Architecture, signisses Dove-

CAULICOLI are, in Architecture, the little carved Scrolls which are under the Abacus in the

Corinthian Capital.

CASUALTY, is the Tin-miner's Words for the Earth, a Stony Matter which is by washing in the Stomping Mills, &c. separated from the Tin Ore, before tis dried and goes to the Crazing Mill. CAZERN: See Casern.

CEMENT, in Architecture, is a strong binding Mortar. 'Tis used to cement Bricks together for some Kinds of Moulding; to make a Block of Bricks for the carving of Scrolls, Capitals, & c. Tis of two Sorts: The bot Cement, which is common, is made by putting to a Pound of Rozin and a Quarter of a Pound of Bees Wax, half an Ounce of fine Brick-Dust, and as much Powder of Chalk; and boiling all together in a Pipkin, Egc. for about 4 of an Hour, stirring it all the while; then let it stand 4 or 5 Minutes, and 'tis sit for

The Brick to be cemented must be heated in or by the Fire, and rubb'd one upon another like Boards in glewing. The cold Cement is less common, and is thus made.

Grate half a Pound of old Cheshire Cheese, well pared, very small, and to it in a Pot put half a Pint of Milk, and so let it stand all Night; Vol. II.

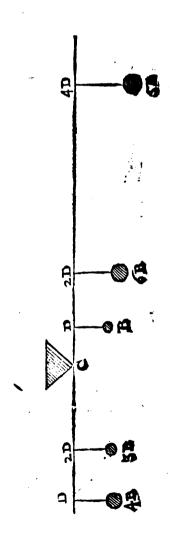
the next Morning put it into a Tray, & c. With the Cheese and Milk, put half a Pound of very fine powdered and fifted quick Lime, and stir all well together with a Trowel, breaking the Knots of the Cheese if any remain; and then add the Whites of 12 or 14 Eggs, which incorporate well with the Mixture, and then it will be fit for Uie: It you would have it reddish, colour it with a little very

fine Powder of Bricks.

CENTRE of Attraction, in the New Astronomy, is that Point to which the revolving Planet or Comet is impelled or attracted by the Force or Impetus of Gravity. Thus the Sun is such a Cen-Impetus of Gravity. tre of Attraction with regard to all the Primary Planets, and as they themselves are toward their

Secondary ones, or Satellites, if they have any.

CENTRE of Gravity. The Confideration of the Centre of Gravity is one of the Noblest Speculations in Geometry; and fince the New Methods have been in Use, such Advancements in it have been made, that hardly much more is to be expected: For the whole Business of the Investigation of Centres of Gravity is now reduced to one General Proposition, which depends on a few simple Mechanical Principles, such as these:



Balance, as that their Masses be reciprocally Proportional to their Distances from C the Point of Suspension, then they will be in Equilibrio, as is the known Case of the Libra, (see Libra:) That is, if D represent the Distance of the Weight B, and 3 D that of 4 B, and 2 D that of 6 B, all from the Point of Suspension C; then will the Weights 4 B and 6 B be in Equilibrio, because 3 B: 6 B: 2 D: 3 D.

2. The Moment of any Weight is = to the-Rectangle under its Velocity, and the Quantity of Matter in the same. V. gr. The Moment of 6B is $= 6B \times 2D$ (2D I say, for the Velocities are as the Distances from C) = 12BD.

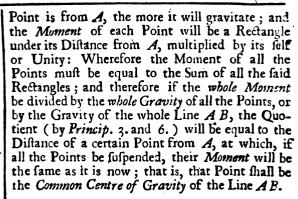
3. And if the Moment and Weight (ot Quantity of Matter) be given, the Distance of the Point of Application from C the Point of Suspension will be found, by dividing the Moment by the Weight. Thus, if the Moment of the Weight 6 B be 12 B D, (as in Principle 2.) then the Distance of the Point of Application from C will be $\frac{12 B D}{c B} = 2 D$.

4. If several Bodies be suspended on each Side the Point C, then multiply every Weight by its respective Distance from the Center of Suspension C: And then if the Sum of all the Resangles on one Side, be equal to the Sum of all those on the other, the Weights or Bodies will be in Aquilibrio: if they are not equal, that Side will preponderate, whose Sum is the greater. Thus, v. gr. the Sum of all the Restangles on the Right Hand C is 18 B D: I say, + 18 B D (supposing + to signify towards the Right Hand, and — towards the Left; and the Sum of all the Restangles on the Left of C, will be — 33 B D: Whence it is evident, that the Preponderancy is toward the Left Hand, and is equal to — 15 B D, which therefore is the Moment of all the Weights.

5. The Moment then of all the Weights being in this Case — 13 BD, and the Sum of all the Weights 19 BD; 'tis plain, if you divide the former by the latter, the Quotient $\frac{1}{15}$ D will be (by Princip. 3.) equal to the Distance of the Common Centre of Gravity of all the Weights from the Point C.

6. When the Weights, B, 6 B, and 5 B, hang all on the same Side of C, the Sum of their Momnets is = 33 B D, as the Sum of the Weights is 12 B. Wherefore one Weight = 12 B, and hung at \(\frac{3}{12}\) D distant from C, will gravitate in the same Manner as the separate Weights did before at their respective Distances: That is, the said Point is the Common Centre of Gravity of those Weights, since it is that Point in which all their Forces unite; and whereat, if they were all jointly suspended, they would produce the same Effect as before they did separately.

7. Let the Line AB be suspended at A, and suppose it divided into an infinite Number of heavy Points; 'tis then plain, that the farther any



8. If a Line, Plane, or Solid, be biffected so by a Line or Plane, as that all the Parts in one Segment be equal to the respective Parts in the other, and also equi-distant from the said Line or Plane; its then clear, that the Center of Gravity of all such Figures, must be in that Line or Plane. And from hence it naturally follows,

Prop. General, That to find the Centre of Gravity of any Line, Plane or Solid, you must imagine Lines to consist of an infinite Number of Points, Planes of an infinite Number of Lines, and Solids of an infinite Number of Planes or Surfaces; and then that all these are sufpended to the same Arm of a Balance common to them all: And let the Point of Suspension be as in A, at the Fnd or Extreme of the said Line in the Edge of the Surface, or in the Surface of the Solid; and then find the Sum of the Moments of all those Points; which Sum divide by the Sum of the Weights, or the Weight of all the Parts, and the Quotient will be the Distance of the Center of Gravity, or the Line, Plane or Solid, from the Point or Axis of Suspension. The Practice of all which in particular Instances, see in Hayes's Fluxions, p. 261, &c.

CENTRES of Gravity. 'Tis plain that the Centre of Gravity of a Circle, and of a Sphere or Globe (supposing the Matter truly Homogeneous all over them) will be their Centre of Magnitude; the Centre of Gravity of all Parallelograms will be in the Point of Intersection of the two Diagonals; and the Centre of Gravity of all solid Parallelograms or Parallelopipeds will be in the same Point of the Plane of Gravity, i.e. in the Point found to be the common Intersection of the two Diagonals of that Plane which cuts the Solid into two Triangular Prisms, and consequently is easily found. The Centre of Gravity of all Planes of Triangles, is in the Point of Intersection of two Right Lines bissecting any two of their Angles; and of all folid Triangles or Triangular Prisms it will be in the middle Point of the Diameter of Gravity: And that Diameter is found by the common Inter-fection of two Planes, each of which biffects one Angle of the Top and Base, and consequently of all the Triangles of which the Prism may be conceived to be composed.

If the Prism be of a Quadrilateral, or any other more compounded Form, the thing will be more difficult, because the Centre of Cravity will lie at a proportionable Distance from the Centre of Gravity of all the Triangular Prisms, that the Multiangular Solid can be divided into. But tho' this be a little more troublesome, 'tis by no Means impossible, any more than to find the Centres of

Gravity of Cones, Pyramids, &c. for which you have Rules enough in Stephinus, Lib. 2. Elem. Stat. and in many other Authors.

CENTRE of an Hyperbola, or an Ellipsis. In these Curves, and in the opposite Sections of Hyperbola's, all the Diameters terminated in the Section (or in the opposite Sections) do naturally bissect one another in one and the same Point, which Point is called the Centre. And this Point in the Ellipses is within the Figure, but in the Hyperbola without, being there the Middle of the

Latus Transversum.

CENTRE of Oscillation. That Point of any Figure where all the Forces are united, is but one, (supposing the Figure to revolve round a Point or Axis) and confequently only one fingle Pendulum can be made, whose Vibiations (the Forces in both being equal) shall be Isochronical to those of the whole Solid; and because that Point in the Figure wherein all the Forces are so united, determines the Length of the simple Isochronical Pendulum, and is that wherein all the Figure is supposed to be contracted with all the Forces, while it vibrates, therefore 'tis called the Centre of Oscillation; and since the Centres of Percussion and Oscillation in every Figure are the same, the way of Investigation of both must be the same: See Centre of Percussion.

CENTRE of Percussion of a Body in Motion,

is that Point wherein all the Forces of that Body are considered as united in one; so that the Force of Percussion in that Point, is greater than any where else; so that the Centre of Percussion is the same with respect to the Forces, as that of Gravity

is in respect of the Weights.

In calculating the Centres of Gravity, we suppose the Figures to be simply suspended to a Point or Axis: But in order to calculate the Centres of Percussion, the Figures are supposed to be actually revolving about a Point or Axis; and as there the simple Momenta are considered, here they are confidered also with the Velocity super-added. And as the Sum of all the simple Momenta on each side the Centre of Gravity are equal, so here the Sum of all the Forces on every side the Centre of Percussion must be equal; and therefore, as the Centre of Gravity is found by dividing the Sum of all the Moments, by the Sum of all the Weights; so to find the Centre of Percussion, you must divide the Sum of all the Restangles under all the Momenta, and their respective Velocities, by the Sum of all the Moments:

See more of this in Hayes's Fluxions, P. 281.

CENTRIFUGAL Force. All moving Bodies endeavour after a rectilinear Motion, because that is the easiest, shortest, and most simple. Whenever therefore they move in any Curve, there must be something that draws them from their rectilinear Motion, and detains them in the Orbit. Whenever this Force, which is called Gentripetal, ceases, which attracts them towards a Centre, the moving Body wou'd strait go off in a Tangent to the Curve in that very Point, and so wou'd get still farther and farther from the Centre or Focus of its former curvilinear Motion: And that Endeavour to fly off in the Tangent, is the Centrifugal Force. The Effect of this Force is such, that if a moving Body were to describe a Circle, it wou'd cause it to describe the largest possible, because a great Circle is less curved, and differs less from a right Line than a small one: A moving Body therefore will fuffer more Violence of Attraction, and confequently will exert more of its Centrifugal Force

when it describes a less Circle, than in a greater. It is much the same in other Curves as in the Circle; for every Curve may be considered as com-posed of an Infinity of Arks of infinitely small Circles, all described by different Radii; and so, that where the Curve harh the greatest Curvature, there it is composed of such Arks as are Portions of the least Circles, or which are described by the shortest Radii. A Body therefore moving in a Curve, doth every Moment endeavour by the Centrifugal Force to get of from a Point which is the Centre of the Ark of an infinitely small Circle then described. And this Endeavour is so much the greater, by how much the Ark of the infinitely small Circle is the Portion of a lesser Circle; so that in one and the same Curve, the Centrifugal Force of the revolving Body may vary according to the different Points of the Curve in which it may at any time be. It may be therefore, that in a Curve where the Force of Gravity in the describing Body is continually variable, the Centrifugal Force may also continually vary in the same manner, and so, that one may also supply the Defect, or abate for the Excess of the other, and confequently the Effe t be every where equal to the abfolute Gravity of the revolving Body. And this as a Problem, viz. To find such a Curve in a vertical Plane, hath been proposed by Mr. Bernoulli of Groningen. Vid. Hist. de l' Academ. Royal, P. 82. for the Year 1700

CENTRUM Phonicum, CENTRUM Phonacampticum } See Echo.

CENTRY-BOX, the same with the Gueritte, only the former is of Wood, and the latter of Stone. It is made to fave the Centry from Injuries of Weather. In a Fortification they are usually placed on the Flank'd Angles of the Bastions, on those of the Shoulder, and sometimes in the Middle of the Curtin.

CERT Money, quasi Certa Moneta, was the Head-Money or common Fine paid by the Resiants and Tenants of several Mannors to their Lords. In some ancient Records this is call'd Certum Lete.

CERUSSE. In Phil. Trans. N. 137 there is this Account of the way of making Cerusse. Pigs of clean and fost Lead are cast into thin Plates, Yard long and fix Inches broad; these are rolled round so as the Surfaces no where meet to touch, for where they do no Cerusse grows. Each of these is put into a Pot just capable of holding one, and upheld by a little Bar from the Bottom, that it come not to touch the Vinegar which is put into each Pot to effect the Conversion. Twenty of these abreast are put into a square Bed of new Horse-Dung; and each Pot is covered with a Plate of Lead, and then over that with Boards as close as can well be. This repeated four times makes one Heap as'tis called, containing 1600 Pots.

After three Weeks the Pots are taken up, the Plates unrolled, laid on Boards, and beaten with a Battledore, till all the Flakes come off, which, if good, are thick, hard, and weighty. The'e Flikes are ground with Water betwen Milstones to almost an impalpable Fineness; after which 'tis moulded into several Parcels, and exposed to the Sun to dry, till it become hard and fit for use.

'Tis observed that some Pots will yield thick

and good Flakes, while others alike ordered and fet by them, without any possible Distinction of Disadvantage, vield sew, small, or none at all. Sometimes the Porsare taken up all dry, and sometimes they prove best; sometimes they are taken up wet. The Plates that cover the Pots yield tetter and thicker Flakes than do the Rolls within; and the Outsides next to the Planks bigger and better than the Insides next to the Rolls, and to the

Spirits which first rise from the Vinegar.

CESSION, is one manner of an Ecclesiastical Renefices becoming void. By the Canon Law, it a Clerk have one Living, though under 8 Pound per Annum Value, and takes a Second of what Value soever, the former is void without a Dispensation; that is, 'tis void de Jure, sed non de Fasto. But by Statute, if a Clerk have one Benefice of 8 Pound per Annum, or upwards, and takes another of any Value whatloever with Cure of Souls, and without Dispensation, the former Living is ipso fa Eto, void: And this kind of Voidance of a Living is called Coffion. And what is called Coffion in other Benefices, is called Creation in relation to a Bishoprick; for if an Incumbent be made a Bithop, his Benefice is faid to be void by Crea-

CESSION, in the Civil Law, is putting another

Person, who therefore is called the

CESSIONARY, into the Place and Right of the true and proper Creditor, in any Case. This

is called also Subrogation.

CESSOR, in Law, is one that ceafeth or neglccleth fo long to perform some Duty belonging to him, as that by this his Cesie or Ceasing, he incurs the Danger of the Law, and hath, or may have, the Writ Cessavit (see Vol. I.) brought against him. him. And where it is said in their Terms, the Tenant Ceffeth without any more Words, it is to be understood, the Tenant ceaseth to do by his Lands or Tenement.

CHAFERY, is the Term for one of the Forges in an Iron-work, (fee Iron.) The other is called

the Finery

CHAFE WAX, is an Officer belonging to the Lord High Chancellor, who fits the Wax for the Scaling of Writs, and such other Instruments as are by his Order made to be sent out.

CHALCOGRAPHY, is the Art of Engraving,

Scalpture, & gc. CHAMBERLAIN, from the French Chambellan, i. e. Cubicularius vel Prafectus Cubiculi, is used in divers Senses in our Chronicles, and old Books of Laws and Statutes: As the Lord Great (hamberlain of England, Lord Chamberlain of the King's House, the King's Chamberlain, 13 E. 1. 6.41, 17 R. 2.6.16. To whose Office it apperc. 41. 17 R. 2. c. 16. taineth to look to the King's Chambers and Wardrobe, and to govern the Under-Servants and Officers there. There is also a Chamberlain of any of the King's Courts; as Chamberlain of the Exchequer, 51 H. 3. Stat. 5. 13 E. 3.11. 14 E.3.14. 26 H. 8.2. There is a Chamberlain of North Wales, of Chester, of the City of London: This Officer is commonly the Receiver of all Rents and Revenues belonging to the City whereof he is Chamberlain. When there is no Prince of Wiles and Earl of Chester, the Chamberlain of Chester hath the Receipt and Return of all Writs coming thither out of any of the King's Courts.

In the Exchequer there be two Officers of this Name, who were wont to keep a Controulment of the Pells of Receipt and Exitus; and kept certain Keys of the Treasury and Records. They kept also the Keys of that Treasury where the Leagues of the King's Predecessors, and divers

ancient Books, as Dooms day Book, and the black

Book of the Exchequer, remain.

CHAMPION, in the Common Law, is used no less for him that trieth a Combat in his own Cause, than for him that fighteth in the Quarrel or Place

of another: And according to Bracton and some others, it is used for one that holdeth by Serjeantry, or some such Service, of another. There is also an

Officer now called,

CHAMPION of the King, who is at a Coronation, while the King is at Dinner, to ride armed, Cap-a-pee, into Westminster-Hall, and by a Herald make a Challenge, That if any l'erson thall deny the King's Title to the Crown, he is thereby ready to defend it: Which done, the Kings drinks to him, and sends him a gilt Cup with a Cover, full

of Winc, which he hath for his Fee.
CHANCELLOR, is a Title given in our Kingdom, to him that is the chief Man for matter of Justice (in private Causes especially) next to the Prince: For whereas all other Justices are tied by the Law, and may not swerve from it in Judg-ment; the Chancellor hath in this the King's absolute Power to moderate and temper the written Law, subjecting himself only to the Law of Nature and Conscience, and ordering all things juxta Aguum 69 Bonum. And therefore Stamford, in his Preregative, c. 20. p. 65. faith, that the Chancellor hath two Powers, one Absolute and the other Ordinary; meaning, that though by his ordinary Power, in some Cases he must observe the Form of Proceeding, as the other ordinary Judges do; yet that in his absolute Power he is not limited by the written Law, but by Conscience and Equity, according to the Circumstances of the Matter in question. This high Officer now bears their Title of Lord High Chancellor of Great-Britain. But there are others that bear this Name of Chancellor,

CHANCELLOR of the Exchequer; who sits in the Court and Exchequer Chamber, and with the rest of the Court ordereth things to the King's best Benefit. He is always in Commission with the Lord Treasurer for the letting of Crown Lands, Egc. and hath by the Privy Scal from the King. Power with others, to compound for Forscitures of Bonds upon penal Statutes; and his Power extends to the First-Fruits Office, &c. CHANCELLOR of the Dutchy of Lancaster,

is an Officer in that Court principally to judge and determine all Controversies between the King and his Tenants about the Dutchy Land, and otherwise to direct all the King's Affairs belonging to that

Court.

CHANCERY, is a Court of Equity and Conscience, moderating the Rigors of other Courts, and is not tied strictly to the Letter of the Law. The Officers in it are, The Lord Chancellor, or Keeper of the Great Seal: Twelve Masters of Chancery, whereof some are always Sitting in their turn on the Bench, as Assistants. The six Clerks, who have under them about 90 Clerks, in the Nature of Attorneys in the Court; two chief Examiners, who have each of them several Clerks. One chief Register, who usually hath four or five Deputies. The Clerk of the Crown. The Warden of the Fleet, the Uther, Serjeant at Arms, and Cryer of the Court. The Cursitors and their Clerks of the Petty Bag. The Clerk of the Appeals, of the Faculties, Parents, Presentations, Difinission, Licenses to alienate, Injunctions, Enrollments, Protections, Subpanas, and of the Affidavits, &c. The Sealer, Chafe-wax, &c.

CHAPEL, is of two forts; either adjoining to a Church, as a Parcel of the same, which Men of Worth hold; ut ibidem Familiaria Sepulchra sibi constituant; or else separate from the Mother Church, where the Parish is wide; and is usually called a Chapel of Ease, because built for the Ease of such Parishioners as dwell too far from the Church. Sometimes this is served by a Curate, provided at the Charge of the Rector, and sometimes at Theirs that have Benefit by it, according to Custom or Composition. And some of these latter Chapels which have a Maintenance perpetual by some Lands charitably bestowed on them, or otherwise, without the Charge of the Rector of

the Church, are called Free-Chapels.

CHAPTER, Capitulum; in the Canon and Common Law, is either Congregatio Clericorum in Ecclesia Cathedrali, regulari vel Collegiata; or Locus in quo fiunt communes tractatus Collegiato-rum. Cowel. These Chapters arose thus; in ancient Times the Bishops had their Clergy residing with them in their Cathedrals, to assist them in the Performance of facred Offices, and in the Government and Discipline of the Church. And even after Parochial Settlements were made, there were still a Body of Clergymen, which continued with the Bishop at his Church; and were indeed his Family, and maintained out of his Income. After the Monastic Life grew into Request and Reputation, many Bishops chose to have Monks rather than Seculars to reside with them and attend them in their Cathedrals. And these Bodies of either Monasticks or Seculars, had the same Privilege of chusing the Bishop and being his Council, which the whole Clergy of the Diocese had before. But by degrees, their Dependance upon the Bishop and Relation to him grew less and less; and when they had distinct Parcels of the Bishop's Estate assigned for their Maintenance, at last the Bishop had little more left than the Power of visiting them. And on the other hand, these capitular Bodies did by degrees also lose their Privi-leges; particularly that of chusing the Bishop, for which the Kings of England had a long, Struggle with the Pope, but at last Henry 8. got this Power vested in the Crown, and now the Dean and Chapter have only the Shadow of it.

The same Prince did also eject the Monks out of these Cathedrals, and placed Secular Canons in their Room. And those whom he thus regulated are called Deans and Chapters of the new Foundation: As are Canterbury, Winchester, Worcester, Ely, Carlisse, Durham, Rochester and Norwich; and of such sort are the Chapters of the sive new Sees of Peterburgh, Oxford, Gloucester and Bristol, to which may be added Westminster; tho this last Bishoprick is now sunk, and the Monastery turned into a Collegiate Church by Queen Elizabeth.

CHAPTRELS, in Architecture, are the same with Imposts, and signify those Parts on which the Feet of Arches stand. Their height or thickness ought to be equal to the breadth of the lower Part of the Key Stone.

CHARGED CYLINDER is that Part of the Chace of a great Gun where the Powder and Ball

are placed.

CHARGE of Lead is 36 Pigs, and each Pig contains fix Stone, wanting two Pound; i.e. every Stone (here) is twelve Pound.

CHARTER, in Law, is a written Evidence of any Thing done between Man and Man: And sometimes Charters are called Charters of the King, and when the King passeth any Grant to any Perion, Body Politick, & J. to excuse a Man from being impanelled on a Jury: Charters of Purdon, whereby Men are forgiven Felonies, & J.

CHARTER-LAND is such Land as a Man holds by *Charter*, i. e. by Deed or Evidence in Writing; and this is otherwise called *Free-hold*

CHARTS used at Sea, are either the Plain or Mercator's Charts, as 'tis usually called, though it should indeed be rather called Wright's Chart. See the Word Plain Chart and Mercator, in Vol. I.

CHATTELS, Catalla, is a Word which came to us from the Normans, who called all moveable Goods by this Name, the contrary was called Fief, or as we now call it Fee: But now in our Law, Chattels are all Sorts of Goods moveable and immoveable, except such as are in the Nature of Free-hold or Parcel thereof. They reckon Chattels also to be either personal or real. The Former are such as either do belong immediately to the Person of a Man, as his Horse, Sword, &&c. or such Things as being injuriously withheld from him, a Man hath no way to recover but by personal Action. But Chattels real do not appertain to the Person, but to some other thing by way of Dependance, as a Box with Charters of Land, Apples upon a Tree, &&c. Such things also as necessarily issue out of some immoveable Thing to a Person, as a Lease or Rent for Years, they call a Chattel real. Also to hold at Will, is a Chattel real.

CHAUNTRY is a Church or Chapel endowed with Lands or other yearly Revenue, for the Maintenance (formerly) of one or more Priests daily saying or singing Mass for the Souls of the Donors, and such others as they shall appoint.

CHEMICE, the Art of casting Figures in Me-

CHEST-ROPE in a Ship, is the same with the Guest or Gist-Rope, and is added to the Boat-Rope, when the Boat is towed at the Stern of the Ship, to keep her from Shearing; i. e. from swinging to and fro.

CHILIADS are the Tables of Logarithms, and fo called because they were at first divided into Thousands. Thus in the Year 1624. Mr. Briggs publish'd a Table of Logarithms for 20 Chiliads of absolute Numbers, and again for 10 Chiliads more, and then for one more, that is, for 31 Chiliads. The Book is called Arithmetica Logarithmica.

A. D. 1628. Adrian Viacq publish'd this again with a Supplement (according to Mr. Briggs's Direction) of the Chiliads before admitted; in all making up 101 Chiliads.

CHINALRY, in our Law, fignifies a Tenure of Land by Knight's Service, or by Obligation to perform some Martial or Military Office to the Lord.

CHISSELS used in Joynery and Carpentry are of several Kinds; as 1. The Former, which is used first of all before the Paring Chissel, and just after the Work is scrib'd, and a little without the scribed Strokes and with its Basil outwards.

the scribed Strokes, and with its Basil outwards.

2. The Paring Chillel hath a very fine and smooth Edge, and its used to pare off, or smooth the Irregularities which the Former makes. This is not struck with the Mallet as the Former is, but pressed with the Shoulder of the Workman, who

holds the Chiffel between the Fore and Little Finger of his right Hand, and with the two middle Fingers clutched upon it.

3. The Skew Former, which is a Chissel used for cleansing acute Angles by the Point or Corner of its narrow Edge, and where the Angles of other

Chissels cannot come.

4. The Mortess Chissel is narrow, but very thick and strong to endure hard Blows with the Mallet, and 'tis ground to a very broad Bafil; its Use is to cut deep square Holes in the Wood, which are called Mortesses: These are of several Sizes, according as the Breadth of the Mortesses

5. The Gough is a Chissel with a round Edge, one fize of which serves to prepare the way for an Augre; and others to cut such Wood as is to be tounded or hollowed, 85c.

6. Sosket Chissels are such as are chiefly used by Carpenters, and have their Shank made with a hollow Socket at the top, to receive a strong wooden Sprig made to fit into that Socket, with a square Shoulder above it; which makes them very strong to bear the heavy Blows of the Mallet: They distinguish these Socket Chissels according to the Breadth of the Blade, and call them half Inch, three quarter Inch Chissels, Inch and half, two Inch, and three Inch Chiffels.

7. The Ripping Chissel is a Socket Chissel about an Inch broad, and having a blunt Edge with no Basil to it; its Use is to rip and tear two Pieces of Wood fastned together from one another, by forcing in the blunt Edge between the two

CHORDS. On all plain Scales, and particularly on the Sector, there is a Line drawn called the Line of Chords, whose Uses are very numerous; as,

1. To measure the Quantity of an Angle plain

With 60 of the Chords, and one Foot of the Compasses in the Vertex of the Angle, strike an Arch between the Legs of the Angle, and then taking that Arch in the Compasses, and applying the Length of the Chord which subtends it to the same Lines of Chords, you will find the Quantity of the Angle by the Numbers there placed.

2. By the Chords on the Sector to divide any Circle into its proper Degrees, and to measure the Quantity of an Arch of a given Circle.

Apply over the Radius of the Circle between 60 and 60 in the Lines of Chords, and then if you take out the parallel Chords of one Degree, & c. and apply them to the Circumference of the Circle given, they shall divide it into its proper Degrees: And the Degrees of any Arch shall be known by entering the Distance between its Extremities in the Sector, parallel to the Radius between 60 and 60; or by so applying it into the Sector, that it fall on the same Numbers on each Leg.

3. To divide the Circumference of a Circle into any Number of equal Parts, or to inscribe any regular Figure in a Circle.

Divide 360 by the Number of equal Parts required, or by the Number of the Sides of the regular Polygon, and the Quotient will be a Num-

ber of Degrees, whose Chord apply'd round the Circumference will divide it as requir'd. As if you would divide any Circle into 32 equal Parts; fet the Sector to the Radius, and then dividing 360 by 32, the Quotient is 11°, 15': The Chord of which taken off parallelly, will divide the Circle into 32 equal Parts; or into the Points of the Mariner's Compass.

CHOREPISCOPI were anciently Rural Bishops delegated by the prime Diocesan; but their Authority became restrained by some Councils, and this very Office by Degrees abolish'd; after whom the Rural Deans were so commissioned to exercise Episcopal Jurisdiction, till inhibited by Pope Alex-ander III. and the Council of Tours.

CHRISM was anciently (in times of Popery) a Confection of Oil and sweet Balsam, which was confectated by the Bishop, and used in Baptism; Confirmation, Extreme Unction, 867c.

CHRISOM, Chrismale, was the Face-cloth or Piece of Linen laid over the Child's Head when it was baptized: Whence in our Weekly Bills of Mortality, fuch Children as die in the Month are

called Chrisonis

CHOROIDES is the fourth Coat of the Eye, lying under the Selerotick; it hath many little Glands which separate a black Liquor, which tinges the Inside thereof; otherwise of a white Colour, in order to hinder the reslected Light from disturbing or confounding the Pictures of Objects from being truly represented on the Retina. This Coat hath a hole before, which is called the Pupilla, which serves to admit Light and Colours into the Eye

CHRONOLOGY, Authors on this Subject are I. Bap. Riccioli Chronologia Reformata. 2 Tom.

Bonon. 1669.

Guil. Beveregii Institutiones Chronologica. Mar. Boxbornii Chronologia. Sethi Calvisii Opus Chronologicum. Alftedii Thefaurus Chronoligicus. Mastini Chronolog. Theses & Tabula. Helvici Chronologia. Jos. Scaliger de Emendatione **T**emporum.

Stranchii Chronolog.
CHRYSALIS, a Term used by the modern Writers of the natural History of Insects, for the same with Nympha, which see. Indeed the Word, as well as Aurelia used in the same Sense, seems to imply a peculiar Yellow or golden Colour in the Nympha; but this is purely accidental, and is by no means found in all Nympha: Though fome confine this Word Chrysalis to the Nympha of Butterflies and Moths only. See Swammer dam Hift.

Inject general. Sect. 2.
CHURCH-SCOT, Payment or Contribution: by the Latin Writers was frequently called *Prinzitia* Seminum, because it was at first a Quantity of Corn paid to the Priest on St. Martin's Day as the first Fruirs of Harvest: This was enjoyn'd by the Laws of King Ina, c. 4. and by Canute, c. 10. but after this, it came to signify a Reserve of Corn Rent paid to the Secular Priests, or to the Religious; and sometimes was taken in so general a Sense, as to include Poultry or any other Provision that was paid in kind to the Religious. that was paid in kind to the Religious.

CHYROGRAPHUM, in the Saxon Times, fignified any publick Instrument of Conveyance attested by Witnesses: This the Normans called

To prevent Frauds and Concealments, they made their Deeds of mutual Covenant in a Script and Rescript, or in a Part and Counter-Part, upon the same Sheet of Paper or Parchment; and in the middle, between the two Copies, they draw the Capital Letters of the Alphabet, or sometimes the Word Syngraphies in the like great Letters; and then talliated or cut the faid Sheet afunder in an indented Manner, which being deliver'd to the two Parties concerned, were proved Authentick by matching with or answering to one another, like our present Indentures, or like Tallies in Wood. And when this prudent Custom had for some time prevail'd, the Word Chirographum was appropriated to such bipartite Writings.

CIMA, in Architecture, is a moulding somewhat resembling an S. Vitruvius makes it of two Quarter Circles join'd together. Our Workmen

call it an O---G-

in Architecture, is what our Workmencall an O - G-- with CIMATIUM, the Hollow downwards, 'tis part of the Ornament of the Dorick Capital; it stands just above the Square, and hath a Fillet over it.

CIRCLE. Its Quadrature, or the squaring of the Circle. This according to Mr. Leibnitz's 7. Philos. Collect. may be understood as twofold; viz. either by Calculation, or by Linear Constru-Zion: And each of these may be either perfectly exact, or else almost so, or pretty near. Of these, that which is done by accurate or exact Calculation may be called the Analytical Way, as that which is done by exact Linear Construction is the Geometrical Way; that which is done by pretty near but not exact Calculation, may be called the Approach; and that by a Construction, only pretty near, may be called the Mechanical

Way.

The Approaches have been further carried on by

Hunganius: and others have

given several Mechanical Ways

The accurate Geometrical Construction may be had, by which not only an entire Circle may be measured or squared, but any Section or Arch of it also: Indeed this is by an exact and ordinate Motion, but it is in those that they call transcendental Curves; which, faith Leibnitz, are errone-oully accounted Mechanical, for they are as Geometrical as those which are commonly so esteem'd. Though indeed they are not all Algebraical, nor can they be reduced to Algebraick Equations of certain Degrees, because they have Degrees proper to themselves; and though not Algebraical, are yet Analytical.

The Analytick Quadrature may be again subdivided into three Kinds, the Analytical Transcendent, the Algebraical, and the Arithmetical.

The Analytical Transcendent is to be obtain'd, amongst others, by Equations of Degrees Indefinite, hitherto consider'd by; as if Xx + X be = 30, and X be sought, it will be sound to be 3, be-

cause 3 + 3 + 3 = 27 + 3 = 30.

The Algebraical is done by Vulgar, though irrational Vulgar, or by the Roots of common Equations; which for the general Quadrature of the Circle, or its Sectors, is indeed impossible.

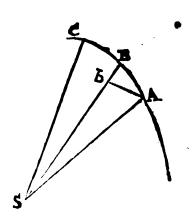
There remains therefore the Arithmetical Way, which is perform'd by certain Series exhibiting the Quantity of the Circle exact, by a Progression of Terms (first) Rational; such as I shall here propound.

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I have found (saith he) that if the Square of the Diameter be put 1, i.e. one, the Area of the Circle will be --- ; +--ナナ・テー that is, diminishing the entire Square of the Diameter by a third Part (that it may not be too big); and then again, because hereby too much is taken away, augment it one fifth, and then diminish it by one seventh; and so on continually in that alternate Order of the Signs, and the natural Order of the odd Numbers.

CIRCULAR-LINES, in Mathematicks, are fuch straight Lines as are divided from the Divisions made in the Arch of a Circle; fuch as Sines, Tangents, Secants, &c. an Account of the Construction of which you have under the Word Scale

CIRCULAR-VELOCITY is a Term in the new Astronomy, signifying that Velocity of any Planet or revolving Body which is measured by



the Arch of a Circle; as suppose by Ab described on the Centre of Attraction S: and the circular Velocity of a Body moving from B to C, is mea-

fur'd by the Ark B C.

CIRCUMSCRIBED Hyperbola is one that cuts its own Asymptotes, and contains the Parts cut off

within its own proper Space. See Curves.
CIRCUMSTANCES are such Things, which tho' they are not essential to any Action, do yet some Way affect it. And they reckon that some Circumstances are purely *Physical*, which don't connect any moral Good or Evil with an Action; such as killing a Man with a Right or Left Hand, &c. And others, they account properly Mural, because they do really influence our Actions, and render them more Good or Evil than they would be without fuch Circumstances. And the Writers of Ethicks sum them all up in this one Verse;

Quis, quid, nbi, quibus auxilis, cur, quomodo, quando. Vid. Whitley's Ethicks, p. 13.

CIVIL Law. The Civil Law is not received at this Day in any one Nation without some Addition or Alteration, for sometimes the Feudal Law is mixt with it, or general or particular Customs; and often Ordinances and Statutes cut off a great Part of it.

In Turkey the Justinian Greek Code is only used. In Italy the Canon Law and Customs have excluded a good Part of it. In Venice, Custom hath almost an absolute Government. In the Milanese, the Fendal Law and particular Customs bear sway. In Naples and Sivily the Constitutions

and Laws of the Lombards are said to prevail. In Germany and Holland the Civil Law is esteemed to be the Municipal Law; but yet many Parts of it are there grown obsolete; and others are alter'd either by the Canon Law, or a different Usage. In Friezeland it is observ'd with more strictness. But in the Northen Parts of Germany, the Jus Saxonicum, Lubecense or Culmense is preferred before it. In Denmark and Sweden it hath scarce any Authority at all. In France only a Part of it is received, and that Part is in some Places as a customary Law; and in those Provinces nearest to Italy the Municipal written Law. In criminal Causes the Civil Law is more regarded in France, but the manner of Trial is regulated by Ordinances and Edicts. The Civil Law in Spain and Portugal is corrected by the Ins Regium and Cu-flom. In Scotland the Statutes of the Sederunt, Part of the Regia Majestaiis, and their Customs,

controul the Civil Law.

CLAMP-NAILS, are such Nails as are used to fasten on Glamps in building and repairing of

CLAMPD. When a piece of Board is fitted with the Grain to the End of another piece of Board across the Grain, the former Board is said to be clamp'd. And thus are the Ends of Tables usually clamp'd, to keep them from warping or

casting.

CLARO-OBSCURO, is a Term in Painting; and signifies the Art of distributing Lights and particular as well on particular Shadows advantageously, as well on particular Objects as on a Picture in general. On particular Objects tis necessary to give them an agreeable Roundness, and a particular Relieve; and in the Picture in general, to expose the Objects with Pleasure to the View of the Spectators, by giving the Eye an Occasion to rest; which is best done by an happy Distribution of great Lights and Shadows, which by their Opposition set off one another.

CLASP-NAILS, are such whose Heads are brought into a little Compass, so that they will fink into the Wood, and when drove home, let a

Smoothing Plane go over them.

CLENCH-NAILS, are fuch as will drive without splitting the Boards, and draw without break-They are used by Boat and Barge Builders; and are proper for any Building with Boards that must be taken down again: For fine Work they

are made with Clasp-heads.

CLEPSYDRA. In the Memoirs of the French Royal Academy for April 1699, there is an Account by Mr. Varignon, of a General and GeometrickMethod to make Clepyfydra or Water-Clocks with any kind of given Veilels, and with any given Orifices for the Water to issue out at, and accoxding to any given Velocity of the Water's Descent.

CLERK. This Word did anciently fignify a Secular Priest, in Contradistinction to a Religious or a Regular. But by Degrees it came to be in general attributed to every Scholar, and at last was common to every Scribe and Notary; and hence so many of our Law Officers have the Title of Clerk.

CLINCH-BOLTS in a Ship, are such as are clinched with a rivering Hammer at those Ends

which come through.

CLOSE-FIGHTS, are, aboard a Ship, such Bulk-heads as are in a close Fight put up fore and aft in the Ship, for the Men to stand behind them

fecure, and fire upon the Enemy; and if the Ship

is boarded, to scour or clear the Decks.
CLOVE, is a Weight of Cheese containing the 32d Part of the Weight; and so is 8 Pound by 9 H. 6. c. 8.

CLOUTS, are thin Plates of Iron nailed on that Part of the Axle-Tree of a Gun-Carriage which comes through the Nave, through which the

Lins-pin goes.
CLOUT-NAILS, are fuch as are commonly used for nailing on of Clouts (or Plates of Iron) to the Axle-Trees of Carriages; and arc proper to

fasten any Iron to Wood.

COCCYGÆUS, is a Muscle of the Os Coccygis, arising Tendino Carnous from the acute Process of the Os Ischium, between the Ligament that reaches from thence to the Os Sacrum, and one of the Heads of the Gemini; from a narrow Beginning it gradually dilates its self into a thin fleshy Belly, interspersed with some tendinous Fibres. It is inferted into the whole Length of the Os Coccyzis, laterally.

Its use is to draw that inwards or forwards after the Excretion of hardned Faces, & C. This Muscle was first discover'd by Dr. Douglis; See his

Myogr. Comp. Specim.

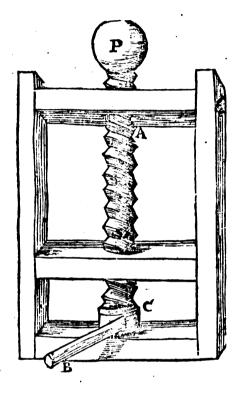
COCKET, is a Seal appertaining to the King's Custom-House: And also a Scroll of Parchment fealed and delivered by the Officers of the Custom-House to Merchants, as a Warrant that their Merchandize be Customed. This Word is used also in the Statutes of Bread and Ale, made 15 H. where there is mentioned Cocket Bread, among several other kinds: And it seems to have been hard Sea-Bisket, which perhaps had then some Cocket Mark or Seal; or else was so called from its being designed for the use of the Cock-swains or Seamen.

COCKS, aboard a Ship, are little square Pieces of Brass with Holes in them, and put into Wooden Shivers, to keep them from splitting and galling by the Pins of the Blocks in which they move.

COCK-WATER, is a Stream of Water brought in a Trough through a long Pole, in order to wath out the Sand of the Tin-Ore into the Launder, while it is bruifing in the Coffer of a Stamping. Mill: See Tin.

COCHLEA.

COCHLEA, is one of the Mechanical Powers, confisting of a Cylinder sulcated or hollowed in a Spiral manner, and moving or turning in a Box or Nut, cut so as to answer to it exactly. Now the Power or Force of this Engine may be thus estimated: Suppose in the Figure annexed the Weight P to be raised by the Turn of the Male Screw CA, by means of the Handle or Lever BC. Tis plain that in one Revolution of the Cylinder AC, the Weight can be raised no more than is the Distance between any of the two adjoining Leaves of the Screw; and that the Power moves as far as is



the Compass of one Revolution: That is, the way of the Power to that of the Weight in the same time, is as the Ambit of the Power in one Revolution of the Cylinder, to the Distance between any two contiguous Leaves of the Screw. Where-fore the Celerity of the Power to that of the Weight will be in the same Ratio. And consequently, if you apply a Power, which shall be to the Weight to be raised, as the way of that Power in each Revolution, shall be to the aforesaid Diflance between any two next adjoining Leaves of the Screw; the Power shall be in aquilibrio with the Weight, and therefore being increased never so little more shall raise it. This Power is plainly a Combination of the Lever and the Axis in Peritrochio together.

CODICIL, is a Schedule or Supplement to a Will or other Writing. Tis used as an Addition to a Testament, when any thing is omitted which the Testator would add, explain, alter, or retract; and is of the same Nature with a Testament, but that it is without an Executor: So that a Codicil is a less folemn Will of one that dies either Testate or Intestate, without the Appointment of an Heir. Testate, when he that made his Codicil, hath either before or afterwards made his Testament, on which that Codicil depends, as to which it refers. Intestate, when one leaves behind him only a Codicil without a Testament, wherein he gives Legacies only to be paid by the

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Heir at Law, and not by any Heir instituted by a Will or Testament. Codicils first came in use in the time of Augustus. A Codicil as well as a Will may be either written or nuncupative. Institute of

Imp. or Civil Law.

COFFER is a long square Box of the firmest Timber, about 3 Foot long, and 1 1 Foot broad, wherein Tin Ore is broken to Pieces in a stamping

Mill. See Tin.

COFFERER of the King or Queen's Hou'ehold, is a principal Officer in the Court, next under the Comptroller; that in the Counting-House and elsewhere at other Times, hath a special Charge and Overlight of other Officers of the House for their good Demeanor and Carriage in their Offices, to all which he pays their Wages. Vid. 39.

COHÆSION of the Parts of Matter. Sir Isaac Newton at the end of the Latin Edition of his admirable Opticks, concludes from the Coherence of the Parts of hard and solid Bodies, that their Particles do attract one another by a certain Force, which acts most intensely when the Particles touch one another. At some little Distance it produces those Chymical Effects or Operations, which you will find an account of under the Word Attraction, and which doth not extend to remoter Distances, 29 far at least as Sense can determine; and indeed tis hardly possible to account for the Firmness and Solidity of many Bodies, which have either a vast number of Pores, or Meatus in them, and consequently whose Particles canhot touch one another with their whole Surfaces, without supposing that those Particles be either strongly compress together, or do strongly attract one another. But it doth not seem reasonable to attribute this Cohassion of the Parts of Matter to any Pressure of the Ether, as some have imagined; because there is no certain Experiment of the Existence of any such thing as their Ather, nor if there were, would it be effectual to solve this Phanomenon, any more than it is for many others, which they account for only by this means. But this mutual Attraction of the Particles of Matter within such very narrow Bounds and Limits, which feem to be as much the Law of Nature, as Gravity, & c. will fairly account for this hitherto Inexplicable Phanmenon. Dr. Cheyne takes into Consideration the plainness of the Surfaces of the cohering Parts of Matter, in order to account for this Property; which indeed feems a necessary requisite. He thinks we may suppose some of the primary Atoms of Matter of which Bodies are constituted, to be terminated with plain Surfaces on all Sides. And fuch produce Bodies of the strictest and firmest Cohesion; others may be terminated partly with Curve, as well as partly with plain Surfaces, and these com-bined may produce Bodies of a middle Degree of Cohesion; and such as have Surfaces entirely Curve may produce Fluids, 85%. But this will not do alone, for though it will bring Bodies to immediate Contact, it will not keep them there, nor hinder them from being separated by any Force, how small seever: And the Fluids which surround our Globe, as the Particles of Light and Air, will get in between the Surfaces of Bodies when they are at any Distance greater than the Diameters of the. constituent Particles of those Fluids, and so by their lateral Pressure will destroy the Efficacy of that attractive Force by which Bodies cohere. For fince Light and Bodies act mutually one upon another; and that the Particles of Air endeavour

to recede one from another (fee Air and Light) they will render that part of Attraction whereby Bodies cohere, altogether insensible at any Distance greater than the length of the Diameters of the Particles of these Fluids: So that the Force by which Bodies cohere, cannot act but at very small Distances, and certainly is much greater in immediate Contact, than at any Distance how

COLAPTICE, is the Art of Carving or Cutting the Refemblances and Figures of Natural Things in Stone. The Term for the Artist here is

Lithoxos.

COLD. It hath been observ'd by Mr. Geoffroy (in a Discourse which he read before the French Royal Academy of Sciences, and which is mentioned in Phil. Trans. N. 274.) that a Mixture of the greatest Part of all the several Kinds of Salts, in many Liquors is accompanied with a fensible degree of Coldness, notwithstanding the violent Fermentations which such Mixtures do sometimes produce. As indeed the Learned and Ingenious Dr. Slare had before Experimented (fee Phil. Tranf. N. 150.) in a Mixture of an Acid Menstruum, and the Volatile Spirit of human Blood. Mr. Geoffroy found that pouring but half an Ounce of Sal Armoniac into three Ounces of Spirit of Vitriol, though a very violent Fermentation ensued, yet the Spirit of Wine in the included Thermometer descended three Inches and a half.

COLDSHIRE Iron, is fuch as is brittle when it

is cold. See Iron.

COLLATION, is the bestowing of a Living on a Clerk by an Archbishop or Bishop, when that Living is the Bishop's or Archbishop's own Gift: But when the Living is in the Gift of another, the Bishop is said to give the Clerk Institution into it on the Patrons Prefentation, and the Arch-deacon gives him Induction into it on the Bishops Mandate,

as well from the Collation as Institution.
COLLATIONE Heremitagii, isa Writ whereby the King confers the keeping of a Hermitage

upon a Cleik.
COLLEGIATE Churches, are Churches built and endowed for a Body Corporate, of a Dean or other President and Secular Priests; as Canons or Prebendaries in the said Church. Such as are with us, Westminster, Windsor, Rippon, Wolverhamp-ton, Southwel, Manchester, &c. None of these Collegiate Churches are Episcopal Sees or Cathe-

COLLUM Minus Uteri, is the Cavity of the Womb next its internal Orifice, where it is more contracted than it is at the Bottom.

COLONNADE, in Architecture, is a Range of

Pillars running quite round a Building, and standing within the Walls of it.

COLOUR, in a Law Sense, is a Plea that is probable, though in truth falle; and hath this End, to draw the Trial of the Cause from the Jury

to the Judge

COLOUR of Office, is always used in the Law in an ill Sense, signifying some ill Act done under Countenance of an Office; and so 'tis opposed to Virtute Officii, which is always taken in the best Sense; and implies a Man's doing a right and just

Thing under the Execution of his Office.
COLOUR. It hath been observed, that transparent Substances, as Glass, Water, Air, 69c. when made very thin by being blown into Bubbles, or otherwise formed into Plates, do exhibit various Colours according to their various Thinnels, al-

though at a greater Thickness they appear very clear and colourless. About these Sir I ac Newton, in his Opticks, Book 2. made many excellent About these Sir Isaac New-Observations serving to illustrate and demonstrates the Theory of Colours.

As, 1. By compressing two Prisms hard together, so that their Sides, which by chance were a little Convex, might somewhere south; he found the place where they touch'd to become absolutely transparent, as if they had been there but one continued piece of Glass: For when the Light fell so obliquely on the Air, between them in other Places as to be all reflected, it seemed in the place of Contact to be all transmitted, insomuch that when look'd upon, it appear'd like a little dark Spot, and when look'd through, it seem'd like a hole in that Air which was formed into a thin Plate by being compressed between the Glasses; and through that hole all Objects that were beyond it might be seen distinctly, which could not be seen at all through other Parts of the Glasses where the Air was interjacent. By pressing the Prisms hard together, this Spot would become confiderably broader.

2. When the Plate of Air, by turning the Prisms about their common Axis, became so little inclined to the incident Rays, that some of them began to be transmitted, there arose many slender Arks of Colours in it, which increased by continuing the Motion of those Prisms, and bended more and more about the faid transparent Spot, till they were compleated into Circles or Rings encompasfing it, and afterwards continually grew more and more contracted. These Arks at their first Appearance were of a Violet and Blue, and between were White Arks of Circles, which presently, by continuing the Motion of the Prisms, became a little tinged in their inner Limbs with Red and Yellow, and to their outward Limbs the Blue was adjacent. The Motion of the Prisms round their Axis being continued, these Colours contracted more and more thrinking towards the Whiteness on either Side of it, till at last they totally vanished into it, and then the Circles in those Partsappeared black and white, without any other Colours intermixed; but by farther moving the Prisms, the Colours would emerge out of the Whiteness again.

In his 4th Observation he considered more nicely the Order of the Colours arising out of the white Circles, according as the Rays became less and less inclined to the Plate of Air; and by using two Object Glasses of pretty long Telescopes, he observed the Succession and Quantity of the Colours to be thus: Next to the Pellucid Central Spot succeeded blue, white, yellow and red; the blue was so small that he could not discern it in the Circles made by the Prisms, nor could he well distinguish any violet in it; but the yellow and red were pretty copious, and feem'd about as much in extent as the white, and four or five times more than the blue. The next Circuit or Order of Colours succeeding and compassing these, were violet, blue, green, yellow and red; and these were all copious and vivid, except the green, which was very little in Quantity, and very faint and dilate. Of the other four the Violet was the least in extent, and the blue less than the yellow and red. The third Circuit or Order was purple, blue, green, yellow and red; in which the purple feemed more reddiff than the violet

Violet in the former Circuit; and the Green much more conspicuous, and as vivid and copious as any Colour there but the Yellow; but the Red began to look saded, and very much inclining to Purple. After this succeeded a fourth Circuit or Order of Green and Red: The Green was very copious and lively, inclining on one Side to Blue, on the other to Yellow. But here was neither Violet, Blue, nor Yellow, and the Red was imperfect and dirty. Also the succeeding Colours became more and more imperfect and dilute, till after three or four Revolutious they ended in perfect Whiteness.

In Observation the 5th and 6th he determines the Thickness of the Air lying between the Glasses, by which each Colour was produced: And in the 7th gives a Table of it in all the Obliquities of the Angle of Incidence: (See Air.) In the 9th he shews, that the Air between the two Object Glasses exhibited Rings of Colours, as well by transmitting Light, as by reflecting it; which he sound by looking through the Glasses. But the Central Spot was now White, and the Colours opposite to those made by Resexion in the former Cases; i. e. those Parts of the Glass, were now Black, which before were White, of vice versa; and those which were then Red were now Blue; which were then Yellow, were now Violet, soc.

In the Tenth he found, that by wetting the Object Glasses a little at the Edges, the Water crept slowly in between them, whereby the Circles became less, and the Colours more faint; and he found the Diameters of the coloured Circles made now by Water to those before made by Air, to be about seven to eight; and that if any other Medium, more or less dense than Water, be compressed between the Glasses, their Intervals at the Rings caused thereby, will be to those made by Air, as the Sines measuring the Refraction made out of that Medium into Air.

In the 12th he found, that by viewing these Rings in a darkened Room, they became more visible and distinct, and appear'd in a greater Number.

In the 13th Observation he found, that when the Prism was made to turn round its Axis, so that all the Colours might successively fall on that Part of the Paper which he saw by Reflection from that Part of the Glasses where the Circles appeared, so that all the Colours might be successively reflected from the Circles to the Eye, while it was held immoveable; he found, I say, that the Circles which the Red Light made, were manifestly bigger than those made by the Blue and Violet; and it was pleasant to see them gradually swell and contract, according as the Colour of the Light was changed: And in the 14th Observation, he. found then the Contraction or Dilatation of the Colours was swiftest in the Red, and slowest in the Violet, and in the intermediate Colours had intermediate Degrees of Celerity: and he gives you the Proportions in Numbers; and he shews also, that the Thickness of the Air between the Glasses there where the Ring is successively made by the Limits of the five principal Colours (Red, Yellow, Green, Blue, Violet) in order, are to one another very nearly, as the fix Lengths of a Chord which found the Notes in a fixth Major fol, la, mi,

Then in Observation 15, he manifestly shews the Origin of these Rings; for he found that these Rings in the preceding Observation, were not of various Colours like those made in the open Air, but appeared all over of that Prismatick Colour only with which they were illuminated; and by projecting the Prismatick Colours immediately upon the Glasses, he found that the Light which sell on the dark Spaces which were between the coloured Rings, was transmitted through the Glasses without any Variation of Colour; for on a white Paper placed behind, it would paint Rings of the same Colour with those which were resected, and of the Bigness of their immediate Spaces: so that its plain, That the Air between the Glasses, according to its various Thickness, is disposed in some Places to research, and inothers to transmit the Light of any one Colour; and in the same Place to research that of one Colour, where it transmits that of anos ther.

In Observation 16. he found, that the Squares of the Diameters of these Rings were in Arithmetical Progression. In Observation 17 and 18, he considers the Phænomena arising from the Colours seen in Bubbles of Water, made tenacious by a little Soap; and in the 19th he collects the Thickness of the Water requisite to exhibit one and the same Colour at several Obliquities, and expresses their Proportions in a Table: And in the 21st Observation he shews, by Help of Observation 10. and 16. the Thickness which Plates of Muscony Glass, Water, or any other Substances, have, at at any Colour exhibited by them.

Sir Isaac Newton, in the 22d Observation of his Second Book of Opticks, found, that a thin transparent Body, which is denser than its ambient Medium, exhibits more brisk and vivid Colours than that which is so much rarer: as he particularly observed in the Air and Glass: for blowing Glass very thin at a Lamp Furnace, those Plates encompassed with Air, did exhibit much more vivid Colours than those of Air made thin between two Glasses: Vid. Observ. 1. and 4.

And he shews farther, that since by his 10th Observation, the Thickness of Air to the Thickness of Water, which between the same Glasses exhibited the same Colour, was as 4 to 3; and since it appears (by the 21st Observation) that the Colours of thin Bodies are not varied by varying the Ambient Medium; therefore the Thickness of a Bubble of Water exhibiting any Colour, will be \$\frac{1}{4}\$ of the Thickness of Air producing the same Colour. And so according to Observation 21. the Thickness of a Plate of Glass, whose Refraction of the mean Refrangible Ray is measured by the Proportion of the Sines of 31 to 20, may be \$\frac{1}{2}\$ of the Thickness of Air producing the same Colours, and the like

of other Mediums. And on these Grounds the excellent Author gives a Table, wherein the Thickness of Air, Water and Glass, at which each Colour is most intense and specifick, is expressed in Parts of an Inch, divided into 100,000 equal Parts. And by means of this Table, he shews how to conjecture at the Bigness of the Parts of Natural Bodies by their Colours.

In the 24th Observation he takes Notice of something very odd and surprizing; and that is, that Bubbles of Water, or of Glass, and Plates of Muscovy Glass, which are not quite thin enough to represent the various Colours above-mentioned, yet when look'd on through a Prism, should appear adorn'd with Rings or Wavings; whereas a Prism usually makes Objects appear coloured only where they are terminated with Shadows, or have Parts unequally luminous: And the Reason of this he explains largely at p. 42, 43, 55c. of Book the 2d, Part the 2d. And from the whole he effectually proves those Properties of Light above discovered to be connate with the Rays and immutable; and consequently that all the Productions and Appearances of Colours in the World, are derived not from any Physical Change caused in the Light by Refraction or Reflexion, but only from the various Mixtures or Separations of Rays by virtue of their different Refrangibility or Reflexibility. And in this Respect the Science of Colours becomes a Speculation as truly Mathematical as any other Part of Opticks, so far as they depend upon the Nature of Light, and are not produced or altered by the Power of Imagination, or by striking or pressing the Edges.

Then in the following Part of the Second Book he confiders the Phanomena of the permanent Colours of Natural Bodies; and the Analogy between them, and the Colours of thin transparent Plates: And having before shewn, That Bodies appear of divers Colours, according as they are disposed to reflect most copiously the Rays originally endued with these Colours; he proceeds to examine their Constitutions, and to shew the Reason of their thus reslecting some Rays more copiously than others; which he doth in the following Propositions.

PROP. I.

Those Superficies of transparent Bodies reflect the greatest Quantity of Light, which have the greatest refracting Power: That is, which intercede Mediums which differ most in their refractive Densities. And in the Consines of equally refracting Mediums there is no Reslexion.

PROP. II.

The least Particles of almost all Natural Bodies ore in some Measure transparent; and the Opacity of those Bodies ariseth from the Multitude of Research caused in their internal Parts.

PROP. III.

Between the Parts of opake and coloured Bodies are many Spaces, either empty, or replenish'd with Mediums of other D'nsities; as Water between the tinging Corpuscles with which any Liquor is impregnated; Air between the Aqueous Globules that constitute Clouds or Miss: And for the most part

Spaces void of both Air and Water, but yet perhaps not void of all Substance, between the Parts of bard Bodies.

PROP. IV.

The Parts of Bodies and their Interstices, must not be less than of some definite Bigness, to render them coloured and opake.

PROP. V.

The transparent Parts of Bodies, according to their several sizes, must reflect Rays of one Colour, and transmit those of another, on the same Grounds that thin Plates or Bubbles do reflect or transmit those Rays. And this I take to be the Ground of all Colours.

For if a thinn'd or plated Body, which being of an even thickness, appears all over of an uniform Colour, should be slit into Threads, or broken into Fragments of the same thickness with the Plate; I see no Reason why every Thread or Fragment should not keep its Colour, and consequently, why an heap of those Threads or Fragments should not constitute a Mass of Powder of the same Colour which the Plate exhibited before it was broken.

And the Parts of all natural Bodies being like so many Fragments of a Plate, must on the same Grounds exhibit the same Colours; and that they do so, will appear by the Affinity of their Properties. The finely coloured Feathers of some Birds, and particularly those of Peacocks Tails, do in the very same Part of the Feather appear of several Colours in several Positions of the Eye, after the very same manner that thin Plates were found to do in the 7th and 19th Observations; and there-fore arise from the thinness of the transparent Parts of the Feathers; that is, from the Slender-ness of the very fine Hairs, or Capillamenta, which grow out of the sides of the grosser lateral Branches or Fibres of those Feathers. And to the same Purpose it is, that the Webs of some Spiders, by being spun very fine, have appeared coloured, as fome have observed; and that the coloured Fibres of some Silks, by varying the Position of the Eye, do vary their Colour: Also the Colours of Silks, Cloaths, and other Substances which Water or Oyl can intimately penetrate, become more faint and ob cure by being immerged in these Liquors, and recover their Vigor again by drying, much after the manner of the thin Bodies mentioned in the 10th and 12th Observations. Leaf Gold, some forts of painted Glass, the Infusion of Lignum Nephriticum, and some other Substances; reflect one Colour and transmit another, like thin Bodies in the 9th and 20th Observations: And some of those coloured Powders which Painters use, may have their Colours a little changed, by being very elaborately and finely ground. Where I see not what can be justly pretended for those Changes, besides the breaking of their Parts into less Parts by that contrition, after the same manner that the Colour of a thin Plate is changed by varying its thickness. For which Reason also it is, that the coloured Flowers of Plants and Vegetables, by being bruised, usually become more transparent than before, or at least in some Degree or other change their Colours. Nor is it much less to this Purpose, that by mixing divers Liquors, very odd and remarkable Productions of Colours may be

effected;

effected; of which no Cause can be more obvious and rational, than that the saline Corpuscles of one Liquor, do variously act upon or unite with the tinging Corpuscles of another, so as to make them swell or shrink, (whereby not only their Bulk, but their Density also may be changed;) or to divide them into smaller Corpuscles, (whereby a coloured Liquor may become transparent;) or to make many of them associate into one Cluster, whereby two transparent Liquors may compose a colour'd one. For we see how apt those saline Menstruums are to penetrate and dissolve Substances to which they are applied, and some of them precipitate what others dissolve.

In like manner if we consider the various Phænomena of the Atmosphere, we may observe, that when Vapours are raised, they hinder not the Transparency of the Air, being divided into Parts too small to cause any Reflexion in their Superficies. But when, in order to compose Drops of Rain, they begin to coalesce, and to constitute Globules of all intermedial Sizes, those Globules, when they become of a convenient Size to reslect some Colours and transmit others, may constitute Clouds of various Colours according to their Sizes. And I see not what can be rationally conceived in so transparent a Substance as Water for the Production of these Colours, besides the various Sizes of its Fluid and Globular Particles.

PROP. VI.

The Parts of Bodies on which their Colours depend, are denser than the Medium which pervades their Interstices.

This appears by confidering that the Colour of a Body depends not only on the Rays which are incident perpendicularly on its Parts, but on those also which are incident at all other Angles: And that according to the 7th Observation, a very little Variation of Obliquity will change the reflected Colour, where the thin Body or small Particle is rarer than the ambient Medium, insomuch that fuch a small Particle will at diversely oblique Incidences reflect all forts of Colours in so great a Variety, that the Colour resulting from them all, confusedly reflected from a heap of such Particles, must rather be white or grey than any other Colour, or at best it must be but a very impersect and dirty Colour: Whereas if the thin Body or small Particle be much denser than the ambient Medium, the Colours, according to the 19th Observation, are so little changed by the Variation of Obliquity, that Rays which are reflected least obliquely, may predominate over the rest so much, as to cause a heap of Particles to appear very intenfely of their Colour. It conduces also something to confirm this Prop. that according to Observation 22. the Colours exhibited by the denser thin Body within the rarer, are more brisk than those exhibited by the rarer within the more denser.

PROP. VII.

The Bigness of the component Parts of Natural Bodies may be conjectured by their Colours.

For fince the Parts of these Bodies, by Prop. 5. do most properly exhibit the same Colours with a Plate of equal thickness, provided they have the same refractive density; and since their Parts seem

for the most part to have much the same density with Water or Glass, as by many Circumstances is obvious to collect; to determine the Sizes of these Parts, you need only have recourse to the preceding Table where the thickness of Water or Glass exhibiting any Colour is express'd. Thus, if it were desired to know the Diameter of a Corpuscle, which being of equal density with Glass, shall reflect green of the third Order; (and what the meaning of these Orders are, I have explained above under Sir Isaac's 4th Observation:) The Number in the Table will be $16\frac{1}{4}$, which shews it to be $\frac{16\frac{1}{4}}{100000}$ Parts of an Inch. And from that 4th and his 18th Observation, he gathers these Particulars.

- 1. That Scarlets, and other Reds, Oranges and Tellows, if they be pure and intense, are most probably of the second Order: Those of the first and third also may be pretty good, only the yellow of the first Order is faint, and the orange and red of the third Order have a great Mixture of blue and violet.
- 2. There may be good Greens of the fourth Order, but the purest are of the third. And of this Order the green of all Vegetables seems to be, partly because of the Intensenses of their Colours; and also that when they wither, some of them turn to a greenish yellow, others to a more perfect yellow or orange, or perhaps to red, passing first through all the aforesaid intermediate Colours. Which Changes seem to be effected by the exhaling of the Moisture, which may leave the tinging Corpuscles more dense, and something also augmented by the Accretion of the oily and earthy Part of that Moisture. Now the green is without doubt of the same Order with those Colours into which it changes, because the Changes are gradual; and these Colours, though usually not very full, yet are often too full and lively to be of the fourth Order.
- 3. Blues and Purples may be either of the second or third Order, but the best are of the third. Thus the Colour of Violets seems to be of that Order, because their Syrup by Acid Liquors turns red, and by Urinous and Alkalizate turns green. For since its the Nature of Acids to dissolve and attenuate, and of Alkalies to precipitate and incrassate; if the purple Colour of the Syrup was of the second Order; an Acid Liquor, by attenuating its tinging Corpuscles, would change it to a red of the first Order, and an Alkali, by incrassating them, would change it to a green of the second Order: Which red and green, especially the green, seem too impersect to be the Colours produced by these Changes. But if the said purple be supposed to be of the third Order, its change to red of the second, and green of the third, may without any Inconveniency be allowed.

ency be allowed.

If there be any Body of a deeper and less reddish purple than that of Violets, 'tis probable its Colour is that of the second Order.'

The Blue of the first Order, though very faint and little, may possibly be the Colour of some Substances; and particularly the Azure Colour of the Sky seems to be of this Order. For all Vapours, when they begin to condense and coalesce into small Parcels, become first of that bigness whereby such an Azure must be reflected, before

they can constitute Clouds of others Colours. And so this being the first Colour which Vapours begin to reslect, it ought to be the Colour of the sinest and most transparent Skiesin which Vapours are not arrived to that Grossness requisite to reslect other Colours, as we find it by Experience.

4. Whiteness, if most intense and luminous, is that of the first Order; if less strong and luminous, it a Mixture of the Colours of several Orders. Of this last kind he takes the Whiteness of Each. Froth, Paper, Linen, and most white Substances to be; and of the former that of white Metals. For fince the densest of Metals (Gold) if foliated, is transparent, and that all Metals become transparent by being dissolved in Menstruums, or by being vitrified, the Opacity of white Metals ariseth not from this Density alone: They being less dense than Gold, would be more transparent than it, did not some other Cause concur with their Density to make them Opake. And this Cause he takes to be such a Bigness of their Particles as fits them to reflect the white of the first Order: For if they be of other Thicknesses, they must rested other Colours, as is manifest by the Colours which appear upon hot Steel in tempering it, and sometimes upon the Surface of melted Metals in the Skin or Scoria which arises upon them in their cooling. And as the white of the first Order is strongest which can be made by Plates of transparent Substances, so it ought to be stronger in the denser Substances of Metals than in the rarer of Air, Water and Glass. Nor doth he see but that Metallick Substances of such a Thickness as may fit them to resset the white of the first Order, may by reason of their great Density (according to Prop. 1.) reflect all the Light incident upon them, and so be as opake and splendent as 'tis possible for any Body to be. Gold or Copper mix'd with less than half their Weight of Silver, Tin or Regulus of Antimony, either in Fusion or amalgamated with a very little Mercury, become white; which shews both that the Particles of white Metals have much more Superficies, and so are smaller than those of Gold and Copper; and also that they are so opake as not to suffer the Particles of Gold or Copper to shine through them: Nor is it to be doubted but that the Colours of Gold and Copper are of the second Order, or of the third, and therefore the Particles of white Metals cannot be much bigger than is requisite to make them reflect the white of the first Order. The Volatility of Mercury argues that they are not much bigger, nor may they be much lefs, lest they lose their Opacity, and become either transparent as they do when attenuated by Vitrification, or by Solution in Menstruums; or black as they do when ground smaller, by rubbing Silver, Tin, or Lead on other Substances to draw black Lines. The first and only Colour which white Metals take by grinding their Parti-cles smaller is black; and therefore their white ought to be that which borders upon the black Spot in the Centre of the Rings of Colours mentioned in the preceding Observation; that is, the white of the first Order: But if you would hence gather the Bigness of Metallick Particles, you must allow for their Density. For were Mercury transparent, its Denfity is such, that the Sine of Incidence upon it (by Sir Isaac Newton's Computation) would be to the Sine of its Refracting, as 71 to 30, or as 7 to 2. And therefore the Thickness of

its Particles, that they may exhibit the same Colours with those of Bubbles of Water, ought to be less than the thickness of the Skin of those Bubbles in the Ratio of 2 to 7.

in the Ratio of 2 to 7.

Whence 'tis possible, that the Particles may be as little as the Particles of some transparent and volatile Fluids, and yet resset the white of the first

Order.

5. For the Production of Blackness ('he shews) that the Corpuscles must be less than any of those which exhibit any other Colours, because at all greater sizes of Particles there is too much Light reflected to constitute this Colour: But it they be supposed a little less than is requisite to reslect the white and very faint blue of the first Order, they will, according to Observation 4, 8, 17, and 18, reflect so very little as to appear intensely black; and yet may perhaps variously refract it to and fro within themselves so long, until it happen to be stifled and lost, by which means they will appear black in all Politions of the Eye Chout any Transparence. And from hence may be understood why Fire, and that more subtle Dissolver Putrefaction, by dividing the Particles of Substances, turn them to black: Why small Quantities of black Substances impart their Colour very freely and intenfely to other Substances to which they are applied, the minute Particles of these, by reason of their very great Number, eafily overspreading the gross Particles of others: Why Glass, ground very elaborately with Sand on a Copper Plate till it be well polished, makes the Sand, together with what is worn off from the Glass and Copper, become very black: Why black Substances do soonest of all others become hot in the Sun's Light, and burn; which Effect may proceed partly from the Multitude of Refractions in a little Room, and partly from the easy Commotion of so very small Particles:) And why Blacks are usually inclined a little to a bluish Colour; for that they are so, may be seen by illuminating white Paper by Light re-slected from black Substances, when the Paper will usually appear of a bluish white: And the reason is, because black borders on the obscure blue of the first Order in the 18th Observation, and therefore reflects more Rays of that Colour than any

The Sensations of different Colours seem to arise from hence, That several sorts of Rays do make Vibrations of several Bignesses, which, according to their Magnitudes, do excite Sensations of several Colours; much after the manner that the Vibrations of the Air, according to their several Bignesses, do excite Sensations of different Sounds. And in particular 'tis probable, that the most refrangible Rays excite the shortest Vibrations, and so produce the sensation of a deep violet Colour; and that the least refrangible Rays excite the largest Vibrations, and so produce the Sensation of a deep Red: And that the several intermediate Sorts of Rays do excite Vibrations of several intermediate Bignesses, and thereby produce the Sensations of the several intermediate Colours.

And 'tis probable also, that the Harmony and Discord of Colours (for some Colours, as that of Gold, Yellow, and Indico, are agreeable to the Eyes, and some not) arise from the Proportions of these Vibrations propagated through the Fibres of the Optick Nerves into the Brain, just as the Harmony and Discord of Sounds arises from the Vi-

brations

brations of the Air: See Newton's Opticks, at the End.

He thews also there at the 21st Query, That to the Production of all the Varieties of Colours, and the various Degrees of Refrangibility of the Rays of Light, there is nothing more necessary than that the Rays of Light be small Bodies or Particles of different Magnitudes. The least Size of which constitute a deep Violet Colour; as being the most dark and languid of all others, and as being most turned out of their way by the Action of refracting Surfaces upon them. And the other Sizes of the Rays of Light, according as they increase in Magnitude, do exhibit stronger and brighter Colours, as Blue, Green, Yellow and Red; and are, in Proportion to their Bigness, less and less capable of being refracted, or turned out of their Way.

COLOURS. Dr. Hook, in his Oper. Post. p. 54. from the Apparition of Colours in the Triangular or Hexangular Stiria of Crystal, where a lovely Variety of Colours is produc'd, in a way different quite from that which Nature takes in the Generation of Colours in other Bodics, as in Flowers, Blood, Metals, &c. he concludes, that all other Hypotheses of Colours are overhe concludes, thrown, and that nothing besides a Refraction, which is considerable enough to obliquate the Pulse of Light, is necessary for the Production of Co-

Lours

COMBARONS are the Fellow-Barons or Commonalty of the Cinque-Ports, of the two ancient Towns, and their Members. The Members that represent them in the House of Commons, are

called Barons of the Cinque-Ports.

COMBINATION of Quantities is defined by Mr. Strode, in his Treatise on this Subject, printed, London, 1678. to be the many several Ways one may take any Number of Quantities, without having any respect to their Places.

Col. Thornycroft's Treatife of Combinations from Phil. Trans. N. 299. in which the whole Affair of Combinations and Alternations is improved and compleated.

And First, He premises,

That as in the Notation of Powers, a a a a bbbcc is defign'd by a4 b3 c2, and universally p times the Position of c, by ap, soc. so in things expos'd likewise, (unless where 'tis propos'd they should be all different) which Indices, as they have here no relation to Powers, but express only the Occurrences of those Things to which they respectively belong, I therefore call Indices of Occurrences.

2dly, That as often as I shall hereafter mention the Combination and Alternations of the ps qs rs or s, (which confider'd by themselves are capable of no Variation) I mean, of those things whose In-

dices they are.

3dly, That m is generally put for the whole Number of things expos'd, whether all different or not, i. e. equal to the Sum of their Indices; and n for such a Number of them as each Combination and Alternation must consist of, (unless presuppos'd equal); which explains what is hereafter meant by the Combinations and Alternations of m things taken n and n, or of m things taken m and m; and the like Expression, by whatever Symbols the Number of things out of which the Combinations and Alternations are to be made, or of which they are to confift, may be defign'd. Vol. II.

Lenma I.

If in a right Line, at any Distances, be plac'd any number of Things, a b c d, &5 c. the Number of the Intervals, a b, b c, c d, &5 c. terminated each by two adjacent Things, is one less than the Number of Things.

For whereas every Interval is terminated by two adjacent Things, if to any Number of Things be added one Thing more, one Interval only is there-by added. Q. E. D.

Lemma II.

The Number of the Alternations of m Things a b c d, & c. different each from other, taken m and m, is m times the Number of the Alternations of m-1 Things a b c, taken m-1 and

For (by Lemma I.) the last Letter d, besides the Position it hath, may have m-2 Positions, viz. in the Intervals which are between m-1 Things abc; but it may also have one more, for it may be put first of all, it may therefore have m Positions; and those in all the different Orders, whereof m-1 Things are capable, which being all the possible Positions of d, in all the Varieties of a b c, is all the Variety whereof the whole Number of things exposed a b c d, &c. is capable. Q. E. D.

Lemma III.

The Number of the Alternations of m things a b c d, &c. different each from other, taken m and m, is equal to $m \times m - 1 \times m \ m - 2 \times m$

3 × m—4, &c. continu'd to m places.
For let m O express the Number of the Alternations of m things different each from other.

- 1 O, of m-1 things, and the like.

Tis evident, that if m = 1, it will be m O = 1; for there can be but one Order of one thing. And if m be greater than Unity, then it will be (by Lem. 2.) $m \ O = m \times m - 1 \ O = m \times m - 1$ $m - 1 \times m - 2 \ O = m \times m - 1 \times m - 2$ $\times m - 30 =$, 65c. till we have an Equation confishing of m places; i. e. $= m \times m - 1 \times m = m \times m + m = m \times$ m-2 x m-3 x, &c. continu'd to m places. Q. E. D.

Lemma IV.

If m w express the Number of the Alternations of m things ap, bp, cp, dp, eq, fr, EGc. taken m and m; and a the Number of pr, g the Number of qr, g the Number of rr, it will be,

77 × =

4 x m x 5 x, &c. continu'd to m places. I × m - 2 × m -

p×p-1 ×p-2 ×, egc. a × q×q-1 ×, egc. b × r ×r-1 ×, egc. y each Series continued to p, q, r, Ge. places respectively.

For the Number of the Alternations of any Number of things, however divided into Parts, is produc'd by a continual Multiplication of the Alternations of those things amongst themselves respectively, which compose each Part, into the Number of their Alternations one amongst the other; i. e. in the present Case (the several Occurrences being supposed to compose the several Parts, and Part in both Cases, are different from the rest of consequently the Number of the Alternations of the things expos'd; i.e. by Lem. 3.

the things composing each Part equal to Unity) m = to the Number of the Alternations of the things composing the Parts one amongst the other; but the Number of their Alternations one amongst the other, is the same in this Case, as if the things expos'd, being all different, were divided into the fame Parts; for the things which compose each

and n, are produc'd by the Alternations of the

composing the Parts one amongst the other: And therefore the Number of those to the Number of

these = to the Number of the Alternations of m things taken m and m, the Indices of whose Occur-

ther m confist of things all different or not; and

Theorem.

If n be express'd, according to all the different Forms of Combination which the things expos'd

p=the highest Index | a =the number of p' γ in ev'ry

2 x, Egc. continu'd to m places.

whether n be equal to, or less than m.

are capable of, and

 $m \times m - 1 \times m - 2 \times m - 3 \times m - 4 \times m - 5 \times,$ E3c. continued to m places. $m = \frac{1}{p \times p - 1} \times \frac{p}{p \times p} \times \frac{1}{p} \times \frac{p}{p}$ For if the things expos'd be divided in two Parts, viz in the Ratio of n and m-n, its evident that their different Combinations taken n

Lenma V.

The Number of the Combinations of m things abcd, Sc. different each from other, taken n ab c d, Egc. different each from other, $\frac{m \times m-1 \times m-2 \times m-3 \times, \text{ Egc.}}{n \times n-1 \times n-2 \times n-3 \times, \text{ Egc.}}$ each Series continued to n places.

 $m \times m - 1 \times m - 2 \times m$ rences are n and $m-n=\frac{m}{n\times n-1}\times \frac{m}{n}$ for $n=1\times \frac{m}{n}$ and $m=n=1\times \frac{m}{n}$ series continued to n=1and m-n places respectively, (by Lem. rem for finding the Combinations and Alternations 4th;) i. e. because n+m-n=m of m things taken n and n universally; i. e. When $m \times m - 1 \times m - 2 \times m - 3, 63^{\circ}$ each Series $= \frac{1 \times n - 1 \times n - 2 \times n - 3}{n \times n - 1 \times n - 2 \times n - 3}, \quad \text{Eff.}$ continued to n places, by Lem. 3. Therefore,

Lemma VI.

The Number of the Alternations of m things abcd, efc. different each from other, taken n and n, is =m x m - 1 x m - 2 x m - 3 x, 53c. continu'd to s places. Q. E. D.

Scholium.

Since in the things expos'd the same things may occur more than once, and also n be less than m, the Indices of the Occurrences which are in some of the Combinations of m things taken n and n, may differ from those which are in others; but those Combinations, the Indices of whose Occurrences are the same, are said to be in the same Form: Therefore whereas n is equal to the Sum of the Indices which are in each Combination taken n and n, if n be express'd by all the different Combinations of fuch Indices only (being integer Numbers) whereof no one may exceed the high-ef Index of the things expos'd, and being more than one in a Combination, are each of them, which are in the same Combination, comprehended in a distinct Index thereof; these Expressions of n will necessarily be the several Forms of the Combinations taken n and n, whereof m things are capable: Whence is deriv'd a General Theo-

q=the next highest e=the number of q. form of r=the next highest r=the number of r' Combifithe next highest r=the number of f' nation. छुट∙ A
B
C
dices not less than
C
D
Which are
in the
things expos'd. And $b = a + \beta$, $c = b + \gamma$, $d = c + \beta$, E. And $b = a + \beta$, $c = b + \gamma$, $d = c + \beta$, E. I fay the Number of the Combinations of m things taken n and n, in any one Form of Combination, shall be $\frac{A \times A - 1 \times A - 2}{a \times a - 1 \times a - 2}$, E. c. $\times \frac{B - a \times B - a - 1}{B \times \beta - 1} \times$, E. c. $\times \frac{C - b \times C - b - 1}{\gamma \times \gamma - 1} \times$, E. c. $\times \frac{D - c \times D - c - 1}{\beta \times 2 - 1}$, E. c. continu'd to so many Terms as there are different Indices in the 69°€.

so many Terms as there are different Indices in the Form of Combination, and each Term to α , β , γ , β , β , β , and this Number multiply'd into

 $n-5 \times n-6$, Efc. continu'd to n places. $n \times n - 1 \times n - 2 \times n - 3 \times n - 4 \times$

pxp-1xp-2x, &c. 2xqxq-1x, &c. tinued to p, q, r, & c. places respectively, shall be the Number of their Alternations.

x 1 x 1 — 1 x, &c. | y x, &c. each Series con-Alternations which are in every Form of #5 shall be the whole Number of Combinations and But the Sum of all the Combinations and Alternations of m things taken n and n.

Demon-

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Demonstration.

First then tis evident, that those Combinations, which are in different Forms, differ from each other.

Again, Tis evident that the Combinations of m things, as a, b, c, d, e, f, f, g, h, i, e, c. (the Indices simply consider'd) taken n and n, in a Form wherein are p_i , q_i , r_i , shall be equal to the Number of the Combinations of the p_i , which are in the things expos'd, taken a and a, multipli-ed into the Number of the Combinations of the q taken g and e, multiply'd into the Number of the Combinations of the r' taken γ and γ .

But because p, and all lesser Indices, are comprehended in every Index which is greater than themselves, therefore is A = to the Number of p, which are in the things expos'd; and for the same Reason would B = the Number of the q', and Cthe Number of r^i : But the Number of the p^i , which are in every Form of Combination, is $\equiv a$; therefore is B - a = to the Number of q': Also because the Number of ps and qs together, which are in every Form of Combination, wherein there are q', is $= a + \beta = b$; therefore is C - b = 1 in any of those Combinations shall be

to the Number of r', and so on, how many soever were the different Indices in any Form of Combination.

But (by Lem. 5.) the Number of the Combinations of the p, which are in the things expos'd, whose Number is A, taken a and a, is $= \frac{A \times A - 1 \times A - 2}{\alpha \times \alpha - 1 \times \alpha - 2}, \text{ so } c. \text{ continu'd to } \alpha \text{ pla-}$ ces; and the Number of the Combinations of the q', whose Number is $B \rightarrow z$, taken ϵ and ϵ , is $\frac{B \rightarrow \alpha \times B - \alpha \rightarrow 1 \times B - \alpha - 2}{\epsilon \times \epsilon - 1 \times \epsilon - 2}, \quad \text{Sc. con}$ tinu'd to & places; and the Number of the Combinations of the r^s , whose Number is C-b, taken γ_* and γ_* is $=\frac{C-b\times C-b-1}{2}$, $\epsilon_0 c$. continu'd to γ places. Q. E. D.

But every Combination in one and the fame Form, affords the same Number of Alternations: Therefore the Number of Alternations in any one Form, is so many times the Number of Combinations, as is the Number of Alternations in any one of these Combinations.

But (by Lem. 4.) the Number of Alternations.

2 × # --3×n-4×n-5×n-6×, esc. continu'd to n places.

 $p \times p - 1 \times p - 2 \times \text{, egc.} \quad a \times q \times q - x \text{, egc.} \quad c \times t \times r - 1 \times \text{, egc.} \quad \gamma \times \text{, each Series continued to}$ $p, q, r, \text{ egc. places respectively.} \quad Q. E. D.$

Now to make an Application of this General more generally demonstrated; I say, ule to those particular Cases which have already If n=m, there can be but one Form of Com-Rule to those particular Cases which have already been consider'd by others, and which are contain'd bination, and but one Combination in that in our 3d, 4th, 5th and 6th Lemma's, and by us Form; and therefore the Number of Alternati-

 $m \times m - 1 \times m - 2 \times m - 3 \times m - 4 \times$, Esc. continu'd to m places.

places respectively; i. e. (if p=1) = $m \times m - 1 \times m - 2 \times m - 3 \times m - 4 \times$, so c. continued to m places, which are the Cases of the 4th and

3d Lemma's.

But if the things expos'd are all different, and n be less than m, which is the Case of the 5th and 6th Lemma's, then also can there be but one Form of Combination, and it will be A = m and a = n, and the whole Number of Combinations

= n, and the whole remarks $\frac{A \times A - I \times A - 2 \times, 6 \circ c}{a \times a - I \times a - \times 2, 6 \circ c}$ = $\frac{m \times m - I \times m - 2 \times, 6 \circ c}{a \times a - I \times m - 2 \times, 6 \circ c}$ each Series $n \times n - 1 \times n - 2 \times$, Efc. continued to n places, and therefore the Number of Alternations = $m + m - 1 \times m - \times 2$, 55°c. continued to n places.

But fully to illustrate this Theorem, which, as delivered in general, may feem somewhat too abstracted to be commonly understood, I shall subjoin one short Example.

Example.

Let the things exposed be a a a b b b c c, or according to our way of Notation, a^3 , b^3 , c^4 ; 'tis requir'd to find the Number of their Combinations and Alternations taken 4 and 4.

pxp-1x, &c. | 2 x q x q-1 x, &c. | 6 x r x, &c. | 7 x, &c. each Series to p, 9, r, &c. Then (because in the things expos'd there is no one thing occurs more than thrice, nor more than three things different from each other) will all the Forms of Combination, which the things expos'd

$$Viz. \left\{ \begin{array}{cc} 3 & 1 \\ 2 & 2 \\ 2 & 1 & 1 \end{array} \right\}$$
Then

are capable of, be these,

In the first Form will p = 3, q = 1, a = 1, c = 1, A=2, B=3, In the 2d Form will p=2, a=2, a=2, A=3, —. In the 3d Form will p=2, q=1, $\alpha=1$, $\zeta=2$,

The Number of Combinations in the First Form $= \frac{A}{\alpha} \times \frac{B-z}{\ell} = \frac{2}{1} \times \frac{2}{1} = \frac{2}{4}$ The Number of Combinations in the Second Form = $\frac{A \times A - 1}{a \times a - 1} = \frac{2 \times 2}{2 \times 1}$ The Number of Combinations in the Third Form $=\frac{A}{\alpha} \times \frac{B-\alpha \times B-\alpha-1}{\beta \times C-1} = \frac{2\times I}{2\times I} = 3$ And the whole Number of Combinations = 10

Also the Number of Alternations:

In the First Form =
$$4 \times \frac{n \times n - 1 \times n - 2 \times n - 3}{p \times p - 1 \times p - 2|^{\alpha} \times q^{\beta}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{3 \times 2 \times 1|1 \times} = 4 \times 4 = 16$$

In the Second Form = $3 \times \frac{n \times n - 1 \times n - 2 \times n - 3}{p \times p - 1|^{\alpha}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1|2} = 3 \times 6 = 18$

In the Third Form = $3 \times \frac{n \times n - 1 \times n - 2 \times n - 3}{p \times p - 1|^{\alpha} \times q^{\beta}} = 3 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1|1 \times 12} = 3 \times 12 = 36$

And the whole Number of Alternations = 70

Many are the Properties of this Theorem, in common with others; as, To find the Uncia of a Multinominal rais'd to any integer Power: To raise an infinite Series to an integer Power, though of an interrupted Order, without introducing any thing immaterial, or which must afterwards be expung'd; and many others. But then so many Terms of the Series must be taken in at first, as shall serve to the Purposes of the intended Approximation, otherwise as often as it shall fall short of that, the Operation must be began de nevo.

Many likewise are the Properties peculiar to this Theorem, and great Variety of Problems might be fram'd; and I scruple not to say, many may occur in Practice, which are solvable by this, and no

other Method whatever. Hence may be found the Number of all Words whereof the 24 Letters are capable, from one Letter in each Word, to any Number of Letters gi-

Hence may be found the Number of all Num-

bers, to any given Number of Places, which may be produced from any Number of Figures given.

Hence also the Compass of a Musical Instrument being given, the Time and Number of the Bars, whereof each Tune shall consist, the Numbers of Tunes may be found which that Instend bers of Tunes may be found, which that Instrument is capable of

To give an Instance of the prodigious Variety that there is in Musick, I have calculated the Numthat there is in Munck, I have calculated the Number of Tunes in common Time, confissing of eight Bars each, which may be play'd on an Instrument of one Note Compass only; and it is this, viz. 27584.270157.013570.368586.999728.299176. whereas the Changes on 24 Bells is but 620448. 401733.239439.360000.which is but 425333.239439.360000.which is but 425333.239439.360000.which is but 425333.239439.360000.which is but 425333.239439.360000.which is but 425333.339439.360000.which is but 425333.339439.360000.which is but 4253333.339439.360000.which is but 4253333.339439.360000.which is but 42533333.339439.360000.which is but 425333333333. his Algebra demonstrates, could not be dispatch'd in 31557. 600000. 00000 Years. If then the Instrument were of as many Notes

Compass as any Instrument now in Use, how prodigiously must the Number of Tunes be increas'd; the Calculation of which (though much more intricate and operase) would be equally attainable by our Theorem.

See Cassini's Dissertation in the COMETS. Memoirs of the French Academy of Sciences, 1699. In the AR. Erud. Lipf. May 1682. there is a way of finding the Distance of a Comet from the Earth, by P. M. Kavina, Mathematick Professor of Faenza: And another in December, 1685. by G. S. D. whereby the Comet's Distance from the Earth is found, without any Change of Place or Station of the Observator, or taking any Altitudes or Azimuths,

Writers on the Subject of Comets.

Lubinietski Theatrum Cometicum. Cum Fig. 2. Vol. Amst. 1661.

Johan. Hevelii Cometegraphia. Geduni, 1668. -Emsdem Prodromus Cometicus, 1660. Erasmus Bartholinus de Cometis. Stanislai Theatrum Cometicum.

Gattus de Cometis. Jac. Bernouilli Conamen Novi Systematis Come-

Dissertation sur le Nature des Cometes, per M. Petit.

Mr. Edmund Halley, Savilian Professor of Geometry in Oxon, and F. R. S. his. Synopsis of the Astronomy of Comets is as follows:

The ancient Egyptians and Chaldeans, (if we may credit Diodorus Siculus) by a long Course of Observations, were able to predict the Apparitions of Comets. But since they are also said, by the Help of the same Arts, to have prognosticated Earthquakes and Tempers; 'tis past all doubt, that their Knowledge in these Matters was the Result rather of mere Astrological Calculation, than of any Astronomical Theories of the Caelestial Motions. And the Greeks, who were the Conquerors of both those People, scarce found any other Sort of Learning amongst them than this; so that 'tis to the Greeks themselves as the Inventors (and especially to the great Hipparchus) that we owe this Aftronomy, which is now improved to such a heighth. But yet amongst these, the Opinion of Ariftotle (who wou'd have Comets to be nothing else but sublunary Vapours, or airy Meteors) prevail'd so far, that this most difficult Part of the Astronomical Science lay altogether neglected; for no body thought it worth while to take notice of, or write about the wandring un-certain Motions of what they effected Vapours floating in the Æther; whence it came to pass, that nothing certain concerning the Motion of Comets can be found transmitted from them to us.

But Seneca the Philosopher, having consider'd the Phenomena of two remarkable Comers of his Time, made no Scruple to place them amongh the Colestial Bodies, believing them to be Stars of equal Duration with the World, though he owns their Motions to be govern'd by Laws, not as then known or found out. And at last (which was no untrue or vain Prediction) he foretels, That there should be Ages some time hereafter, to whom Time and Diligence shou'd unfold all these Mysteries; and who shou'd wonder that the

Ancients

Ancients could be ignorant of them, after some lucky Interpreter of Nature had shewn in what Parts of the Heavens the Comets wander'd, what and how great they were. Yet almost all the Astronomers differ'd from this Opinion of Seneca; neither. did Seneca himself think sit to set down those Phenomena of the Motion, by which he was enabled to maintain his Opinion, nor the Times of those Appearances which might be of use to Posterity, in order to the Determining these Things. And indeed, upon the turning over very many Histories of Comets, I find nothing at all that can be of Service in this Assair, before A. D. 1327. at which Time Nicephorus Gregoras, a Constantinopolitan Historian and Astronomer, did pretty accurately describe the Path of a Comet amongst the fix'd Stars, but was too lax as to the Account of the Time; so that this most doubtful and uncertain Comet only deserves to be inserted in our Catalogue for the Sake of its appearing near 400 Years ago.

Then the next of our Comets was in the Year 1472 which being the swiftest of all, and nearest to the Earth, was observed by Regionnentanus, This Comet (so frightful upon the Account both of the Magnitude of its Body and the Tail) mov'd Forty Degrees of a great Circle in the Heavens in the Space of one Day; and was the first of which any proper Observations are come down to us. But all those that consider'd Comets until the Time of Tycho Brahe (that great Restorer of Astronomy) believ'd them to be below the Moon, and so took but little Notice of them, reckoning them

not other than Vapours.

But in the Year 1577, (Tycho seriously pursuing the Study of Stars, and having gotten large Instruments for the performing Cælestial Mensurations, with far greater Care and Certainty than the Ancients could over hope for) there appear'd a very remarkable Comet; to the Observation of which, Tycho vigorously apply'd himself, and found by many just and faithful Trials, that it had not a Diurnal Parallax that was at all perceptible; and consequently was not only no aereal Vapour, but also much higher than the Moon; nay, might be plac'd amongst the Planets for any Thing that appear'd to the contrary: The cavilling Opposition made by some of the Schoolmen in the mean Time being to no purpose.

Next to Tycho came the Sagacious Kepler. He having the Advantage of Tycho's Labours and Obfervations, found out the true Physical System of the World, and vastly improv'd the Astronomical

Science.

For he demonstrated that the Planets perform their Revolutions in Elliptick Orbits whose Planes pass through the Center of the Sun, observing this Law, That the Areas (of the Elliptick Sestorstaken at the Centre of the Sun, which he proved to be in the common Focus of the sellipses) are always proportional to the Times in which the correspondent king elliptical Arches are describ'd. He discover'd also, That the Distances of the Planets from the Sun are in the Sesquialteral Ratio of the Periodical Times, self.

or (which is all one) That the Cubes of the Distances are as the Squares of the Times. This great Astronomer had the Opportunity of observing two Comets, one of which was a very remarkable one. And from the Observations of these (which afforded sufficient Indications of an Annual Parallax) he concluded, That the Comets miv'd freely through the Planetary Orbs with a Motion not much different from a Restilinear one; but of what Kind he could not then precisely determine.

Next, Hevelius (a noble Emulator of Tycho Brahe) following in Kelper's Steps, embraced the same Hypothesis of the Rectilinear Mation of Comets, himself accurately observing many of them; yet he complain'd, that his Calculations did not agree to the Matter of Fact in the Heavens: And was aware, That the Path of a Comet was bent into a Curve Line towards the Sun. At length came that prodigious Comet of the Year 1680. which defeending, as it were, from an infinite Distance perfendicularly towards the Sun, arose from him.

again with as great a Velocity.

This Comet, which was seen for four Months continually) by the very remarkable and peculiar Curvity of its Orbit (above all others) gave the fittest Occasion for investigating the Theory of their Motion. And the Royal Observatories of Paris and Greenwich having been for some Time sounded and committed to the Care of most excellent Astronomers, the apparent Motion of this Comet was most accurately (perhaps as far as human Skill could go) observed by Messieurs Cassini and Flame

steed.

Not long after, that great Geometrician, the illustrious Sir Isaac Newton, writing his Mathematical Principles of Natural Philosophy, demonstrated not only that what Kepler had found, did necessarily obtain in the Planetary System, but also that all the Phenomena of Comets would naturally sollow from the same Principles; which he abundantly illustrated by the Example of the aforesaid Comet of the Year 168c. shewing, at the same Time, a Method of Delineating the Orbits of Comets Geometrically; wherein he (not without the highest Admiration of all Men) solv'd a Problem, whose Intricacy render'd it worthy of himself. This Comet he prov'd to move round the Sun in a Parabolical Orb, and to describe Area's (taken at the Center of the Sun) proportional to the Times.

Wherefore (following the Steps of so great a Man) I have attempted to bring the same Method to Arithmetical Calculation; and that with desired Success. For having Collected all the Observations of Comets I could, I fram'd this Table, the Result of a prodeious deal of Calculation; which, though but small in Bulk, will be no unacceptable Present to Astronomers. For these Numbers are capable of representing all that has been yet observed about the Motion of Comets by the Help of the following general Table; in the making of which I spar'd no Labour, that it might come forth perfect, as a Thing consecrated to Posserity, and to last as long as Astronomy it

The Astronomical Elements of the Metions in a Parabelick Qrb of all the Comets that have been bitherte duly observed

Comt	Nodus	Inclin.	Peribelion 1	Distan.	Log. Dift.	Temp. equat.	Peribelion
An.	Ascend.	Orbita.	. 1	Perileel.		Peribelii.	a Node.
1 1	Ů			a Sole.	a Sol.		1
	gr. "	gr. ' '	gr.			d. h. '	gr.
			Ö 7.59. C			June 2. 6.25	
147.	V311.46.20	5.20. 0	015.33.37	5 42 73			123.47.10 Retrog.
			₩ 1.39. c				107.46. 0 Retrog.
1532	TI 20.27. C	32.36. C	9521. 7. C	50910	9.7 06803	OEt. 19.22.12	3:40. 0 Direct.
1556	11/25-42. 0	32. 6.30	vs 8.50. c	46390	9.666424	Apr. 21.20. 3.	103. 8. 9 Direct.
1 577	Y 25.52. 0	74-32-45	€ 9.22. O	18342	9.263447	08. 26.18.45	103.30. 0 Retrog.
11580	N 18.57.20	64.40. C	9019. 5.50	59628	9.775450	Nov. 28.15.00	90. 8.30 Direct.
1585	7.42.3C	6. 4. 0	γ 8.51. o	109358	0.03 885 0	Sept. 27.19.20	28.51.30 Direct.
1590	水15.30.40	29.40.40	m 6.54.30	57661	9 .7 60882	Jan. 29. 3.45	51.23.50 Retrog
11506	₩ 12.12.30	55.12. C	m 18.16. c	51293	9.710050	tuly 31.19.55	83.50.30 Retrog.
1607	0 20.21. c	17. 2. 0	2.16. c	58680	9. 768 490	OH. 16. 3.50	108.05. o Retrog.
1618	п 16. 1. с	37·34· C	Υ 2.14. C	<u> 37975</u>	9 579498	Oct. 29.12.23	73.47. 0 Direct.
1650	II 28.10. 0	79.28.	728.18.4 0	84750	9.928140	Nov. 2.15.40	59.51.20 Direct.
1661	II 22.30.30	32.35.50	9525.58.40	44851	9.651772	Jan. 16.23.41	33.28.10 Direct.
1654	H21.14. C	21.18.30	શુ 1041.25	102575	0.011044	Nov. 24.11.52	59.27.25 Retrog
1665	7 18.02. c	76. 5. 0	п11.54.30	10649	9.027309	Apr. 14. 5.15.	156. 7.30 Retrog
1672	V\$27.30.30	83.22.10	Ø 16.59.30	69739	2.843470	Feb. 20. 8.37	109.29. 0 Direct.
1677	11 26.49.10	79.03.19	EL 17-37- 5	28059	9.448072	Apr. 26,00.37	99.12. 5 Retrog
1680	V3 2. 2. C	60.56.	oʻx~22.3 <i>9.</i> 30	co612	7. 787 106	Dec. 8.:0. 6	9.22.30 Direct.
1682	821.16.30	17.56.	m 2.52.45	58328	9.765877	Sep. 4.07.39	108.23.45 Retrog
1682	11723.23. 0	83.11.	H 25.29.30	56020	9.748342	Fuly 3. 2.50.	
1684	28.15. 0	65.48.40	; m 28.58. c	96015	9.982339	Mai. 29.10.16	29.23.00 Direct.
1686	¥2: 34.40	31.21.40	1 17. 00.30	3 2500	9.511882	Sept. 6.14.33	86.25.50 Direct.
1698	27.44.10	111.46.	1300.51.15	5 9129	9.839660	1087. 8.16.57	

This Table needs little Explication, fince 'tis plain enough from the Titles what the Numbers mean. Only it may be observed, that the *Perihelium* Distances are estimated in such Parts, as the Middle Distance of the Earth from the Sun contains 100000.

A General Table for Calculating the Motions of Comets in a Parabolick Orbit.

Mea	div a	Lozar. pro.	Mea	Ang. a	Logar. pro	Med	Ang. a	Logar, pro	M:d	Ang. 4	Logar. pro
mot.	Perihelio.	dift. a Sole.	met.	Perihelia.	dift. a Sole.	mot.	Peribelio.	dift. a Sole	mor.		dift. a Sole.
0	gr. ' "		0	gr. "		0	gr. "		10	gr. ' "	
1	1.31.40	0.000077	31	42.55.06	o.5624co	61		0.172914	91	86.20.34	0.274 76
2	3. 3.15	C.OOC309	32	44. 3:20	0.065838	62		0.176557	92	86.46.20	0.277239
3		0.0006 <i>9</i> 4	33	45.1029	0.069319	63		0.180188	93	87.11.43	ാ.28⊃28 7
4	6. 6. c	0.001231	34	46.16.35		64	71.56.5 6	ം1838ാദ്	94		0.283306
5	7.37. I	0.001921	35	47.21.36	0.076396	1_65	72-35-57	0.187404	95	88.01.27	0.286308
. 6	9. 7.43	C.CO2759	36	48.25.33	o.079984	66	73.14.15	0.190978	96	88.25.49	0.289293
7	10.38. 2	0.003745	37	49.28.27	o.083600	67	73.51.59	0.194540	67	88.49.48	6.292252
8	12. 7.54	0.004876	38	50.30.19	0.087244	68	74.29. 6	0.198085	98	89.13.32	0.295201
9		c.oc6151	39		0.090910	69		0.201614	99	89.36.54	0.298122
1	15. 6. 7	0.007564	4C		0.094596	73		0.205122	100	90.00.00	0.301030
11	16.34.20	0.009115	41	53.29.14	0.098300	71	76.16.56	0.208612	102	90.45.14	0.306782
12	18. 1.54	010798	42	54.27.32	0.102019	72	70.51.43	0.212080	124		0.307469
13	19.28.47	0.01260 <i>9</i>	43	55.24.21	J.10 57 42	73	77.25.57	0.215529	106	92.12.14	0.318060
14	20.54.54	0.014550	44		0.109490	74		0.218963	168		6.323587
15	22.20.14	0.c1660 7	45	57.15. 6	0.113240	75	78.32.54	0.222378	110	93:34.52	0.329042
16	23.44.44	0.018783	46	58. 9. 0	C.116995	76	79. 5.35	0.225769	112	94.14.40	0.334424
17	25. 8.22	0.021072	47	59. 2. 4	0.1 20756	77	79.37.45	0.229142	114		0.339736
18	26.31. 8	0.023470	48	59.54.11	0.124518	78	8c. 9.23	0.232488	116	95.31.22	0.344979
19		0.025969	49	60-45.25	0.128278	79	80.40.34	0.235809	1 18	96. 8.22	0.350153
20	29.13.47	0.028 57 0	50	61.35.45	25035	80	81.11.16	0.239127	I 2C	96.44.30	0.355262
21	30.33.40	0.031263	51	62.25.14	0.135792	81	81.41.34	0.242416	122	97.19.18	0.360306
22		0.034045	52		0.139544	82	82.11.19	0.245684	I 24	97.54.17	0.365284
23	33.10.23	0.036916	53	64. 1.40	0.143291	83		, , , , ,	126	98.28.00	0.370200
24	34.27.12	0.03 <i>9</i> 864	54		0.147029	84		0.252159	1 28		0.375052
25	35.42.59	0.042892	55	65.34.50		85	83.38. 4	0.255366	130	99.33.11	0.379842
26		0.045982	56	66.20.13	0.154482	86	84. 6. 8	0.258552	I 32	100. 4.43	0.384576
27.		0.049154	57	67.04.50		87	84.33.49	0.261720	1 34	100.35.45	0.389252
8	39.23.54		58		0.161890	88	85. 1. 5	c.264865	136	101. 5.48	0.393868
9	4 .35.23	0.055668	59		o.165578	89	85.27.58	0.267989	1 38	101.25.22	c.3 <i>9</i> 8428
0'	41.15.47		60	69.14.16	0.169254	90	85.54.27	0.271002	140	172. 4.19	0.402930
											Med.

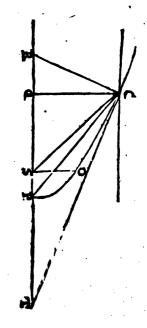
Med	dug a	Logar. pro.	Mea	dne. a	Legar, pro	Mia	Ang. 3	Logar. pio	Med.	dig. a.	Logur. p. o.
m:t.	Peribelio.	dist. a Sole.	met.	Peribelio.	dift. a Sole	mot.	Peribelio.	dift. a Sole	mot.	Peribelio.	dift. a Sole.
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142	102.32.41	0.407380	204	113.37.25	0.5234Có			0.708104	820	141.49.24	0.970837
144	103.00.31	C411784	208	114. 9.52	7.529705	370	128. 2.33	0.716976	840	142.10.00	0.978397
146	103.27.47	0.416132		11441.25		380	128.35.38	c.725606	860	142.29.56	0.985771
		0.420430	216	115.12.02	0.541958	350	129. 7.27	0.734006	8 85	142.49.10	2.992973
15	104.20.43	0.24676		115.41.51			129.38. 4	0.742186	900	143. 7.48	0.10000
152	104.46.22	C-+28866	224	116.10.52	0.553782	410	1 30. 7.34	0.750160	920	143.25.51	1.006871
		0.433012		116.39. 7		420	130.36. 2	0.757930	940	143.43.21	1.013586
150	105.36.16	0.437110	232	117. 6.38	ા 5 651 <i>99</i>	430	131. 3.30	0.765516	960	144.00.18	1.020155
1 58	106.00.32	C-441164	336	1 17.33.27	0.57 0 7 62		131.30. 2		<i>9</i> 80	144.10.46	1.026583
1.60	106.24.23	0.445178	240	117.59.35	2 .57 62 3 3	450	131.55.41	o.78c148	1000	144.32.46	1.032876
I ó2	106-47-47	0.449144		118.25. 5			132.20.30	0.787216	1500	149.26. 8	1.158188
164	107.10.44	C453060		118.49.57			1 32-44-32	0.794122	2000	152.26.15	1.246058
166	107.33.17	0.456936	252	119.14.14	0.592122		133.37.50		2500	154.32.20	1.313702
		0.460772	256	119.37.56	0.597252	490	133. 0.25	0.807494	300 0	I 56. 7.27	1.368678
170	108.17.14	0.464208	260	120. 1.6	0.602301	500	1 33.52.20	ા 8ા ૩ ૭6૭	3500	157.22.19	1414974
172	108.38.37	0.468318	264	1 20.23.44	c.607274	520	134.34.18	0.826522		158.24.36	
		0.472030		1 20-45.52		540	135.14. C	o.838600	4500	159.16.36	1.490125
176	109.20.20	0.475705	272	121. 7.30	o.616998	560	135.51.28	0.850187	5000	IUC. 1.12	1.521521
178	109.40.40	0.479340	276	121.28.39	0.621750		136.27. 6		5500	160.40. 5	1.549864
180	110.00.40	48293 7	280	121.49.22	⊶6264 38		137. C.57		6000	161.14.24	1.575718
182	I 10.20.20	0.4864 <i>9</i> 8	284	122. 9.38	0.631056	620	137.33.13	0.882575	6500	161.45.00	1.599460
184	110.39.41	0.490022	288	122.29.28	0.635608	640	138. 3.58	0.892649	7000	162.12.34	1.621417
186	1 10 .58. 44	0.493512	292	122.48.54			1 38.33.21	0.902401	7500	I 62.37.34	. 1.641838
188	111.17.25	0496965	296	123. 7.57			139. 1.29		8000	163.00.23	1.660922
190	111.35.55	3.50048 4		123.26.36			120.28.25	D.927DI2	8500	163.21.20	1.678834
192	111.54.05	0.503769	310	124.11.40	0.659559	720	129.54.16	0.929907	9000	163.40.42	1.695708
194	112.11.58	0.507121		1 24.54.56				0.938549	9500	163.58.38	1.711662
		3510441		125.35.34	0.679876	760	140.42.56		10000	164.15.20	1.726784
		0.51 3729		126.14.44				0.955124		170.52.	
				126.52.12	0.698970	1800	141.28.	0.963082			
								<u> </u>			

The Construction and Use of the General Table.

As the Planets move in Elliptical Orbs, so do the Comets in *Parabolick* ones, having the Sun in their common *Focus*, and describe equal *Area's* in equal *Times*. But now because all *Parabola's* are similar to one another, therefore if any determinate Part of the Area of a given Parabola be divided into any Number of Parts at Liberty, there will be a like Division made in all Parabola's, under the same Angles, and the Distances will be proportional: And consequently this one Table of ours will serve for all Comets. Now, the manner of the Calculation of this Table is thus: In the or the Calculation of this lable is thus: In the Fig. let S be the Sun, POC the Orbit of a Comet, P the Perihelion, O the Place where the Comet is 90 gr. distant from the Sun, C any other Place. Draw the Right Lines C P, C S, and make S T, S R equal to C S; and then having drawn the Right Lines C R, C T, (whereof the one is a Tangent, and the other a Perpendicular to the Cuttor) let fall C O perpendicular to the Aris. the Curve) let fall CQ perpendicular to the Axis PSR.

Now, any Area, as COP'S, being given, 'tis requir'd to find the Angle CSP, and the Distance CS. From the Nature of the Parabola RQ is ever $=\frac{1}{3}$ the Parameter of the Axis, and confequently if the Parameter be put =2, then RQ =1. Let CQ=z; then PQ shall $=\frac{1}{3}zz$, and the Parabolick Segment $COP=\frac{1}{13}zzz$. Roots of these Equations $z^3+3z=0.04:0.08:0$, 12:0, 16, 5%. be successively extracted, there will be obtained for many z or Ordinates CQ remains the Triangle CSP will $=\frac{1}{3}z$, and so the Mixtilineal Area $COPS=\frac{1}{13}z^3+\frac{1}{4}z=a$, wherefore resolving into 100 Parts. And in like manner is the Calculus quently if the Parameter be put = 2, then RQ = 1. Let CQ = z; then PQ fhall = $\frac{1}{2}zz$, and the Parabolick Segment $COP = \frac{1}{12}zzz$. But the Triangle CSP will = $\frac{1}{4}z$, and so the Mixtilineal Area $COPS = \frac{1}{12}z^2 + \frac{1}{4}z = a$,

this Cubical Equation, z or the Ordinate CQ will be known. Now, let the Area OPS be propos'd to be divided into 100 Parts; this Area is is of



to be continued beyond the Place O. Now the Root of this Equation (fince R Q is equal I) is the Tabular Tangent of the Angle CR Q, or $\frac{1}{2}$ the Angle CS P, and fo the Angle CS P is given. And RC, the Secant of the fame Angle CR Q, is a mean Proportional between RQ or Unity; and RT, which is the double of SC, as is plain from the Conicks. But if SP be put = I, and fo the Latus Rectum = 4, (as in our Table) then RT will be the Diffance fought, viz. the double of SC in the former Parabola. After this manner therefore I compos'd the foregoing Table, which ferves to represent the Motions of all Comets: For hitherto there has been none observed, but comes within the Laws of the Parabola.

It remains now, that we give the Rules for the Calculation, and shew the way of determining the Place of a Comet seen, by those Numbers. The Velocity of a Comet moving in a Parabola, is every where to the Velocity of a Planet describing a Circle about the Sun, at the same Distance from the Sun, as 12 to 1, as appears from Cor. 7. Prop. 16. Lib. 1. of the Princip. Phil. Nat. Math. If therefore a Comet in its Peribelium were supposed to be as far distant from the Sun as the Earth is, then the Diurnal Area which the Comet wou'd describe, would be to the Diurnal Area of the Earth, as $\sqrt{2}$ to 1. And consequently, the Time of the Annual Revolution, is to the Time in which such a Comet wou'd describe a Quadrant of its Orbit from the Perihelium, as 314159, & c. (that is, the Area of the Circle) to 14159. Therefore the Comet would describe that Quadrant in 109 Days 14 Hours, 46 Minutes, and so that Parabolick Area (analogous to the Area POS) being divided into 100 Parts, to each Day there would be allotted 0912280 of those Parts; the Log. of which, viz. 9.960128, is to be kept for continual Use. But then the Times in which a Comet, at a greater or les's Distance, would describe similar Quadrants, are as the Times of the Revolutions in Circles, that is, in the S squiplicate Ratio of the Distances: And so the Diurnal Area's, estimated in Centesi-mal Parts of the Quadrant & which Parts we put for Measures of the mean Motion, like Degrees) are in each in the Subsesquialteral Proportion of the Distance from the Sun in the Perihelion.

These necessary things premis'd, let it be propos'd to compute the apparent Place of any one of the mention'd Comets for any given Time. Therefore,

- 1. Let the Sun's Place be had, and the Log. of its Distance from the Earth.
- 2. Let the Difference between the Time of the Perihelion, and the Time given, be gotten in Days and Decimal Parts of Days. To the Log. of this Number let there be added the conflant Log. 9.960128, and the Complement Arithmetical of the 3 of the Log. of the Distance in the Perihelium from the Sun: The Sum will be the Log. of the mean Motion, to be sought in the first Column of the General Table.
- 3. With the mean Motion let there be taken the correspondent Angle from the Perihelium, in the Table, and the Log, for the Distance from the Sun: Then in Comets that are direct, add, and in retrograde ones, substract, if the Time be after the Perihelium, the Angle thus found, to or from the Place of the Per tihelium; on in direct Comets substract, and in re-

trograde ones aild, if the Time be before the Perihelium, the foresaid Angle to or from the Place of the Perihelium; and so we shall have the Place of the Comets in its Orbit. And to the Log. found for the Distance, let there be added the Log. of the Distance in the Perihelium, and the Sum will be the Log. of the true Distance of the Comet from the Sun.

4. The Place of the Node, together with the Place of the Comet in its Orbit, being given, let the Diffance of the Comet from the Node be found; then the Inclination of the Plane being given, there will be given also (from the common Rules of Trigonometry) the Comet's Place reduced to the Ecliptick, the Inclination or Heliocentrick Latitude, and the Log. of the curtate Distance.

5. From these things given (by the very same Rules that we find the Planet's Place from the Sun's Place and Distance given) we may obtain the Apparent or Geocentrick Place of the Comet, together with the Apparent Latitude. And this it may be worth while to illustrate by an Example or two.

Example I.

Let it be required to find the Place of the Comet of the Year 1663, March the 1d, 7h, 00', P. M. London. That is, 96d, 19h, 8', after the Perihelium, which happened Novemb. 2, 11h, 52.

0.011044
9.983434
9.960128 1.985862
1.929424
85.001
10.41.2 5 83.38.05—
17. 3.20 21.14.00
34.10.40 32.1 <i>9</i> .0 5
18.54.55
0-255369 0-011044 9-990754
0.257167 9.997918 21.44.45 29.18.30 8.36.15

Example II.

Let it be required to find the Place of the Comet of the Year 1683, July 23°, 13h, 35', P. M. London: Or 13h, 40', Equat. Time. That is, 21d, '10h, 50' after the Perihelium.

Log.

Log. dist. Perihel.	9.748343 ,
Log. Sesquialt.	2 . 622514
Comp. Arith. Log. Temp.	0.377486 9.960128 1.310723
Log. Med. Mot.	1.648337
Medius Motus	44.498
Perihel. 11. Ang. Corresp.	25.29.3C
Comet. in Orb. Y	28.42.10
Nod. Descend. X	23.23.00
Com. a Nodo	35.1 9.10
Red. ad Eclip.	4-48.30
Com. Helioc. * Incl. Bor. Log. pro dift. Log. Perihel. Co-fin. Incl.	28.11.30 35.200 0.111336 9.748343 9.913187
Log. dift, Curt.	9.772866
Log. dift. @	0.006104
Decus fi	10.41.25
Com. Vifus &	\$.11.50
Lat. Bor.	28.52.00

At the Instant of Time specified in the first Example, 'twas observed (at London) that the Comet applied to the fecond Star of Aries; so that it was found to be 9' more Northerly, and 3' to the East, according to Mr. Hook's Observation. But at that of the Second Example, I my self (near London, with the same Instruments whereby I formerly observed the Southern Constellations) found the Place of the Comet to be 5, 5°. 11 1. and 28°. 52'. North Latitude, which agreed exactly with the Observation made at Greenwich almost the very same Moment.

As for the Comet of the Year 1680, which came almost to the very Sun it self (being in its Perihelion, not above f of the Semidiameter of the Sun distant from the Surface of it) since the Latus Rethum is so very small, could hardly be contained within the Limits of the General Table, because of the excessive Velocity of the Moan Motion. Therefore in this Comet the best way is (after the mean Motion is found) to get from thence (by the Help of the foregoing Equation $z^3 + \frac{1}{2}z = \frac{1}{12}$ of the mean Motion) the Tangent of half the Angle from the Perihelion, together with the Log. for the Destance from the Sun. Which things being given, we are to proceed by the same Rules as in the rest.

After this manner therefore the Astronomical Reader may examine these Numbers, which I have calculated with all imaginable Care from the Obfervations I have met with. And I have not thought fit to make them publick before they have been duly examin'd, and made as accurate as twas possible, by the Study of many Years. I have published this Specimen of Cometical Astronomy, as a Prodromus of a designed suture Work; lest happening to die, these Papers might be lost, which every Man is not capable to retrieve, by reason of the great Difficulty of the Calculation.

·Vol. II.

Now it they not be amiss to put the Reader in mind, That our Five first Comers (the Third and Fourth observed by Peter Apian, the Fifth by Paulus Fabricius) as also the Tenth seen by Mastles, if I mistake not, in the Year 1586, are not so certain as the rest; for the Observations were made neither with fit Instruments, nor due Care, and upon that Account are difagreeing with themselves, and can by no means be reconcild with a regular Computation. The Comet which appear'd in the Year 1684, was only taken notice of by Blanchimes, who observed at Rome: And the last, which appeared in the Year 1698, was seen only by those at Paris, who determined its Course in a very un-common way. This Comet was very obscure; and although it moved swift, and came near enough our Earth, yet we, who were whit to be curious enough in these Matters, saw nothing of it. For want of Observations, I have lest out of the foregoing Catalogue, those two remarkable Comets which have appear'd in this our Age, one in Noveniber, in the Year 1689, the other in February, in the Year 1702. For they directing their Couries towards the Southern Parts of the World, and being scarce conspicuous here in Europe, met with no Observers capable of the Business. But if any one shall bring from India, or the Southern Parts, an accurate Series of requifite Observations, I will willingly fall to work again, and undergo the Fatique of representing their Orbits in Numbers, as I have done the rest.

By comparing together the Accounts of the Motions of these Comets, 'tis apparent their Orbits are disposed in no manner of Order; nor can they, as the Planets are, be moved indifferently every way, as well retrograde as direct: From whence it is clear, they are not carried about or moved in Vortices. Moreover, the Distances in their Periheliums are sometimes greater, sometimes less; which makes me suspess there may be a far greater Number of them, which moving in Regions more remote from the Sun, become very obscure; and

wanting Tails, pass by us unseen.

Hitherto I have considered the Orbits of Comets as exactly Parabolick; upon which Supposi-tion it would follow, that Comets being impell'd towards the Sun by a Centripetal Force, descend as from Spaces infinitely distant, and by their Falls acquire such a Velocity, as that they may again run off into the remotest Parts of the Universe, moving upwards with such a perpetual Tendency, as never to return again to the Sun. But fince they appear frequently enough, and fince none of them can be found to move with an Hyperbolick Motion, or a Motion swifter than what the Conset might acquire by its Gravity to the Sun, 'tis highly probable they rather move in very Excentrick Orbits, and make their Returns after long Periods of Time: For so their Number will be determinate, and perhaps not so very great. Besides, the Space between the Sun and the fix'd Stars is so immense, that there is room enough for a Comet to revolve, though the Period of its Revolution be vafily long. Now the Latus Rectum of an Ellipsis, is to the Latus Rectum of a Parabola, which has the same Distance in its Perihelium, as the Distance in the Aphelium in the Ellipsis, is to the whole Axis of the Ellips; and the Velocities are in a subduplicate Ratio of the same : Wherefore in every Excentreck Orbit, this Ratio comes very near to a Ratio of Equality; and the very small Difference which happens on account of the greater Velocity in the Parabole

rabola, is easily compensated in determining the Situation of the Orbit. The principal Use therefore of this Table of the Elements of their Motions, and that which induced me to construct it, is, That whenever a new Comet shall appear, we may be able to know, by comparing together the Elements, whether it be any of those which has appeared before, and consequently to determine its Period and the Axis of its Orbit, and to foretell its Return. And indeed there are many Things which Apian observed in the Year 1531. was the same with that which Kepler and Longomontanus took Notice of and described in the Year 1607. and which I my felf have feen return, and observed in the Year 1682. All the Elements agree, and nothing seems to contradict this my Opinion, besides the Inequality of the Periodick Revolutions: Which Inequality is not so great neither, as that it may not be owing to Physical Causes: For the Motion of Saturn is so disturbed by the rest of the Planets, especially Jupiter, that the Periodick Time of that Planet is uncertain for some whole Days together. How much more therefore will a Comet be subject to such like Errors, which rises almost four times higher than Saturn, and whose Velocity, though increased but a very little, would be sufficient to change its Orbit from an Elliptical to a Parabolical one. This, moreover, confirms me in my Opinion of its being the same; that in the Year 1456. in the Summer Time, a Comet was seen passing retrograde between the Earth and the Sun, much after the same manner: Which, shough no Body made Observations upon it, yet from its Period, and the Manner of its Transit, I cannot think different from those I have just now mention'd. Hence I dare venture to foretel, That it will return again in the Year 1758. And, if it should then return, we shall have no Reason to doubt but the rest must return too: Therefore Astronomers have a large Field to exercise them-selves in for many Ages, before they will be able to know the Number of these many and great Bodies revolving about the common Center of the Sun; and reduce their Motions to certain Rules. I thought indeed that the Comet which appear'd in the Year 1532. might be the same with that obferv'd by Hevelius in the Year 1661. But Apian's Observations, which are the only ones we have concerning the first of these Comets, are too rude and unskilfull for any thing of Certainty to be drawn from them in so nice a Matter. I design to treat of all these things in a larger Volume, and contribute my utmost for the Promotion of this Part of Astronomy, if it shall please God to conti-aue my Life and Health.

In the mean time, those that defire to know how to construct Geometrically the Orb of a Comet by three accurate Observations given, may find it at the End of the Third Book of Sir Isacc Newton's Principles of Natural Philosophy, entituled De Systemate Mundi, in the Words of its Renowned Inventor. Which have since been more fully explained by my very worthy Collegue Dr. Gregory, in his Learned Work of Afronomia Physica & Geometrica.

One thing more perhaps it may not be improper

or unpleasant to advertise the Astronomical Reader, That some of these Comets have their Nodes so very near the Annual Orb of the Earth, that if it shall so happen, that the Earth be found in the Parts of her Orb next the Node of a Comet, whilst the Comet passes by; as the apparent Mo-

tion of the Comet will be incredibly swift, so its Parallax will become very sensible; and the Proportion thereof to that of the Sun will be given. Wherefore such Transits of Comets do afford us the very best Means, though they seldom happen to determine the Distance of the Sun and Earth: Which hitherto has only been attempted by Mars in his Opposition to the Sun, or else Venus in Perigao; whose Parallaxes, though triple to that of the Sun, are scarce any ways to be perceived by our Instruments; whence we are still in great Uncertainty in that Assair. This Use of Comets was the ingenious Thought of that Excellent Geometrician Mr. Nicolas Facio. Now the Comet of 1472. had a Parallax above twenty times greater than the Sun's. And if the Comet of 1618. had come down, about the Middle of March, to his descending Node; or if that of 1618, had arrived a little fooner at its ascending Node, they would have been yet much nearer the Earth, and consequently have had more notable Parallaxes. But hitherto none has threaten'd the Earth with a nearer Appulse than that of 1680. For by Calculation I find, that Novemb. 11°. 1 h. 6'. P. M. that Comet was not above the Semidiameter of the Sun to the Northwards of the Way of the Earth. At which Time, had the Earth been there, the Comet would have had a Parallax equal to that of the Moon, as I take it. This is spoken to Astronomers: But what might be the Consequences of so near an Appulse, or of a Contact; or lastly, of a Shock of the Celestial Bodies (which is by no means impossible to come to pass) I leave to be discuss'd by the Studious of Physical

COMMENDAM. Before the Reformation, it was common for the Ordinary to grant a Sequestra-tion of a Living (especially if in his own Gifr, or lapsed to him) for six Months Time: And such a Sequestration was called Commenda-Semestris. And this was the only Commendam that the Canon Law approved of: tho' Commendams for a longer Time, and even for Life, were all along used. A Bishop, now, is only capable of holding a Benefice, or other inferior Dignity, by this Title of Commendam; which he doth by License from the Archbishop of Canterbury, or from the King in Chancery. But the Bithop can't hold any Living in Commendam without the Patron's Confent; as Watfon faith, c. 18. p. 141. In Case of a Commendam, no Institution is necessary; and a Bishop may be Licenfed to hold a Living in his own Gift by these Words: Authoritate sua propria capere, so apprebendere absquere Institutione, Inductione, Collatione, &c.

COMMISURA Craffioris Norvi amulta is a Medullary Process in the Brain, connecting together the Corpora Striata, or the Tips of the Crura

Medulla oblongata.

COMMUNICATION. Lines of Communication in the Art of Fortification, are Trenches made to continue and preserve a safe Correspondence between two Forts or Posts; or at a Siege, between two Approaches, that they may relieve one another on Occasion.

COMPARTITION, in Architecture, is the useful and graceful Distribution of the whole Ground-plot of an Edifice, into Rooms of Office,

of Reception, or Entertainment.

COMPARTMENT, in Architecture, is a particular Square, or other figured Space (for an Infeription, & c.) mark'd out in some ornamental Part of a Building. - COM-

COMPASS: The Latin and Greek Names used for the Points of the Compass, are as follows: NORTH. Septentrio.

N. b. E Hypaquilo, Hyperboreas. N. N. E. Aquilo Gallicus, N.E.b.N. Mesaquilo Mesoboreas.

N. E. Supernas Borrhapeliotes (Vales.)

E. N. E. Cacias, Carbas.

E. b. N. Mesocæcias. E. A. S. T. Oriens, Subsolanus. E. b. S. Hypeurus, Hypereurus. E. S. E. Vulturnus.

· S.E.b.E. Meseurus.

Euro auster, vulg. Notapeliotes. S. E.

S.E. b.S. Hypophænix, Hypereanotus.
S. S. E. Eurosotus, by Vegetius, $\triangle dx \acute{\rho}ro$ G.
S. b. E. Mesophænix, Meseuronotus.

SOUTH. Aufter.

S. b. W. Mesolibonotus.

S. S. W. Austroafricus.

S.W.b.S. Hypolibonotus, Hyperlibonotus.

S. W. Notolibycus, Austro-Zephyrus. S.W.b.W. Mesafricus, Mesolopus.

W.S.W. Africus, Subvesperus.

W.b.S. Hypafricus.

WEST. Favonius, (Veget.) Subvespertinus

Occidens. WEST. Occidens.

W.b.N. Mesocorus, Mesargestes. W.N.W. Corus, Caurus.

N.W.b.W. Hypocorus, Hyperargestes.

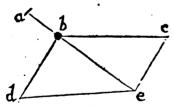
N. W. Corus Etelia, Zephytoboreas. N.W.b.W. Hypocircius, Mesothracias.

N.N.W. Circius.

N. b. W. Mesocircius.

Metius Lib. V. Doetrin. Sp. COMPERTORIUM, is a Judicial Inquest in the Civil Law, made by Delegates, to find out and relate the Truth of a Cause.

COMPOSITION of Motion. If a Body as b, be impelled or drawn by three different Forces, in the three different Directions, b a, b c, and b d, fo



that it yield to none of them, but continue in aqui-Libro: Then will those three Powers or Forces be to one another, as three right Lines drawn parallel to those Lines expressing the three different Directions, and terminated by their mutual Concourses. Let be represent the Force by which the Body b is impelled from b to a; then will the same right Line be represent also the contrary equal Force, by which it is impelled from b to e. But by what hath been faid before in Composition of Motion, the force be is resolvable into the two Forces acting according to the two Directions, bd, and bc, to which the other impelling from b to e, is as b e to b d, and b c or d e, respectively. So likewise two Forces acting without the Directions bd, bc, and being equipollent to the Force acting without the Direction be, from b to e; will be to the Force acting according to the Direction be from b to e, as bd, bc to bd; and therefore the Forces acting in the Directions bd, bc, and equipollent to the Force acting in the Direction be, are to the Force acting in the Direction, as bd, bc, or de to be:

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That is, if a Body be unged by three different equipollent Powers in the Directions, ba, bd, and b c, these three Forces shall be to one another, as b e, b d, and d e, respectively. Q. E. D. And this single Proposition is the Foundation of all the Me-

chanicks, as hath been often shewn by Geometers. COMPOSITION of Quantities, with respect to the Doctrine of Combinations, in the joining in any Number of Given Quantities, Letters or. Figures, one Row with another Row of the same, or with two or three, or more other Rows. See Combination.

COMPOSITION in Painting, comprehends two Parts, Invention and Disposition; one of which finds out (by the means of History) proper Objects for a Picture; and the other places them aright: the just Mixture of which two Things, according to a true Oeconomy, is properly Composition.

CONATUS Centrifugus: This is sometimes called the Conatus Excussorius, and is always expressed by the versed Sine of the Angle of Circulation, and these Conatus Centrifugi of Bodies revolving in equal Circles, with an equable Motion, are in a duplicate Ratio, or as the Squares of their Velocities. But if the Bodies revolve in unequal Circles, their Conatus Centrifugi will be in a Ratio, compounded of the Ratio of the Squares of the Velocities direlly, and the Simple Ratio of the Radii of those Circles Inversty. If the Body describe equal Areas in equal Times (as is the Case of the Planets which revolve in Ellipses round the Sun) then the Conatus Centrifugi will be reciprocally as the Cubes

of the Radii.
CONATUS Excussorius. See Conatus Centri-

CONGENERES Musculi; are such Muscles in an Animal Body, as serve together to produce the same Motion; and they are so called, because they

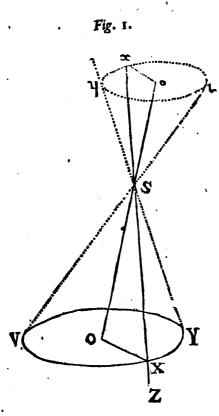
assist one another in their Action.

CONGRUITY: That there is such a Property as Congruity in the Particles of several Fluids, is plain from these and such like Instances: Quickfilver will Rick to Gold, Silver, Tin, Lead, Efc. and unite with them; but will roll off from Wood, Stone, Glass, &oc. and Water that will wet Salt and dissolve it, will slip off from Tallow, egc. without adhering to it; as it will from a dufty Surface, and from the Feathers of Water-Fowls. Two Drops of Water, or of Mercury, will, on Contact, immediately join and coalesce: But Oil of Tartar poured on Quickfilver, and Spirit of Wine . on that Oil, and Oil of Turpentine on that, and Air over all; tho' these are stopp'd in a Bottle, and shaked never so long, they will by no means continue mingled, but will separate and keep distinct. Whether the Cause of this *Incongruity* be not, that the Particles of the Fluids cannot be brought fo near to one another, as to come within the Sphere of one another's Attraction; and why they cannot be brought to do fo by shaking, are Enquiries worth pursuing. The Ingenious Dr. Hook calls worth pursuing. The Ingenious Dr. Hook calls Congruity both a Tenacious and Attractive Power, in which he's certainly right; but perhaps what he takes to be the Effects of Congruity, is the Cause of it.

CONICK SECTIONS. I thought fit to give the Reader here a Translation of L'Hospital's Sixth Book of Conicks; wherein he will see how the Sections and their primary Properties are deduced from the Cone it felf, without the tedious Number of Lemmas, which some have premised about a Line cut Harmonically; whose Demonstrations alone, are more than all these Propositions, and not so natural nor easy neither.

DEFINITIONS.

1. If an Infinite right Line, as xSZ, having one Part of it, as S, fix d there as in an immoveable Point, plac'd above the Plane of the Circle VXT;



be supposed to move round the Circumserence of the said Circle; the Revolution of this Line x S X Z, will produce or form what we call a Conick Surface; and if the Line be continued each way beyond the immoveable Point S, it will generate two Conick Surfaces, which are called Opposts.

II. The fix'd Point S, is called the Vertex of either Surface.

III. The O. VXT, is called the Base of the Cone VXTS; and the O n x y S, the Base of the Opposite Cone.

IV. For the Solid contain'd under the Base VXI, and that *Conick Surface* which is generated by the Motion of the Line SX, is called a *Cone*.

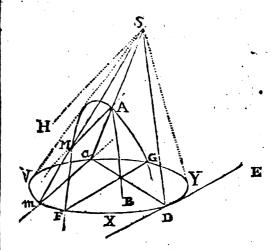
V. The Right Line S X, drawn from the Vertex to any Point in the Periphery of the Base, is called the Side (because 'tis one of the Sides of the Δ , which will be formed by cutting the Cone thro' the Vertex, and by the Axis.)

VI. The Line SO, drawn from the Centre of the Circle of the Base thro' the Vertex, is called the Axis.

VII. A Right Cone, is that whose Axis is Normal to the Plane of its Base; but if it be not so, its called a Scalene Cone.

VIII. If a Conick Surface be cut by a Plane, which doth not pass thro its Vertex, as FAG; and which also is not parallel to the Plane of the Base,

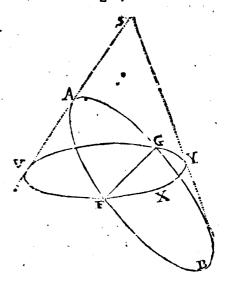
Fig. 2.



(for then a Circle will be produced, which though truly a Conick Section, is not here consider'd) the Curve Line formed by the Intersection of the Plane FAG, with the Conick Surface, is called a Conick Section.

1X. If thro the Vertex S, a Plane be drawn parallel to any Conick Section, the Infinite Right

Fig. 3.



Line DE, which is the common Sedion of that Plane, with the Plane of the Base, is called the Direction.

X. A Conick Section FAG, is called a Parabola, when the Directrix DE touches the Circle of the Base of the Cone (as in Fig. 2.); an Ellipsis, when the Directrix falls all without the Cone; and an Hyperbola when the Directrix cuts the Circle of Base.

But in this last Case, if the Plane of the Conick Sestion be produced, it must cut the apposite Conick Surface; and there will form another Conick Sestion, which is called Opposite, and both together are called Opposite Sestions, or Opposite Hyperbola's, as FAG and KNH, in Fig. 4.

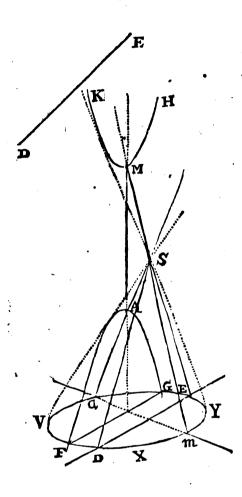
X!. If

XI. If a Line be drawn in the Plane of any Conick-Sections, fo that it meet it only in one Point, and being produced both ways, enters not at all into the Section, but falls all entirely without, that Line is called a Tangent in that Point.

CONSECTARIES.

I. In the Parabola, all the Sides of the Cone (vid. Def. 5.) being produced infinitely, must necessarily cut its Plane, except the Side SD, drawn

Fig. 4.



from the Vertex S to the Point D, where the Direttrix touches the Base; because no other Side but that can be in the Plane D S E, which is parallel to the Section; and that all the others cut it in the Point S: Whence it is plain, that the Parabola will be extended infinitely, and can never return into it self.

II. In the Ellipsis, all the Sides of the Cone, when produced, must cut the Plane of the Section; because the Plane S D E, which is parallel to it, is cut by all of them in the Point S, (Fig. 3.) Whence this Section must include a Space, and return into it self.

III. In the Hyperbola and the Opposite Sections, all the Sides of the Cone (but S.D., S.E., drawn from the Vertex to the Points D. E., where the Directrix cuts the Base) being infinitely produced both ways from the Vertex S, must cut the Planes of the Opposite Sections: Because there are no other but those two Sides, which can fall in the Plane

SDE which is parallel to the Sections; and also

because all the others cut it in the Point S.

The Sides of the Portion SDVE form the Points of the Hyperbola FAG; and those of the Portion S D Y E being produced on the other Side of the Vertex S, form the Points of the opposite Sections K M H.

And from hence tis clear, That the appointe Hyperbola's are extended infinitely, and can no more return into themselves than the Parabolick Section.

Theozem I. PROP. I.

If the two opposite Conick Surfaces be cut, by a Plane passing through the Vertex, as Sam (in Fig. 4.) the Intersection of that Plane, with the two Surfaces, will make two Right Lines Sa, Sm, which may be supposed to be infinitely produced each way from S.

For let a m be the Common Section of this Plane with that of the Base: Tis plain it will cut the Periphery of the Base in the two Points a and m, because the Plane Sam is supposed to fall within the Cone. Wherefore the Sides Sa and Sm being produced each way from S, must be the two common Sections of the intersecting Plane Sam, with the opposite Conick Surfaces: As appears from the manner of their Generation in Def. 1. Q. E. D.

CONSECTARIES. •

I. As that Part of the Line am joining the two Points a, m, in the Periphery of the Base, falls within the Base, and all the rest of it, if produced, falls without; so it follows, that if the Plane Sam, be supposed exfinitely extended all round S, that Part of it only which is contained within the Legs of the Angle a Sm, and its Vertical one be-yond S, will fall within the two opposite Conick Surfaces, and all the rest of it without them.

II. From whence it follows, That if you join any two Points, as A M, in a Conick Section, (Fig. 2.) it will be all contained within the Section; and all Parts of it, when produced either way, will fall without it: For drawing from the Vertex S two Lines, as Sm, Sa, and supposing them to determine such a Plane as above, 'tis plain the Line AM will fall all within the Less of the Angle a S m, Egc.

III. Wherefore any Line passing through the Vertex S, and parallel to such a Line as AM drawn within the Section, will fall withour the Conick Surface; and will meet the Plane of the Base produced without the Circumserence of the Rase of the Cone.

IV. It follows also, (from Confest. I.) That any two Points, one in each of the opposite Hyperbola's, (Fig. 4.) being joined by a Right Line, as AM, that Line will be wholly without and between the op-posite Sections; but infinitely produced each way, will be ever after entirely within the Oppolite Hyperbola's: For drawing through S the Lines S a, Sm, passing through the Points A, M, and supposing them to determine a Plane, extended every way from S, &c. it is evident, that that Part of the Plane which is contained within the Legs of the Angle S A, S M, where the Line A M falls, is comprehended between those two Surfaces; and that Part of the same Plane which is contained between the Productions of the Line AM, from A and M each way, will fall all of it within the opposite Hyperbola's.

V. From the 2d and 4th Confestaries it will follow, that a Right Line can't cut a Conick Section, or the opposite Hyperbola's, in more than two Points.

PROP. II.

If either of the opposite Conick Surfaces be cut by a Plane as 0 ux y, (see Fig. 1.) which is parallel so the Base OVXY, the Section will be a Circle, whose Centre shall be in 0, the Point where that Plane cuts the Axis produced as far as is necessary beyond S:

For in the Base, drawing any where a Radius OX; and from the Vertex S the Side SX; which produced, shall meet the Plane ouxy in x; the Lines OX and ox will be parallel: And the Plane SOX being produced into the opposite Cone beyond S, the Δ 's SOX and Sox will be equal; and therefore 'twill always be that SO:OX::So:Sx. But the two first Terms being always the same, the 4th Term Sx can't change its Length, let the Point x fall where it will: Wherefore the Curve x y is a Circle.

PROP. III.

If in the Plane of a Parabola, as FAG (Fig. 2.) you draw from any Point, as A, within the Cone, an infinite Right Line, as AB, parallel to the Side SD: I fay, that Line shall always be within the Section; and though infinitely produced towards B, can never cut the Parabolick Circumference any more.

For drawing, or supposing to pass through the Vertex S and the Line AB, a Plane, as S AB; that will, by its Intersection with the Conick Surface form two Sides; one of which shall always be the Line SD, (because AB is parallel to it) and the other the Line Sa, which passes through the Point A. But the Plane DSa, contained between the Sides SD, Sa, produced infinitely from D and a, will all fall within the Surface of the Cone (by Conf. I. Prop. I.) Wherefore the Line AB, which is always within that Plane, and is parallel to the Side SD, will fall all of it within the Parabola, and can cut its Circumserence no where but in B.

PROP. IV.

A Line drawn in the Parabola F A G, from any Point, as A, within the Cone, and not parallel to the Side S D, will, if produced, meet the Parabola in another Point, as M. (See Fig. 2.)

For if you suppose a Mane to pass along that Line and the Vertex S, as S A M, that will be all of it within the Conick Surface, and can't pass by the Side S D: Whence it follows, that this Plane will form, by its cutting the Surface of the Cone, the two Sides S a and S m, (see Prop. I.) one of which, S a, passes through the Point A; and the other, S m, is by no means parallel to the

Plane of the Section; (for by the Nature of it, only the Side S D is fo, (fee Def. X.) Wherefore the Side S m produced, must cut the Plane of the Parabola in the Point M; through which the Line A M passes, which is formed by the Intersection of the Plane a S m with that of the Parabola. But 'tis plain, that this Point M is one of the Points of the Parabola FAG, because 'tis both in the Plane of the Section, and also in the Surface of the Cone: Wherefore, 65°C.

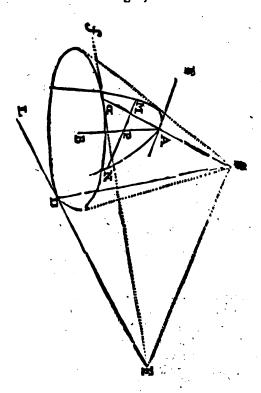
PROP. V. Probl. I.

Through a Point given, as A, in any Conick Section, to draw a Tangent, as AF, to the Curve.

Having drawn through the given Point A, and the Vertex of the Cone, as S, a Right Line, as S A, cutting the Base in a; and then to the Periphery of the Base in the same Point a, a Tangent, as E a F. The Line F A made by the common Section of the Plane S E, a f; (produced, if necessary, beyond the Vertex S) with the Plane of the Section, shall be the Tangent required.

For fince the Tangent E a f is entirely without the Base, but only in the Point a, it follows, that the Plane SE a f, infinitely produced above or be-

Fig. 5.



low S, can cut the opposite Canick Surface no where but in the Line Sa, produced also infinitely either way; and that all the rest of that Plane will be without those Surfaces. Wherefore the Line AF, made by the Intersection of that Plane with that of the Section, can interfere with neither of those Surfaces but only in the Point A, where the Line Sa cuts the Plane of the Section: Wherefore 'tis a true Tangent to the Curve in that Point.

CONSECTARIES.

I. As there can be but one Tangent to the Periphery of the Base in the Point a, so there can be

but one to the Point A drawn in any of the Conick Sections.

II. Whence arises the way of drawing a Tan-gent, as A P parallel; a Right Line, as M N, given in Polition in the Plane of any Conick Section;

or in the two opposite Sections.

For having drawn through the Vertex S a parallel to MN, as SE, that will either meet with the Directrix in some Point, as E, or be parallel to it; because that Line SE may be parallel to the Plane of the Section, and consequently may fall in the Plane SDE. If it cut it in any Point, as E, falling without the Base of the Cone; then drawing from the Point E, to the Periphery of the Base, the Tangent E a f; 'tis plain, that the Plane S E a f will make, by its Intersection with the Plane of the Section, a Tangent, as A F, which shall be parallel to the Line M N; because the two Sections A F, S E, of the parallel Planes M A N, S F D, being cur by the Tangent Plane S E a f S E D; being cut by the Tangent Plane, S E af must be parallel to one mother, as well as S E and

III. The same things being supposed, as in the preceding Confectary, and Fig. 4. it will follow, 1. That in the Parabola this Problem will be impossible, when the Line MN is in a parallel Position to the Side SD; drawing thro the Point Dwhere the Directrix touches the Periphery of the Base, for then the Points E and D will be co-incident; and thro' that Point D, no Tangent but D E can be drawn: And as the Plane which passes the Vertex S and the Directrix E D, is parallel to the Plane of the Section (by Def. 9.) by its Intersection with the Plane of the Parabola, no Tangent can be formed. But when the Line given in Position is not parallel to the Side S.D., a Tangent, as A.F., may always be drawn parallel to it; for then the Point E falling without the Circular Base of the Cone. of the Cone, two Tangents, as E a f and EDL, may always be drawn from that Point to the Circumference of that Circle; of which one, EDL, will co-incide with the Directrix; and the other, E a f, will find by the Intersection of the Plane SE a f with that of the Parabola, a Tangent, as AF, which shall answer the Problem.

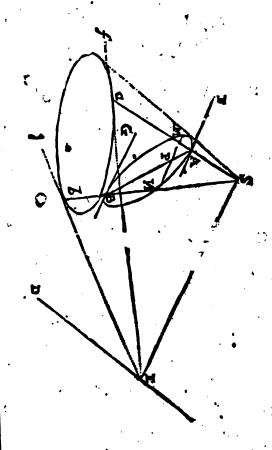
Tis the same thing when the Line SE is paral-

lel to the Directrix, for then the Tangent E a f will always be parallel to the Directrix: And as there is but one Tangent that can be drawn parallel to it, because the Directrix it self touches the Base of the Point IP, it follows, that a Tangent may

be drawn, Esc.

2. In the Ellipfis, there may always be drawn two Tangents, A F, GB, parallel to the Right

Fig. 6.



Line M N, given in Polition, and confequently to one another.

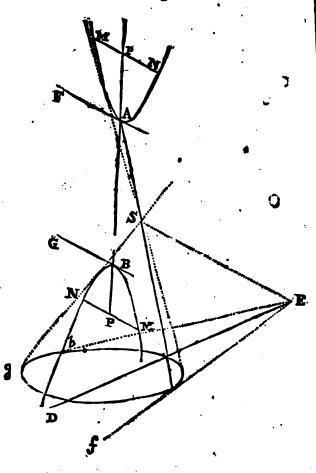
For here all the Points of the Directrix D E fall without the Base of the Cone; and therefore you may always draw from the Point E, two Tangents; Baf, and Ebg to the Circle of the Base; and these will serve, by the Intersection of the Planes SB a f, and SB b g, with the Plane of the Section on two Tangents, AF and BG, which will arrswer the Problem.

Tis the same thing when the Line S E is parallel to the Directrix, for then instead of the Tangents E a f, E b g, going from the Point E in that Directrix, you need only draw two parallel Tangents;

which is always possible.

In the Hyperbola and opposite Sections, the Problem becomes impossible, when the Point E falls within the Circular Base of the Cone; because

Fig. 7.



hen no Tangent can be drawn to that Point of the lase. But when it falls without, you may always fraw two Tangents, A F and AB, parallel to the Line M.N given in Position: For the Directrix D. E, cutting the Base, you may always draw from the Point E two Tangents, as E a f, and E b g to the Base; and which falling on each Side of the Directrix, will make, by the intersection of the Directrix, will make, by the intersection of the Directrix. of the Planes SE af, SE b g, with the Planes of the Sections, two Tangents AF and BG, which will answer the Problem.

And 'tis the same, when the Line S B is paral-lel to the Directrix D E: for then instead of the two Tangents, E a f and E b o, you need only draw two Tangents parallel to the Directrix; which

is always possible.

And here Note, that in this Case the two paral-lel Tangents A F and B G, will always belong to the opposite Sections, and never to the same, which is plain; because the two Tangents, E aj and Ebg, drawn to the Base, fall on each Side the Directrix.

IV. From the last Consectary, it follows, 1. That in the Parabola or Hyperbola, you cannot draw two Tangents which shall be parallel one to another: But in the Ellipsis and in the opposite Sections; one Tangent being given in Polition (as

fuppose A F); you may always draw another, as G B parallel to it: (See Fig. 6, 7.)

2. When the Line M N, given in Position, is terminated by the Section; you may always

parallel to it; and in the Ellipsis and opposite Hyperbola's, two Tangents, as AF and BC; because the Line S E drawn from the Vertex, paratlel to M N, will cut the Plane of the Base produced somewhere without the Circle, or else be parallel

D*efinitio* ns

XII. In the Parabola (vid. Fig. 5.) a Line, as A B drawn from any Point, as A parallel to the Side S.D, which passes through the Point D, where the Directrix touches the Baie, is called a Diameter; and the Point A its Orgine.

XIII. In the Ellipsis and Opposite Hyperbola's, (Fig. 6, 7.) a Right Line, as AB, conecting the Points of Contact of the two parallel Tangents, A Fand BG, is called a Diameter; the Points A and B, its Extremities.

XIV. A Line, as MD, drawn thro' any Point, as P_0 of the Diameter AB produced, if there be occasion (Fig. 5, 6, 7.) terminated by the Section in the two Points M N, and also parallel to the Tangent AF, which passes thro A, the Orgine of the Diameter in the Parabola, or by one or other of the Extremities of it in the Ellipsis, or Opposite Hyperbola's; that Line is said to be an entire Ordinate to the Diameter A B, being continued on each Side the Point P, tho its half, as PM or PN, is usually called an Ordinate.

XV. And when the Ordinates are at Right Angles with any Diameter, that Diameter is then called the Axis.

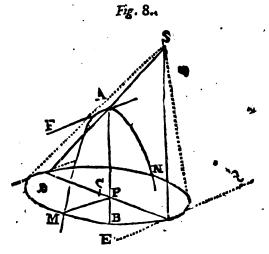
CONSECTARIES.

I. From Def. 12. it follows, that in the Parabels all the Diameters must be parallel one to another; because they are all so to the Side SD.

II. And that from one Point in that Section, there can go but one Diameter; for thro' one Point, there can be but one parallel drawn to any Line given in Polition, as S D is.

PROP. VII. Problem II.

A Diameter, as AB, an Ordinate, PM, in any Conick Section, to describe the Figure.



Thro' the ordinate P M, describe any Plane draw in the Parabola one Tangent, which may be whatever, so it be but different from the Plane, APM,

APM. Then from the Point P, in that Plane draw to PM the infinite Part Pa, and taking in that Line Pa, any Point as C for a Centre, with

the Radius CM describe a Circle, and 'tis done.

1. When the Section is to a Parabola, draw, from one of the Points, a or D, where the Circle of the Base cuts the Part Pa (viz. a) thro' the Orgine of the Diameter, the Right Line a A, which shall meet in the Point S, another Line, as S D drawn parallel to AB; and then suppose a Conick Surface described, whose Vertex is the Point S, and its Base the Circle D M a G. I say, that it will form, by its Intersection with the Plane AP M, the Parabola M A N required.

For having drawn parallel to MN, and through the Points D and a, the Right Lines ED and fa; its clear, those Lines will be Tangents, because they are parallel to MP, which is

But the Place SDE passing thro' S, the Vertex of the Cone, and thro' the Tangent DE, is paralel to the Plane APM; because SD parallel AP, and DE parallel MP: Wherefore the Section MAN, made by the Plane APM in the Conick Surface, will be a Parabola, whose Diameter is

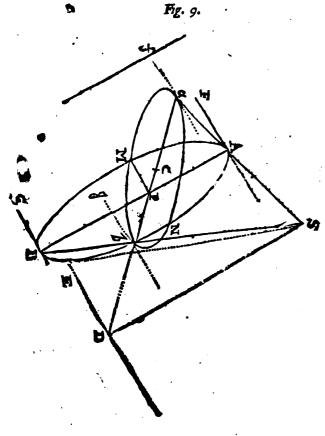
A B.

The Tangent Plane also, Saf, some in the Plane APM (by Prop. 5.) a Tangent, as AF, which is parallel to MN, as being the common Section of the two Planes Saf, APM, which pass by the Parallels af, PM, and consequently (by Def. 14.) the Right Line PM, is an Ordinate to the Diameter AB. Diameter AB.

2. When the Section is to be an Ellipsis or Hy-

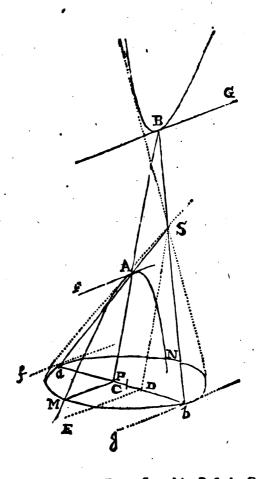
perbola.

Draw thro' the Point ab, where the infinite P a cuts the Circle; and through the Extremes of the Diameter A, B, the two Right Lines, a A and B b, they will meet in the Point S, from whence a Conick Surface may be described, whose



Vol. II.

Fig. 10.



Vertex may be that Point S, and its Base the Circle a Mb N. Then, I say, that the Plane APM shall form, in this Conick Surface, the Section M A N required.

For drawing S D parallel to the Diameter of the Section AB, and meeting a b the Diameter of the Base, in the Point D thro that Point, and also thro' a and b, draw the Parallels D E, af, and b g to PM: Then 'ris apparent, that the Plane S D E shall be parallel to APM; and that D E

(by Def. 9.) shall be the Directriz.

But in the Ellipsis, the Point D falls without the Diameter a b produced beyond the D, because the Diameter of the Section A B falls within the Angle a S b made by the Sides of the Cone a S and S b. But in the Hyperbola the Point D falls within the Circle of the Base, because then the Diameter A B falls within a S B; which is the Angle lying on the Side of the Angle a S b. Whence it follows, that (according to Def. 10.) the Section M A N, will in the former Case be an Elliosis, and in the latter, an Heterbola.

Ellipsis, and in the latter, an Hyperbola.

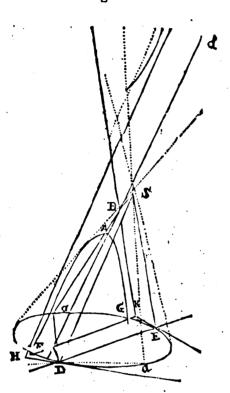
The Tangent A F passing thro' A, the Extremity of the Diameter A B; being the common Section of the Tangent Plane S a f, and the Interfeeting Plane APM, which paffes thro' the Parallel of and PM, will be parallel to the Ordinate PM; and for the fame Reason also, the Tangens BG will be parallel to PM, for that is the common Section of the Tangent Plane S b g, and the Secant Plane AMP, which pass by the two Paralhele b g and PM, small be parallel to PM. Where-fore the Line AB (by Dof. 13, 14.) is a Piameter, whole Ordinancis P.M. It

It may happen in the Ellipsis, that the Line Aa and bB may be parallel to one another; but there can be but only one Point in the Line ab for C the Centre of the Circle of the Base.

DEFINITION XVI.

If thro' the Point D and E in the Hyperbola, where the Directrix cuts the Base of the Cone, you draw the Tangents D H and E K; and thro' the

Fig. 11.



Vertex S, and those Tangents, you draw two Planes, SD H and SE K; which shall cut the Surface of the Cone in the Right Line C H and C K infinitely produced: Then are those Lines, CH and C K, called Assurptions.

CONSECTARY L

If thro' any Point of Contact of the Base of the Cone, as D, you draw thro' the Vertex S, the Side or Right Line D S, infinitely produced: Tis then plain, that the Tangent Plane, SDH, can have nothing common with the opposite Conick Surfaces, but the Side S D, because the Points of the Tangent D Hfall without the Periphery of the Base of the Cone, but only D. But the Plane SDE passing thro' the Vertex S, and the Directrix DE, being parallel to the Planes of the opposite Sections; the common Sections, S D and C H of those Planes, with the same Plane SDH, must be parallel to one another: And therefore the Assymp ptote C H must fall entirely without and between their opposite Conick Surfaces; and consequently must leave the opposite Hyperbolas on each Side entirely, without ever touching them or meeting with them. And the same thing may be shewn of the other Assumptotes CK: But as two Assumptotes CH, CK, are formed by the Plane SDH, SEK, which fall on each Side of the same Conick Surface, and its opposite; it follows, that all the

Points of the Hyperbola F A G are contained within the Angle H C K; and all Points of the opposite Section within its vertically opposite Angle.

. PROP. VII.

If thro' any Point, as B, in the Assymptote C K, you draw a Line, as B A parallel to the other Assymptote C H; I say, that it shall intersect one of the opposite Hyperbolas in one only Point as A: and being produced infinitely, will be always within it.

See Fig. 12.

For, fince the Lines B A and SD are parallel to C H, they must be so to one another, and so are both in the same Plane; which Plane will enter within the two Conick Surfaces, because it paties by one of their Sides S D, and makes an Angle with the Tangent Plane S D H.

The Plane of the Parallels, B A, SD, will form in the two Conick Surfaces, two Sides; of which, one is SD, and the other the Side Sa, which must necessarily cut the Line BA, in some Point, as A; because it lies in the Plane which passes thro' the Parallels SD, AB; and which enters SD in S

Parallels S D, AB; and which enters S D in S. Wherefore, because the Point A is found at the same Time in one of the Conick Surfaces, and in the Plane of the Hyperbola's, it must be in one of those Hyperbola. And since the Line B A being infinitely produced on the Side of the Point A, falls entirely in the Plane D Sa, contained between the Sides D S, Sa; therefore the Point A will be in the Hyperbola F AG, and in the vertically opposite one ASD, when it belongs to the opposite Hyperbola: 'Tis apparent, it must always fall within one of the two Conick Surfaces; and con equently within the Hyperbola also, which is contained in the Section. Q. E. D.

CONSECTARY.

From hence 'tis plain, that between the Hyperbola F A G, and its Assymptote C H, no Line can be drawn parallel to that Assymptote.

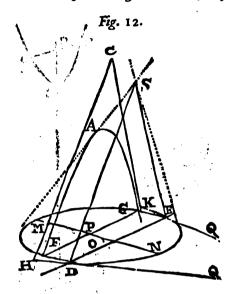
But as the Line A B divides the Hyperbola, which it cuts into two indefinite Portions, of which one must fall entirely within the Space contained between the two Parallels B A and C H; it follows, that the lesser CB becomes, the more or farther the Point A will get into that Space, and this still more and more, till CB become less than any Quantity: That is, the Hyperbola and its Assymptote will approach still nearer and nearer towards one another; so that their Distance will be less than any assignable Length, and yet can never meet, by Cor. 1. of Def. 16.

PROP.

PROP. VIII. Problem.

CH and CK, the Assymptotes of an Hyperbola, FAG, being given, and any Point in the Curve, as F, to describe the Hyperbola.

Having drawn through the given Point F any Right Line, as HK, cutting the Assymptotes, make a Plane to pass through that Line, any how



(so it be different from the Plane of the Assymptotes HCK) in which Plane draw through P the middle Point in HK an infinite Perpendicular, as MN. Then on any Point of it, as O, as a Centre, and with the Radius OF, describe the Circle FMN. Then draw through the Points H and K two Tangents to the Circle; and through their Points of Contast D, E draw DS, ES, parallel to the given Assymptotes CH and CK. These will meet in a Point, as S; from which, as from a Vertex, if you describe a Conick Surface, whose Base shall be the Circle FMN; I say, this Conick Surface shall, by the Intersection of the Plane HCK, form the Hyperbola FAG; which was required.

For,

1. 'Tis clear, from the Property of the Circle, That the Chord FG is biffected in the Point P, by the Diameter MN, which is perpendicular to it. Wherefore fince PH = PK (by the Confruction) FH must be = GK, and GH = FK; and confequently GH * HF = FK * KG.

2. From the Circle also it follows, That GH *

2. From the Circle also it follows, That $GH \times HF = \overline{HD^2}$, and $FK \times KG = \overline{KE^2}$; and confequently HD = KE.

3. If the Tangents HD and KE are produced, till they meet in the Point Q, DQ will be = EQ.

Wherefore DQ:EQ::HD:KE.

Whence it will follow, That the Line DE joining the two Points of Contact, is parallel to the Line HK; and the Plane SDE to the Plane CHK: And therefore the Line DE is the Directrix, (by Def. IX.) And as it cuts the Base in two Points, the Section FAG will be an Hyperbola, by Def. X.

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Tis plain also, That this Hyperbola must pass through the Point F, since that Point is common both to the Conick Surface, and to the Plane HCK, which is that of the Hyperbola: and that Hyperbola shall have the Lines CH, CK for its Assymptotes, because they are the common Sections of the Tangent Planes SDH, SEK, with the Plane of the Hyperbola, (Def. XV.)

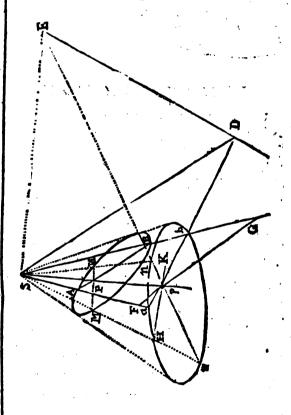
When it happens that the Tangents DH, EK

When it happens that the Tangents DH, EK are parallel, then will also the Lines DE, HK be parallel.

PROP. IX.

If two Right Lines, as M N, A B, terminate within any Conick Section, or within the opposite Sections, do intersect each other in a Point, at P; and if they be parallel to any two other Right Lines, as S E, S D, which are given in Position: I say, the Rectangle M P N is to that of A P B, always in a given Ratio; or the Ratio between these Rectangles will always be the same, let the Lines M N, A B, lie where they are.

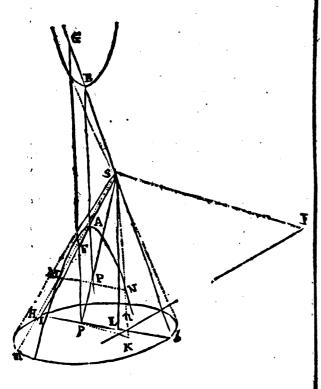
Fig. 13.



 \mathbf{X}

Fig. 14.

Fig. 14. ,



DEMONSTRATION.

Drawing thro' the parallels SE, MN, and SD, AB, two Planes, their Intersection with the Plane of the Base, will form the two Right Lines Enm, Dba; and in the Conick Surface, the Sides SMm, SNn, SAa, SBb: And their common Intersection will be the Line SPp, which meets the Plane of the Base in the Point p, being the Intersection of the two Lines, Em and Da. Thro' that Point p then, and in the Plane SMN, draw the Line HK parallel to MN, and in the Plane SAB, draw FG parallel to AB.

Then the similar Triangles SPM, SpH, SPN, SpK, SPA, SpF, SPB, SpG; will give these Proportions: That the []MPN, []HpK:: $SP^2SP^2::[]APB$, []FpG. Also the []MPA, []APB::[]HpK[]Fpg: But the Ratio of the []HpK to []FpG, is compounded of two Ratio's of []HpK to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to []FpG, is compounded of []MpX to [

a $p \times p b$ to $Fp \times p G$. But because of the similar Triangles, Hp m, SEm, and Kpn, SEn: It will be Hp, mp: SEm E, and p K, pn: SE, En.

And then multiplying the Antecedents and Confequents of those Ratio's, $Hp \times p K$, $mp \times p n$: $SE^2 mE \times E n$.

It may be proved also from the Similarity of the Triangles F p a, S D a, and G p b, S D b: That $ap \times pb$, $Fp \times pG :: aD \times Db : SD^2$.

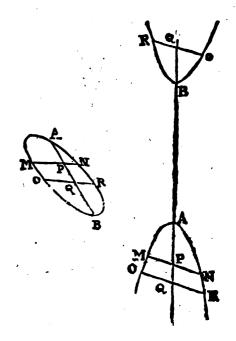
Tis evident therefore, That the Ratio of $PM \times P$

Tis evident therefore, That the Ratio of $PM \times PN$ to $AP \times PB$, is compounded of two Ratio's of SE^2 to $mE \times nE$, and of $aD \times Db$ to SD^2 : Which by the Property of the Circle (which Figure the Base of the Cone makes) will remain always the same, let the Lines MN, AB, lie how they will, because the Points do not change: Wherefore the Reclangle APB, is always in a given Ratio. Q. E. D.

CONSECTARY.

Hence you see, that if in any Conick Section, or in the opposite Sections, there be two Right Lines, MN, OR, parallel one to another; and cutting

Fig. 15, 16.



a third Line, AB, which is also terminated within the Section; it will always be [] MPN [] OQR:: [] APB, [] AQB.

PROP. X.

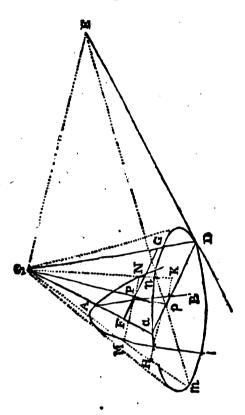
If thro' any Point, as A, of a Parabola or Hyperbola M A N, a Right Line, as A B be drawn parallel to the Side of the Cone S D; (that is, being drawn in the Parabola thro' the Point D, where the Directrix touches the Base; and in the Hyperbola thro' one of the two Points where the Directrix cuts the Base): And suppose thro' any Point, as P, in that Line A B, a Right Line M N be drawn parallel to the Line S E, given in Position, and terminated by that Section, or the opposite Section: Suppose also another Right Line, F G, drawn parallel to the Line D a, the common Section of the Plane S A B with that of the Base, and terminated by the Sides S a, S D: Then, I say, the Ratio of the Rectangle F P x P G, or F P G is given, i.e. it will be always the same, wherever the Point P be taken in the Line A B.

BEMON.

DEMONSTRATION.

Thro' the Parallel SE, MN, suppose a Plane to be drawn, that will form with the Base of the Cone, the Right Line Enm, in the Conick Sur-

Fig. 17.



face, the Sides SMm, SNn, and in the Plane S Da; the Line SPp, which meets the Base in the Point P, where the Lines EM, DA, intersect each other. Then thro'that, in the Plane SMN, I draw the Line HK parallel to MN.

This being supposed, the Similar Triangles SPM, SpH, SPN, SPK, SPE, Spa, SPG, SPD will give us these Propositions.

MPN, [] HpK::SP'Sp':: [] FPG, apD; or (by the Property of the Circle)

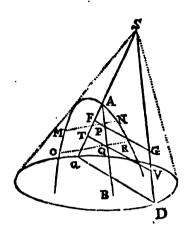
Mpn.
Also the MPN, FPG: Hpk, mpn. But the Ratio of [] Hpk to the [] mpn, is compounded of the two Ratio's of Hp to pm, and of pk to pn: That is, (because of the Similar Triangles, Hpm, SEm, and Kpn, SEN) of the two Ratio's of SE to Em, and of SE to En; and confequently HpK, mpn, or MPN, FPG::SE' 🗍 mEn.

And then, because the Point E varies not, in what Place soever the Point p be taken; and since all the Emn are equal, by the Property of the Circle; it will follow, that the Rectangle MPN must be to [] FPG in a given Ratio. Q.E.D.

CONSECTARY.

Hence the evident, that if thro' any Point, as A of an Hyperbola or Parabola, MAN, if in the latter, a Diameter, as AB; or in the former, a

Fig. 18.



Parallel to one of the Assymptotes, as AB, be drawn, and that thro' any two Points, a PQ, in that Line AB, two Parallels, MN, OR, be drawn and terminated by that Section, or by the opposite Sections; it will always be []MPN, []OQR:AP, AQ.

For drawing the Plane SAB, forming by its

Intersection with the Conick Surface, the two Sides SD, Sa: of which, the Side SD, (if the Section be a Parabola) passes thro the Point D; where the Directrix touches the Base; and if it be an Hyperbola, thro' one of the two Points where it cuts it: And drawing also, in the Plane SDa, through the Points P, Q, the Right Lines FG, TV, parallel to Da: Tis plain, in the precedent Proposition, that [MPN, FPG::OQR, TQV]; and then alternately, [MPN, OQR, ::FPG, TQV]. But the Parts PG, QV, are equal to one another; because the Lines AB, SD, are parallel: And moreover, [] MPN, OQR, ::FP, TQ, ::AP, AQ; by reason of the Similar Triangles, APF, and AQT. Wherefore [] MPN, must be to [] OQR:: AP, AQ. Q. E. D.

After this, the Noble Author, because a Cylinder is a Solid less compounded than a Cone; for it hath all its Sides parallel one to another, instead of their terminating in a Point, as they do in the Cone; thinks fit to confider the Ellipsis as a Cylindrick Section, and from thence demonstrates the Properties of its Diameters, as also those of the Parabola and Hyperbola.

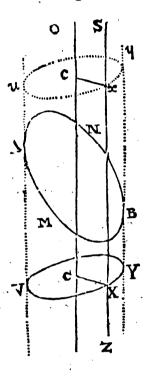
In order to which, he premises these Definitions.

Of the Ellipsis in Particular.

DEFINITIONS.

XVII. If an Infinite Right Line, as Sz, which is without the Plane of the Circle VXY, be moved with one of its Points X, quite round the Circum-

Fig. 19.



terence of that Circle, and keeps always parallel to it self, till it come again to the Place or Point whence it set out; then the Convex Surface, described by the Motion of that Line, is called a Cylindrick Surface.

XVIII. The Describent Line S Z, in any kind of Position of its Motion round the Circumference of the Dirigent Circle, is always called the Side.

XIX. The Circle VXY, is called the Base.

XX. The Infinite Line CO, drawn from the Centre of the Base C, and parallel to the Sides, is called the Axis.

XXI. The Infinite Solid, comprehended under the Pase VXY and the Cylindrick Surface, is called a Cylinder.

XXII. If the Cylinder be cut by a Plane, neither parallel to its Sides, nor to the Plane of the Base, the Curve Line AMBN, formed by the Intersection of that Plane with the Cylindrick Surface, is called a Cylindrick Session.

PROP. XI.

If a Cylinder be cut by a Plane, (see Fig. 147.) as uxv, parallel to the Plane of its Base VXY; the Section uxy, shall be a Circle, whose Centre shill be the Point c, where that Plane intersects the Avis: and its Radius shall be the Right Line cx = CX, the Radius of the Base.

DÊMUNSTRATION.

For having drawn through any Point x, of the Section u x y, a Side, as x X, of the Cylindrick Surface that shall be parallel to the Axis Cc; (by Def. 20.) wherefore a Plane may be made to pass through these two Lines, which by its Interection with the two parallel Planes CVXY; and cnx y will form the two Right Lines; Cx and cx parallel to one another; and which also might be equal to one another, because they are terminated by the two parallel and equal Lines, Cc and Xx.

But as this must always be the Case in what

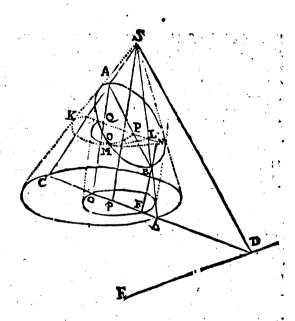
But as this must always be the Case in what Foint soever of the Section $u \times y$, x be taken: It will follow, that the Lines $c \times x$, drawn from the Point c, to all the Points x, of the Section $u \times y$, are equal to all the Radii, $C \times X$, of the Base; (i. e.) the Section $u \times y$, must be the Circumference of a Circle, whose Centre is c, where the Plane $u \times y$ cuts the Axis of the Cylinder, and its Radius is $c \times x$, a Line $x = C \times x$, the Radius of the Base. $x = C \times x$.

PROP. XII.

Every Ellipsis may be considered as a Cylindrick Section.

Having in the Base of any Cone, where an Ellipsis is formed, drawn the Diameter ab, which shall be at Right Angles in the Point D with the

Fig. 20.



Directrix DE: Let there be drawn also in the Comck Surface, the Sides Sa, Sb, meeting the. Plane of the Ellipsis in the Points A and B, and draw also in the parallel Planes AMB, SDE the Right Lines AB, SD.

Then taking DF, a mean proportional between aD and Db; and drawing to SF, the Parallels AG, BH: Let a Circle be described on the Plane of the Base, whose Radius shall be GH; and on that Circle let a Cylindrick Surface be formed, whose Sides shall be AG, BH.

This done, I say, that if through any Point, as P, in the Line AB, you draw a Parallel to the Directrix

retiriz DE, which shall cut the Conick Surface

in M, and the Cylindrick in O.

Those Two Points, M and O, will be co-incident. For making a Plane to pass thro' that Parallel P M, which shall be itself parallel to the Plane of the Two Bases, both of the Cone and Cylinder; it will form, by its Intersection of the Conick Surface, the Circle K M L, (by Brop. 2.) whose Centre will be the common Section of that Plane, with the Axis of the Cone; and in the Cylindrick Surface, another Circle, QMR, (by the Precedent) whose Centre will be the common Section of the fame Plane Sab (by Def. 6.) passes thro' the Axis of the Cone; and the Plane AGHB, (which is co-incident with the Plane Sab) passes thro' the Cylinder, (by Def. 20) and consequently the Lines KL and QR, which are the common Sections of those Two Planes, with the Plane parallel to the Base, and which passes thro' the Line P O, or PM, will be the Diameter of the Two Circles; and that Line PO M, shall be Normal to those Diameters, because 'tis parallel to DE, which (by the Construction) is Normal to a b, and also to G H, which must be coincident with a b, to which the Diameters KL and QR, (which also must be coincident) are parallel.

Moreover, the Lines AB, SD, being formed by the Intersection of the same Plane, Sab, with two others which are parallel, (and with the Plane SDE, and that of the Ellipsis) must be parallel to

one another.

Which being well understood, it will follow: That in the Cone, because of the Circle KML, you will have $PM = \prod KPL$, and because of the Similar Triangles APK, SDa, and PBL, SDb; you will have those Proportions: AP, PK: SD, aD, and BB, BL: SD, aD, whence it will follow, $AP \times PB$, AB,

 $RP \times PL$ (or PM^2) :: $SD^2 a D \times Db$.

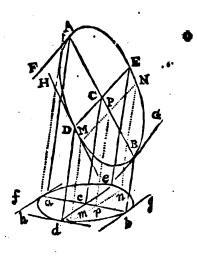
2. In the Cylinder, because of the Circle QOR, $PO^2 = []QPR$, and from the Similar Triangles, APQ, SDF, and PBR, SDF; these Proportions will arise, AP, QP, :: SD, DF, and PB, PR, :: SD, DF: Whence it will sollow, that AP, PB, $QP \times QR$ (or PO^2) :: SD^2 , DF^2 , (or $Da \times Db$). Wherefore, $PM^2 = PO^2$: and therefore MP = PO, and consequents $=PO^{1}$; and therefore MP=PO, and consequently the Points M and O will be coincident: And because this will always be the Case in what Part soever of the Line AB, the Point P be taken; it will follow, that the Plane of the Ellipsis meets or cuts the Conick and Cylindrick Surfaces in the same Points; and therefore the Ellipsis may always be considered as a Cylindrick Section.

PROP. XIII.

. All the Diameters of the Ellipsis pass thro' one only Point: Which is that where the Plane of the Ellipsis cuts or intersetts the Axis of the Cylinder, and do there bifest one another: And conversely, all Right Lines passing thro' that Point, and terminated at each End by the Ellipsis, are bisetted in that Point, and are also Diameters of the Ellipsi fis.

They call that Point the Centre of the Ellipis. 1. Let AB be any Diameter whatfoever; so let C be the Point where the Plane of the Eliph

Fig. 21.



interfects the Axis of the Cylinder. If you draw the Lines Aa, Bb, parallel to the Axis Cc, 'tis plain (by Def. 20.) that they will be the Sides of the Cylindrick Surface; and that the two Planes, PAa, GBb, passing thro' those Lines, and thro' the Tangents A F, BG, (which according to the Definition of the Diameter, will be parallel to one another) must be parallel, and must touch the Cylindrick Surface in the Sides Aa, Bb. From whence it follows, that those two Planes will form in the Plane of the Base, the two Lines af, bg, parallel to each other, and Tangents to the Base in the Points a, b; where the Sides A a, B b, interfe& it.

Now from the Elements of Geometry's plain, that the Line ab, which connects the Points of the Contact of the two parallel Tangents; af, bc, in any Circle, must pass thro' its Centre c. Wherefore the Plane Aab B will pass aro' the Axis of the Cylindrick; and the Line AB, which is the Intersection of the Plane with that of the Ellipsis, must pass thro' the Point C, where that Axis intersects the Plane of the Ellipsis.

Again, he reason of the Parallel As C and by

Again, by reason of the Parallels At, Cc, Bb, tis plain, that the Diameter of the Ellipsis AB, is divided into two equal Parts, or bisected in C; because the Diameter of the Circle of the Base ab, is bisected in its Centre c, which was the first

thing to be prov'd.

2. If thro' the Extremities of any Line, as AB. passing thro' C, where the Plane of the Ellipsis cuts the Axis Cc of a Cylinder, you draw the Aa, Bb, parallel to that Axis, tis plain, from Def. 17.) that they will be the Sides of that Cylinder; and that the Plane AabB, must pass thro' its Axis. Whence you see, that the Line Ab, which is the common Section of the Plane, and of the Plane of the Ba'e, passes thro'c the Centre of the Base; and also that it is cut into two equal Parts, the Line AB must also be bisected in C

Again, the Tangents af, bg, which pass thro the Extremities of the Diameter a b, being parallel; the Tangent Planes $f \, a \, A$, $c \, b \, B$, must be parallel also; and will form in the Plane of the Ellipsis two parallel Lines, Ac, BG, which shall be Tangeats so that Curve in the extreme Points

A, B, of the Line AB; wherefore that Line will be a Diameter.

Which was the Second Point to be prov'd.

CONSECTARY.

Hence its evident, that through any one Point given in the Plane of an Ellipsis different from its Centin there can one only Diameter be drawn:

PROP. XIV.

Every Ordinate MPN (See Fig. 149.) of an Elliplis is bijected in the Point P, by the Dianeter A B. and converfly.

If a Right Line, as MPN, terminated within an Ellipsis, and not passing thro' its Centre C, is bested in the Point by a Diameter, as AB, it thall be true Ordinate on each Side of that Dia-

Having drawn thro' the Points A, B, M, N, the Sides Aa, Bb, Mm, Nn, parallel to Cc the Axis of the Cylinder, and intersecting the Plane of the Base in the Points a, b, m, n; the Line Pp, which is the common Intersection of the two Planes AabB, MmnN, will be parallel to the Sides of the Cylinder; because all those Sides are parallel to one another. The Plane A a b B also must pass thro' Cc the Axis of the Cylinder, because the Diameter AB passes thro' the Point C, where that Axis intersects the Plane of the Ellipsis, and consequently it will form in the Plane of the Rase a Line, as a b, which will pass through the Centre c, i. e. which will be a Diameter.

This being supposed:

1. Because by the Hypothesis the Line MPN is an entire Ordinate to the Diameter AB, it will be parallel to the Tangents AF, BG, which pass thro' the Ends of that Diameter; and confequently the Tangent Blanes, FAa, GBb, will be parallel to the Plane MmnN; wherefore the three Lines, formed by those three Planes, by their Inresection with the Plane of the Base, as af, bg, and mn, must also be parallel; and consequently the hane mn will be Normal to the Diameter ab, the name m n will be Normal to the Diameter a b, and therefore will be bifected by it in the Point p; wherefore, because of the Parallels Mn, Pp, Nn, it will follow, that the Line MN must also be bifected in the Point P,

2. And then, as to the Converse, if you draw in the Plane of the Ellipsis, the two Tangents, AF, BG, (Cor. 4. Prop. 5.) parallel to MN, and then from the Points of the Contact, the Diameter AB. 'Tis plain (from Def. 12, 14.) that

meter A B. Tis plain, (from Def. 13, 14.) that from the Right Line M N, will be an entire Ordinate to that Dameter, and consequently will be

hisected in P by that Diameter.

But as there can but one Diameter, be drawn thro' P, (by the Precedent) it will follow, That if a Line, as M N, terminated within any Ellipse, and not passing thro its Centre, be bisected in B, by a Diameter AB, it shall be a true entire Ordinate to that Diameter.

PROP. XV.

If in an Ellipsis there be two Diameters, AB, DE, (See Fig. 149.) and one of them, as DE, be parallel to the Tangents AF, BG, which pass thro the Extremities of the other A.B.

I say, that the Diameter AB, shall be parallel to the Tangents which pass thro' the Extremities of the Diameter DE.

Note, In this Case the Diameter AB, and DE, are called Conjugate one to another.

Having drawn thro' the Points A, B, D, E, the Sides Aa, Bb, Dd, and Ee, of the Cylinder, which cuts the Plane of the Base in the Points a, b, d, e: The Planes AabB, Dde E, will pass thro' the Axis of the Cylinder, because the Lines AB and DE are Diameters of the Ellipsis; and consequently they will form in the Plane of the Base, the two Diameters ab de But the Tangent the two Diameters a b, de. But the Tangent Plane FAa, being parallel to the Plane DdeE, will form in the Plane of the Base a Tangent, as af, parallel to the Diameter de; which Diameter also will be Normal to the Diameter ab.

If then, thro' one of the Extremities d, of the Diameter de, you draw a Tangent to the Circle, as db, that will be parallel to ab, and the Plane h dD, to the Plane Aab B. Wherefore the h d D, to the Plane A a b B. Wherefore the common Sections of those two Planes, with the Plane of the Ellipsis, i.e. the Tangent DH, and the Diameter AB, must also be parallel one to

another.

The same thing may be proved with regard to the Tangent that passes thro' the other End E, or of the Diameter DE.

Wherefore the Proposition is proved.

CONSECTARIES

I. From hence 'tis plain, that if there be two Conjugate Diameters in an Ellipsis, as AB, DE; the two Planes which pass thro' those Diameters, and thro' the Axis of the Cylinder, will form in the Plane of the Base two Diameters, ab, de, which thall be Normal one to another.

II. It follows also from this Proposition, that if thro' any Point, as P, of a Diameter, as AB, in an Ellipsis, you draw an entire Ordinate, as MPN, that shall be parallel to the Conjugate Diameter DE; and you will have (by Confest Prop.9.) these Propositions; $MP \times PN$, (or PM^2): $DC \times CE$, (or CD):: $AP \times PB$. $AC \times CB$, (or AC^2) and that will give us PM^2 . $AP \times PD$:: DC^2 . $\frac{DC^2}{(\text{or } DE^2)} \frac{AC^2}{(\text{or } AB)}$: That is, the

Square of any Semi-Ordinate to the Diameter, that is, MP is to the Rectangle APB under the Parts of that Diameter: : as the Square of the Conjugate Diameter DE, is to the Square of the Diameter AB.

PROP

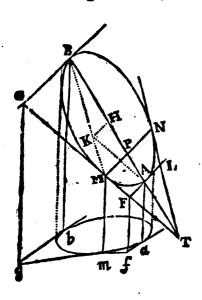


PROP. XVI.

If thro' any Point, as Min an Elipsis A MB, and Tangent FMG be drawn, which in the Points GF, shall intersect any two parallel Tangents, as AB, BG; Isay, FM, MG:: AF, BG.

For, drawing thro' the Points of Contact, A, B, M, the Sides A a, B b, Mm, of the Cylinder; and thro' these Sides, and the Tangents AF, BG, FG, drawing the Planes FA a, GBb, FM m,

Fig. 22.



or G M m: Tis plain, that Ff, Go, the common Sections of the first two Planes with the third, must be both parallel one to another, and to the Sides of the Cylinder. For the two Planes, F M m, FA a, passing thro' the Sides M m, A a, which are parallel, will have their common Section Ff, parallel to those Sides; and for the same Reason Go, the common Section of the two Planes G B b and G M m, will be parallel to the Sides B b, M m. Moreover, the Line a f, b g, which from the parallel Tangent Planes Fa, G B b, with that of the Base being parallel: The Parts f m, mo, of the third Tangent formed in the Plane of the Base, by the third Tangent Plane F M m, or G M m, must be (by the property of the Circle) parallel to the Tangents a f, b o, vid. f m parallel f a, and mo parallel o b.

Which being supposed, by reason of the Right Lines A a, Ff, Mm, G o, Bb, and AF, BB, and af, bo, which are respectively parallel to one another, you will have.

another, you will have,

FM, MG:: fm. or fa, mo, or gb:: FA,
GB. Q. E. D.

CONSECTARIES.

I. If thro' the Points of Contact A, B, of the two parallel Tangents AF, BG, a Diameter, as AB be drawn, which shall intersect in the Point T, another Tangent, as FMG; and if an Ordinate, as MP, be drawn to that Diameter; 'tis plain, that AP, PB:: FM, MG:: AF, BG:: AT, BT. And also that PB—AP, BP:: BT—AT, (or BA) BT.

Vol. IL.

II. From hence the following manner of drawning to the Point M in an Ellipsis, a Tangent, as M T, is taken, when the Diameter A B is given, with the Position of its Ordinates.

From one of the Ends B, of the Diameter AB, to give a Point M, let the Right Line BM be drawn: And then having drawn the Ordinate MP to the Diameter AB, and taken in that Diameter towards the Point P, a Part, as PH = PA, draw HK parallel to PM, which shall intersect the Line MmK; thro' which Point, and the other End of the Diameter A, drawing AK, and then MT parallel to it; that Line MT shall be the parallel required.

For on account of the Parallels MP, HK, and AK, MT; you will have BP, DH, or PA:: BM, MK:: TB, TA.

III. If in an Ellipsis there be two Tangents, as

MT, NT, which meet in the Point T.

I say, the Diameter AB, passing thro' the Point P, the middle of the Line MN, joining those two Tangents in their Points of Contact; shall pass also thro' T, their Point of Intersection.

For, PN is an Ordinate to the Diameter AB, as well as PM; and consequently the (by Cor.1.) Tangents MT, NT, must so meet or intersect the Diameter in a Point, as T; that PB—AP, PB: AB, BT, that is, in the same Point.

IV. If to the Point of Contact, M, N, of two Tangents to the Ellipsis, a Right Line, as MN be drawn, and that it have a third Tangent, as FAL parallel to it: I say, that FA, AL, the Parts of that third Tangent taken between its Points of Contact A; and the two former Tangents will be equal one to another.

For, drawing thro' the Points of Contact A, the Diameter AB: 'Tis plain, the Line M N will be an entire Ordinate to that Diameter, because it is parallel to the vertical Tangent FL; and therefore also it must be bisected in P, and (by Cor. 3.) will pass thro' T, the Point of Intersection of the two Tangents M F, NL; or will be parallel to them (by Prop. 15.) when the Line M N is a Diameter.

But 'tis plain in both Cases, that FL will be bleected in A, by the Diameter AB; because MN is so bisected in the Point P, by the same Diameter.

Of the Parabola and Hyperbola, particulally.

PROP. XVII.

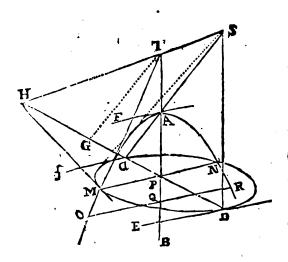
In the Parabola, every entire Ordinate (as MP N) to a Diameter, as A B, is bifested by that I is meter in the Point P, and vice versa.

Y

For

For having made an Elliptick Plane which shall pass thro' the Line MN, that will form with the





Tangent Plane S D E, parallel to the parabolick Plane, a Tangent, as D E parallel to MN.

Again, the Plane S A F, drawn thro' S the Vertex of the Cone, and thro' the Tangent A F, which passes thro' A, the Vertex of the Diameter A B, will form in the Elliptick Plane, a Tangent, as f a; and the Line D a jointly, the Points of Contact of the two Tangents D E, A f, will pass thro' tact of the two Tangents DE, af, will pass thro' the Point P, because the Diameter AB is parallel to the Tangent Side S D.

This supposed,

Because by the Hypothesis AF and MN, are parallel, (vid Def. 14.) it will follow, that the Tangent af, which is the common Section of two Planes passing thro' those Lines, will be parallel to M N, and consequently to D E. Whence it appears, that the Line D a (by Dest. 13.) joining the Points of Contact of the two parallel Tangents D E, a f, is a Diameter of the Ellipsis; and also that the Line M N, which is parallel to those Tangents, and terminated by the Ellipsis shall be Tangents, and terminated by the Ellipsis, shall be (by Prop. 14.) bisected in the Point P.

The Converse will thus appear.

Draw in the Parabolick Plane, the Tangent AF (by Cor. 4. of Prop. 5.) parallel to the Line MN; and thuo' the Point and Contact A, a Diameter, as AB, the Line MN will be an Ordinate rightly apply'd (by Defi 14.) and consequently must be bisected in P.

And because there is but one only Diameter that can pass thro' that middle Point P; AB must be it, (by Def 15.) and in the following Corollary.

CONSECTARY.

Hence 'tis evident, that if thro' any two Points Prence its evident, that it thro any two Points P, Q, of a Diameter AB, two entire Ordinates, MPN, OQR, be drawn; you will always have this Proportion: (by Confett. Prop. X.) That $MP \times PN$, or PM^2 . $OQ \times QR$ (or OQ^2) :: AP, AQ; that is, the Square of any two Ordinates, as of MP, QO, to any Diameter, as AB, are always as the Abcissa or intercepted Parts of that Diameter. APof that Diameter, AP, AQ.

PROP. XVIII.

(See Fig. 23.)

If thro' M any Point in a Parabola, you draw an Ordinate MP, to any Diameter AB, and also a Tangent MP, meeting in T, that Diameter produced beyond the Vertex A; I say, A P will always be equal to A.T.

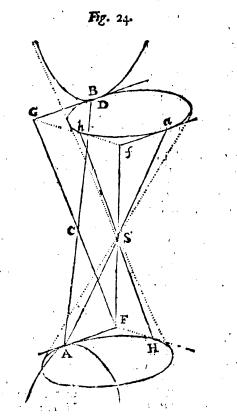
The same thing being supposed, as in the last Proposition: Let there be also drawn thro'S the Vertex of the Cone, and the Line MT, a Tangent Plane STM, which will form in the Elliptick Plane, the Tangent M H, which will cut the Diameter of the Ellipsis u D, in a certain Point as H, thro' which the Line S U passes: And lastly, let the Right Line TG be drawn parallel to SA.

This being well understood, you will have (by Cor. 1. Prop. 16.) D H, Ha:: DP, Pa, and alternately DH, DP:: Ha, Pa. But by reason of the parallel Lines AB, SD, and SA, TG: Tis plain, that DHDP:: SHST:: HaGa, wherefore Ha, Pa:: Ha, Ga; and consequently Pa =Ga; and therefore AP=AT. Q. E. D.

PROP. XIX.

In the opposite Hyperbola's, every Diameter, as A'B, passeth thro'C, the Point of Intersection of the Assymptotes, and is there cut into two equal Parts, and vice versa; that Point is called the Centre.

Let HSb be one of the two common Sections of a Plane parallel to the Hyperbolick Plane, and the two opposite Conick Surfaces, and let the



Assymptote FG be formed by the Intersection of the Plane of the Hyperbola, with that which touches the two Surfaces HSb.

Let

Let there be drawn thro' the parallel Tangents A F, B G, which pass thro' the Ends of the Diameter AB, and intersect the Assymptote FG in the Paires FG. the Points F, G, two parallel Elliptick Planes; and those will form with the Tangent Plane which passes thro the Side HSb, the parallel Tangents FH, and Gbf; and in the Tangent Plane SAF,

the parallel Tangents, Af, af.

This proportion being made, the parallel Lines This proportion being made, the parallel Lines FH, Gh, being contained between the two other parallels FG, Hh, will be equal. And the fimilar Triangles, SHf, Shf, and SFA, Sfa, will give HF, hf:: Sf, sf:: FA, fa; and also HF, FA:: hf, hf:: hf: =CB: That is, the Assymptote FG, bisects the Diameter AB in C.

The same thing may be proved of the other Assumptote, that it shall passalso thro'C, the middle of the Diameter AB; from whence 'tis apparent, That the Diameter AB passes thro' C the Centre of the two Assymptotes, and is there bisected.

Let there be then a Line, as AB, which passing thro' C the Intersection of the Assymptotes, shall intersect the opposite Hyperbola's in the Points AB. If then you draw thro' the Point A, the Tangent AF, and to the opposite Hyperbola, a Tangent DG, (by Conset 4. Prop. 5.) parallel to AF; 'tis plain, that since the Line AD may be proved to be a Diameter, it will pass thro' C, the Point of the Intersection of the Assymptotes. It must be co-incident then will AB, which (by the Hypotheses) passes thro' the same two Points, A, C; wherefore the Line AB is a Diameter, and is bisected in C.

CONSECTARY.

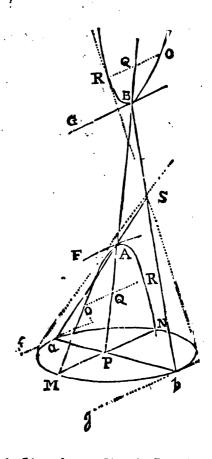
Hence you see that from any Point given within an Hyperbola, there can be but one only Diameter drawn; because no other Line can pass through that Point, and thro' the Centre.

PROP. XX.

In the opposite Hyperbola's, every entire Ordinate
MPN, is bisected in P, by its proper Diameter A B; and vice versa.

Having made an Elliptick Plane to pass thro' the Line M N, it will form in the two Tangent Planes, SAR, SBG2, the Tangents a f, b o.

Fig. 25.



And the Line ab connecting the Points of Contact of those two Tangents, being the common Section of the Elliptick Plane of the Plane S A B, will pass thro' the Point P.

But because by the Hypothesis, the two Lines AF, MN are parallel; it follows, That the Line af, which is the common Section of two Planes passing thro' these two Lines, will be parallel to M N.

For the same Reason, the Tangent bg, which is the common Section of the Elliptick Plane, and of the Tangent Plane S B G, which two Planes do pass thro' the two parallels MN, BG, will be parallel to M N.

The Tangents then, a f, b g, will be parallel one to another; from whence it will follow, that the Line ab (by Def. 13.) is a Diameter of the Ellipsis; and also that the Line MN (by Prop. 14.) is bisected in the Point P.

And to prove the Converse;

Draw in the Plane of the Hyperbola, two Tangents, as AF, BG, (by Cor. 4. of Prop. 5.) parallel to the Line MN, terminated within the Hyperbola: And then, having drawn thro' their Points of Contact, the Diameter; 'tis plain (from Def. 14.) that the Diameter will have the Line M N an entire Ordinate rightly apply'd, and that it shall bisect it in P. But as there can be but one Diameter pass thro' that Point (by Cor. of Prop. 20.); it will follow, that if a Line, as MN terminated in Pby a Diameter AB; it must be an entire Ordinate, and rightly applied in that Point.

CONSECTART.

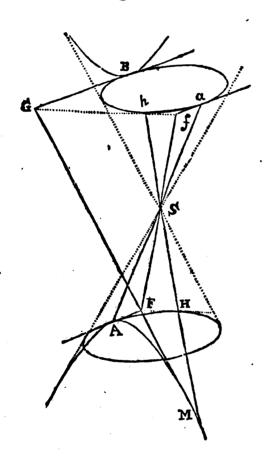
Hence 'tis apparent, that if you rightly apply two entire Ordinates MPN, and OQR, to one and the same Diameter; it will always be (by Consett. Prop. 9.) $MP \times PN$, (or PM^2) $OQ \times QR$ (or OQ^2):: $AP \times PB$, $AQ \times QB$.

PROP. XXI.

If thro' any Point M in an Hyperbola, a Tangent M F G be drawn, intersecting two other parallel Tangents, A F, B G, in the Points F G; 1 say, that M F, M G: A F, B G.

Drawing two elliptick and parallel Planes, which shal' pass thro' the Tangents AF, BG, they will form in this Tangent Plane SMG, two Tangents

Fig. 26.



. HF, bG, which will be parallel; and the Elliptick Plane passing thro' BG, will form in the Tangent Plane SAF, a Tangent af, which will intersect the Tangent bg in the Point f, where the Line SF cuts the Elliptick Plane.

This being laid down or supposed: The Tangents of RG, will be parallel because each is so we had

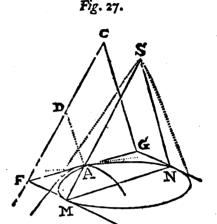
This being laid down or supposed: The Tangents af, BG, will be parallel, because each is so to the Tangent AF. And therefore (by Confest from Def. 15.) you will have BG, Gh:: af, fh, (and because of the similar Triangles Shf, SHF; and Shf, Shf::

N. B. Tis evident, That from this Prop. the fame Corollaries may be drawn, as are in the Ellipsis (from Prop. 16.): And therefore there is no need to expose them at length here.

PROP. XXII.

If a Right Line F G, terminated between the Assumption of an Hyperbola, touch the Curve in a Point at A, it will always be bised in that Point.

Let there be drawn thro' S the Vertex of the Cone, and thro' the two Assymptotes CF, CG, two Planes touching the Conick Surface. (See



Def. 16.) in the Sides SM, SN, where the Plane MSN, parallel to the Hyperbolick Plane, interfects it.

Let there be supposed drawn also an Elliptick Plane, passing thro the Right Line FG; this will form in the two Tangent Planes, two Tangents MF, MG; and in the Plane MSN, a Right Line MN parallel to FG; and connecting the Points of Contact of the two Tangents.

This supposed, 'tis apparent, that the Line FG (by Confect. 4. Prop. 16.) is bisected in A; because it touches both the Ellipsis, and the Hyperbola in that Point.

CONSECTARIES.

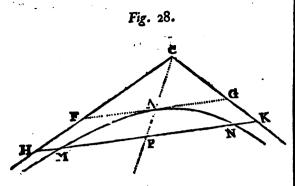
I. As there can be but one Line FG, which passing thro' a given Point A, within any Angle FCG, and terminated by its Legs, can be bisected in that Point: It follows, that if a Right Line FG, terminated by the Assymptotes of an Hyperbola meet the Curve in a Point, as A, and be there bisected, it will be a Tangent to the Hyperbola in that Point.

II. Hence tis evident, that to draw through a Point given, as A, in an Hyperbola, whose Assymptotes C F, C G, are given, a Tangent, as F A G; you need only draw A D parallel to one of the Assymptotes C G, and terminated by the other; and having then taken D F = to C D, draw the Line F A G, for that shall be the Tangent required.

For, by reason of the similar Triangles FCG, and FDA; the Line FG must be bisected in A, because CF, (by the Construction) is so in D.

III. IP

III. If any two Points MN, within an Hyperbola, be joined by a Right Line, as M M, interfeeting the Assymptotes in the Points HK: Then

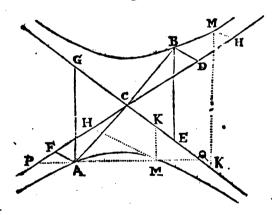


will the two Lines MH, NK, being the Parts of MN, lying between the Curve and its Af-

symptotes, he always equal.

For having drawn thro' P, in the middle Point of MN, a Diameter, as CP, and thro' the Point A, where that Diameter meets the Curve, a Line, as FG parallel to MN, and terminated by the Assymptotes; 'tis plain, that that Line TG, FG, (by Prop. 20.) will be a true Tangent in the Point A, and consequently will be bisected in that Point (by this Prop. 22.) Whence tis clear, from the Similar Triangles CAF, CPH, and CAG, CPK; that PH = PK, and consequently (because MN is bisected) MH = NK. Q.E.D.





IV. If thro' any Point, as A, in an Hyperbola, two Right Lines, AF, AG, be drawn and terminated by its Assymptotes; and if from any other Point, as M, in the same Hyperbola, or its Opposite, you draw two other Right Lines MH, MK terminated also by its Assymptotes, and parallel to the two former AF, AG.

I say, the Rectangle FAG, will always be

equal to the Rectangle HMK.

1. When the Points AM, fall in one and the fame Hyperbola, having drawn a Right Line joining the two Points A, M, and cutting the Assymptotes in P and Q; the Similar Triangles PAF, PMH, and QMK, QAG, will give these Proportions: AF, MH:: AP, MP, (by Cor. 3.):: MQ: AQ:: MK: AG; and then multiplying the Extremes and Means, you have $FA \times AG = HM \times MK$

2. When the Points A, M, fall in the two opposite Hyperbola's; having drawn thro' the given

Point A, and the Centre C, the Diameter A B, and also the two Right Lines BD, BE, parallel to AF, AG, and terminated by the same Assymptotes; its evident, that the Triangles CAF, CBD, and CAG, CBE, being not only Similar by a CaG, CBD, and CAG, CBC, contains a cont lar, but also respectively equal one to another, because CA = CB, (by Prop. 19.) Therefore BDAF, and BE = AG, and consequently BD $BE = FA \times AG$. But from the former $\times B E = F A \times A G$. But from the former Case, $KM \times MH = DB \times BE$; wherefore now also FA * AG = KM * HM.

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CONICK Surface. Let the Side of a right Cone be call'd a, the Radius of its Base r: Then by what is provid under the word Pyramid, the Area of the Convex Surface of the Cone is $=\frac{1}{2}$ the Periphery of the Base multiplied into the Side of the Cone. That is, Since 2r = to the Diameter, and 2re = to the Periphery, it will be expressed by rea. And from hence it will be easy to deduce that noble Proposition of Archimedes: That a Cirtle whose Area is equal to the Convex Surface of the Cone, will have its Radius a mean Proportional between the Side of the Cone and the Radius of the Base. For since : ar is such a mean Proportional between a and r; if you suppose that to be the Radius of the Circle required, its Diameter will be $2\sqrt{ra}$ and its Periphery $2\sqrt{rae}$; and by multiplying the Periphery $2\sqrt{re}$ into $\frac{1}{2}\sqrt{ra}$, the half Radius, the Area will be rea, the very same with that of the Surface of the Cone.

Q.E.D.

The Surface of a right Cone may be easily had

Paline of the Circle of the Base; for as that Radius is to its Periphery, so will the Radii of the other Circles up to the Vertex be to their respective Peripheries. But all those Radii are the Elements of a right Angle Triangle, whose Altitude and Base are given, and consequently its Area is known: Wherefore as any one Radius to its Periphery, so will the Area of the Triangle, which is the Sum of all, be to the Sum or Aggregate of all the Peripheries, i.e. to the whole Conick Surface, which therefore will be known.

Conick Surface, is the Convex Surface of a Cone without its Base, and this is formed by the Motion of a right Line fix'd in a Point above and below moved round the Periphery of a Circle.

CONJUGATE Diameters, in respect of one another in the Ellipsis, are such as are parallel to Tangents meeting the Curve in each others Ver-

Conjugate Sessions. See Sessiones sequentes.
CONSERVATOR, is a delegated Umpire, or standing Arbitrator, which as a third impartial Friend, was chose and appointed to compose and adjust all Differences that should arise between two

other Parties. Dr. Kennet's Gloffar.

CONSISTORY, is the Court Christian, or Spi-rual Court. This was held formerly in the Name ritual Court. of the Cathedral Church, or in some Chapel, Isle, or Portico belonging to it, in which the Bishop presided, and had some of his Clergy for Assessors and Assistants: But this Consistory Court is now, half by the Bishop's Chancellor or Commissary, and by Archdeacons or their Officials.

CONSTITUENT Particles of any Natural

Body, are those small Particles of which it is composed. See Particles.

CONSTITUM, in the Civil Law, is a Promise for a Debt upon a Nude Covenant, without Stipulation.

CONSTRUCTION of Equation, an easy way of constructing Cubic and Biquadratick Equations without the Parabola, communicated by the Ingenious J. P. M. A.

In order to this Method of Construction, I consider each Side of the Equation, as the Product of two Multipliers, the one of two Dimensions, the orher of one, (each Term in a Cubick Equation being supposed of three Dimensions.) E. G. In this Equation $x \times x + p \times x = n$; I confider it as in this Form $x \times x \times x + p = n = b^2 \times c$, (b) being taken at pleasure for any Number whose Square is less than n divided by b b gives c.) Or else in this Form, $xx + px \times x = n = b^2 \times c$; either of which Forms may be made use of, as seems less for Construction. And because x is yet unknown, and must be taken by guess, I put z instead of z the Multiplier of two Dimensions, and y for x in the other of one Dimension; and then the former Equation will fland thus $z \times y + p$ $=b^2 \times c$; or (the other way,) $zz + pz \times y =$ $b^2 \times c$. In both which Forms, the given Quantity $b^2 \times c = n$, is the same as in the first Equation, and consequently the Result or Value of the other Terms is the same also.

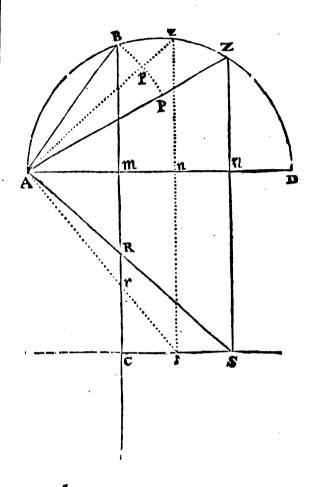
The Design then, of this Method is, by taking a Number or Line by guess (suppose 2) to reprefent x in one of the Multipliers of the given Equation, to find another Number or Line (y) which shall represent x in the other Multiplier; and then if z and y be not equal, to bring them by Tryals to Equality, which in most Cases, is easily done, observing their Difference and the Nature of the Scheme or Figure.

Before I give Examples, I will premise this Lemma, which shews the Ground and Demonstration

of this way of Construction.

Let AB D, be a Semi-circle on the Diameter AD, AB and AZ, two Subtenses drawn at plea-fure from the end of the Diameter A, from B and Z are drawn the infinite Lines B Cand Z S perpen-

Fig. 1.



dicular to AD, BC intersecting it in m, and ZS in n; from A draw the Line AS intersecting BC in R, and ZS in S; I say, that ABq: AZq::

For (by the Nature of a Circle) $DA \times mA =$ A B q, and D $A \times n A = AZq$; then D $A \times m A$: D $A \times n A$: m A : m A : m R : n S; that is,

ABq: AZq::mR:nS.

Multiply the extreme and middle Terms, and 'tis $ABq \times nS = AZq \times nR$; if therefore we suppose AB = b, nS = c, AZ = to the Square Root of the Multiplier of two Dimensions (in 2 Cubick Equation reduc'd into the Form above directed) then will m R be equal to the other Multiplier of one Division. So in the first Form above, $(zz \times y + p = b^2 \times c)$ if AZ = z, then is mR= y + p, and in the Second Form $zz + pz \times y$ $=b^2 \times c$, if $AZ = \sqrt{zz + pz}$, then is mR = y, and if y = z, then z = x in the given Equa-

Example I.

Suppose I would construct this Cubick Equation $x \times x - 4xx = 72$, or $x \times x - p \times x = n$. I take 16, as a convenient Square Number, (which I call bb) and therewith I divide 72; the Quotient Quotient is $4\frac{1}{5}$ which I call c, $[\frac{n}{bb} = c]$, and bbc = n = 72] I deduce also the other side of the Equation into two Multipliers (as above) and then its $zz \times 4 - p = 72 = 16 \times 4\frac{1}{12}$, which is the first Form of Construction.

I describe a Semicircle ABD, (See Fig. 1.) of a convenient bigness for my Scale of equal Parts, (which here, for this Figure, is of 24 in an Inch, 10 of which parts make an Unite or 1.) and having drawn the Diameter AD, I take 4 (Units or large Divisions) off the Scale, and draw the Chord AB = 4 = b; from B I draw the infinite Line BC, perpendiculiar to AD, and intersecting it in

I take $4\frac{1}{4}$ (=c) off the Scale, and fet that Diffance with the Compasses from m to C, and thro'

For the first Tryal I consider that the Root x must be bigger than 4 or p, (else the Negative Term -4 xx, wou'd take away more than xxx, and so the given Quantity wou'd be Negative;) therefore taking 4 (= p) from the Scale, with Center A, and Radius Ap = 4, I describe the little Arch Pp; and then (at x = 2) intersecting the Arch x = 2 intersecting the Arch x = 2 intersecting the Arch x = 2 intersecting the Arch x = 2 intersecting the Arch x = 2 intersecting the Arch x = 2 intersecting it in x = 2 por x = 2 and intersecting it in x = 2 perpendicular to x = 2 and intersecting it in x = 2 perpendicular to x = 2 intersecting it in x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular to x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular to x = 2 perpendicular than the Line x = 2 perpendicular than the Line x = 2 perpendicular to x = 2

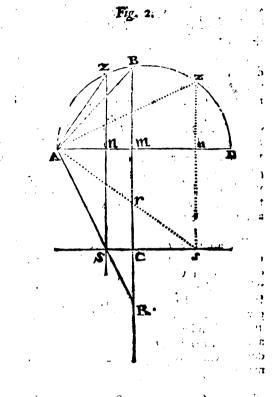
After the same manner I try another z, which the view of the Scheme will now direct me to limit, till I find AZ, which Answers the demand. For making AZ = z, then is $PZ \in z - 4$ = MR (= y - 4) consequently Z = y = z, z taking from the Scale, is equal to 6, the Root

fought.

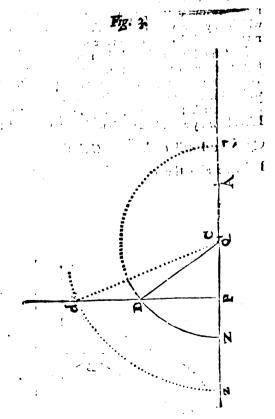
The fame Conclusion would follow if I had inverted the Order of proceeding, and had begun with Mr, and thereby found Az (in a first tryal,) for in this Case I must have taken a Line for y (by guess) and made mr = y - p, and then having drawn AS intersecting mC in r, and CS in S. Also SZ parallel to BC, touching the Semicircle in z, I draw Az which will be equal to z; so is the Line pz = z - p, which ought to be equal to mr; but not being so, another Trial must be made.

EXAMPLE II.

In the Semicircle ABDI draw the Chord ABDI draw the Chord ABDI and ADI and ADI and ADI are ADI and ADI are ADI.



I find $\sqrt{zz-pz+qq}$ by Fig. 3. where AP = p = 3, and is bisected in C. $PQ = q = \sqrt{2}$ = 14. Pd is perpendicular to PA, Az, AZ,



So. are Lines taken by guess for z. z d, ZD, so. are Arches of Circles drawn with Centre C and Radius Cz, CZ, &c. So are Pd, PD, &c. =

For continuing the Arch ZD (for Instance) to ζ in the Diameter; ZA ($=P\zeta$) =z. PZ=zp. Therefore $PD (= \sqrt{P \zeta \times PZ}) =$ $\sqrt{z \times z - p} = \sqrt{zz - pz}$, And PQ being = q. DQq. (=DPq + PQq) = zz - pz+ 99. therefore $DQ = \sqrt{zz-pz+qq}$.

Having found $dQ = \sqrt{zz - pz + qq}$; I draw Az (See Fig. 2.) -dQ, and then (as in the former Example) find $mr = \gamma$, which being much less than z (or Az, Fig.3.) I find that I have err'd in my Supposition of z. And considering that (See Fig. 3.) the bigger Az is, the bigger will dQ be also, and consequently mr the less; I try again with a lesser z, and at last find, that making AZ(Fig. 3.) = z, DQ will be $\sqrt{zz-pz+pq}$, to which I make AZ (Fig. 2.) equal, and thereby find mR = y = z, which is therefore the Root, and the Scale shews the Number to be 6 = x.

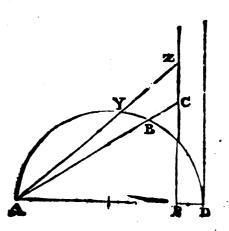
For another Example, may be proposed the doubling of the Cube; that is, having the Root or Side of a Cube given, to find another Line whose Cube shall be double the former Cube. In this Case, let AB (Fig. 1.) be the Side of the given Cube; mC = 2AB, Az = z, the sought Root taken by gues, by which finding mr (as above) if mr = Az, then is Az the Root of the double Cube sought; else another Trial must be made

ABQ: Azq::mr:nS=mc=2AB theref. $AB \times ABq = 2 AB$, cub. $Azq \times mr =$ Az cub. (when Az = mr.)

Several things might be added conducing to a more ready determining of the Root fought; which any one who shall think fit to make trial, may himself observe and make use of.

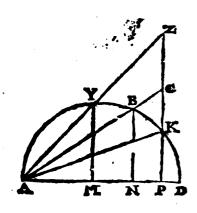
By something alike Method may Biquadratick Equations be constructed also, and if the lowest Term be wanting, as easily as a Cubick. Of which I'll here give you an Instance. Suppose this Biquadratick Equation $x^4 + px^3 + q^2x^2 = n$ I divide n by a less Square Number, suppose b' the

Quotient I call CC, $\frac{\pi}{bb} = CC$, then $\pi = b$, C. I divide also the other Side of the Equation in-



to two Multipliers, viz. $x^2 \times 2x^2 + px + qq$ $b^2 \times C^2$, whence $x \times \sqrt{x^2 + px + qq} = b \times \overline{C}$. Or, Substituting y and z for x (as I do in Cubes) while z is unknown) $q \times \sqrt{zz + pz + qq} =$ I take z by guess, and therewith find $\sqrt{zz+pz+qq}$ (as is done in the Second Example of Cubick Equations.) In a convenient Semicircle ABD, I apply the Chord AB = b, and producing it, make AC = c, [but if b be greater than c, I make AB = c and AC = b.] Thorough C I draw Z CP perpendicular to AD, and applying $AZ = \sqrt{zz + px + qq}$, so is the intercepted Chord AT = y, and if y = z, then is either equal to x, the Root fought. Else Trial must be made with another x.

I might have taken the Biquadratick Root of a, and then b-c, to which the Diameter AD must have been equal; the Demonstration depends on this, that $AT \times AZ = AB \times AC$, which I thus prove, (having drawn AK to the intersection of



ZP with the Semicircle) ABq: AKq:: (An: $AP::) AB: AC: AB \times AC = AKq$. By a like Reafon $ATq:AK::(AM:AP::) AT: AZ: AT \times AZ = AKq = AB \times AC$. The fame Method will hold for compleat Biquation in the same of the same

draticks, but will be too operose.

See Mr. Halley's Confirmation of Cubicks and Biquadraticks, in Phil. Trans. No. 188, 190. As also Bernoulli's Animadversions on the Cartesian Geometry, in the Act. Erud. Lip. 1. for June 1688. And his True Geometrical Confiruation of Solid,

and more than Solid Problems by Right Lines and Circles only, for the Month of Sept. 1689.

Dr. Gregory, in his Preface to his Excellent Oxford Euclid in G. L. shews that all Quadratick Equations may be constructed from the 58 and 59 of Euclides Data.

CONTRARY Flexion and Retrogression of Curves, when a Curve Line as AFK (Vid. Hay's

Fluxions, pag. 153.)
CONTRARY Legg'd Hyperbola, is an Hyperbola, so called by Sir Isaac Newton, because its Legs are convex towards contrary Parts, and run contrary ways. See Curves.

CONTRASTE, is a French Term used in Painting and Sculpture, and fignifies the due placing of the different Objects and Parts of the Figures; and produces that Variety which is so pleasing in the Attitudes, as if in a Groupe of three Figures, one stand out forward, the other backward, and the third appear to the middle between them, they ûy,

fay 'tis well Contrasted: So they say also, that to render the Attitudes of Figures agreeable and just, they must be natural and active, varied in their Actions, and Contrasted in their Members: So that for Figures to be well Contrasted, is for them to be lively, and to express the Motion proper to the Design of the whole piece, or of any particular Grouppe

CONVERGING Hyperbola, is one whose Concave Legs bend in towards one another, and run

both the same way. See Curves.

Converging Series, is a Method of Approximation still nearer and nearer towards the true Root of any Number or Equation, even tho' it be impossible to find any such true Roots in Numbers.

See Approximation and Square Roots in Vol. I.
COPPERAS. The way of making Copperas is as follows; Copperas Stones, which some call Gold Scones, are found on the Sea-shore in Essex, Hamp-Ibire, and so Westword. There are great Quantities in the Clifts, but not so good as those on the Shore, where the Tides Ebb and Flow over them.

The best of them are of a bright shining Silver Colour; the next, such as are of a Rusty deep Yellow; the worst are such as have Gravel and Dirt

in them, of a fadder Umber Colour.

In the midst of these Stones are sometimes found the shells of Cockles, and other small Shell-Fishes small pieces of the Planks of Ships, and pieces of Sea-mal

In order to the making of Copperas, they make Beds according as the Ground will permit; those at Deptford are about 100 Foot long, and 15 Foot broad at the Top, and 12 Foot deep, shelving all

the way to the Bottom.

They ram the Bed very well, first with strong Clay, and then with the Rubbish of Chalk, where-by the Liquor which drains out of the Dissolution of the Stones, is convey'd into a Wooden Shallow Trough, laid in the middle of the Bed, and covered with a Board; being also boarded on all sides, and laid lower at one End than the other, whereby the Liquor is convey'd into a Cistern under the Boiling House.

When the Beds are indifferently well dryed, they lay on the Stones about two Foot thick.

These Stones will be five or six Years before they yield any confiderable Quantity of Liquor; and before that, the Liqour which they yield is but

They ripen by the Sun and Rain; yet Experience proves, that watering the Stones, although with Water prepared by lying in the Sun, and poured thro' very small holes of a Watering pot, doth retard the Work.

In time, these Stones turn into a kind of Vitriolick Earth, which would swell and ferment like

Leavened Dough.

When the Bed is come to Perfection, then once in four Years they refresh it, by laying new Stones

on the Top.
When they make a new Bed, they take a good Quantity of the old fermented Earth, and mingle it with new Stones, whereby the Work is haftned. Thus the old Earth never becomes useless.

The Cistern before-mentioned, is made of strong Oaken Boards, well joined and calked. at Deptford will contain 700 Tun of Liquor. Great care is taken, that the Liquor doth not drain thro' the Beds, or out of the Cistern. The best way to prevent the same, is to divide the Cistern Vol. 11.

in the middle, by Oaken Boards calked as before; whereby one of them may be mended in case of a

The more Rain falls, the more but the weaker will be the Liquor: The goodness whereof is tried by Weights prepared for that purpose. Four-teen-penny Weight is rich; or an Egg being put into the Liquor, the higher it swims above the Liquor, the stronger it is. Sometimes the Egg will swim near half above the Liquor.

Within one Minute after an Egg is put in, the ambient Liquor will boil and froth; and in three

Minutes the Shell will be quite worn off.

A drop of this Liquor falling on the Manufactures of Hemp, Flax, or Cotton Wooll, will presently burn a hole thro' it. As also in Woollen and Leather.

Out of the aforesaid Cistern, the Liquor is pumped into a Boiler of Lead, about 8 Foot Square, containing about 12 Tuns, which is thus ordered. First, they lay long Pieces of Cast Iron, 12 Inches Square, as long as the Breadth of the Boiler, about 12 Inches one from another, and 24 Inches above the Surface of the Fire. Then Cross-wise they lay ordinary flat Iron Bars as close as they can lie, the Sides being made up with Brick-work. In the middle of the Bottom of this Boiler is laid a Trough of Lead, wherein they put at first 100 Pound Weight of old Iron.

The Fewel for boiling is New-Caftle Coals. By degrees, in the boiling, they put in more Iron, amounting in all to 1500 pound Weight in a boiling. As the Liquor wastes in boiling, they pump in fresh Liquor into the Boiler: Whereby, and by a Defect in ordering the Fire, they were wont to be above 20 Days before it was enough; when that is, they try, by taking up a small Quantity of Liquor into a shallow Earthen Pan, and observing how foon it will gather and crust about the Sides thereof. But now of late, by the Ingenious Contrivance of Sir Nicholas Crifp, the Work is much facilitated. For at his Work at Deptord, they boil off three Boilers of ordinary Liquor in one Week; which is done, first by ordering the Furnace so, as that the heat is convey'd to all Parts of the Bottom and Sides of the Furnace.

Then, whereas they were wont to pump cold Liquor into the Boiler to supply the waste in boiling, whereby the Boiler was checked sometimes to Hours. Sir Nicholas hath now a Vessel of Lead, which he calls a Heater, placed at the end of the Boiler, and a little higher, supported by Bars of Iron as before, and fill'd wirh Liquor, which, by a Conveyance of Heat from the Furnace, is kept near Boiling-hot; and so continually supplies the waste of the Boiler, without hindring the boiling. Thirdly, by putting due Proportions of Iron from time to time, in the Boiler; as soon as they perceive the Liquor to boil flowly, they put in more Iron, which will foon quicken it. Besides, if they do not continually supply the boiling Liquor with Iron, the Copperas will gather to the Bottom of the Boiler and melt it; and so it will do if the Liquor be not presently drawn off from the Boiler

into a Cooler, so soon as it is enough.

The Cooler is oblong, 20 Foot long, 9 Foot over at the top, 5 Foot deep, taper'd towards rhe Bottom, made of Terras. Into this they let the Liquor run fo foon as it is boil'd enough. The Copperas herein will be gathering or shooting 14 or 15 Days, and gathers as much on the fides as in the Bottom; so. above 5 Inches thick. Some put Bushes into the Cooler, about which the Copperas will gather: But at Deptford they make no use of any.

That which sticks to the Sides and to the Bushes, is of a bright Green; that in the Bottom, of a foul

and dirty Colour.

In the end of 14 Days, they convey the Liquor into another Cooler, and reserve it to be boil'd

again with new Liquor.

The Copperas they shovel on a Floor adjoining: So that the Liquor may drain from it into a Cooler.

The Steam, which comes from the boiling, is of

an Acrimonious smell.

Copperas may be boiled without Iron, but with Difficulty; without it, the Boiler will be in danger of melting.

Sometimes in stirring the Earth upon the Beds, they find pieces of Copperas produc'd by lying in

the Sun.

CORBETT, in Architecture, is a short piece of Timber placed in a Wall, with its end sticking out 6 or 8 Inches, as occasion serves. The under Part of the end thus sticking out, is sometimes cut into the Form of a Boultin, sometimes of an O--G--, and sometimes of a Face, &c. according to the Workman's Fancy; the upper Side being plain and flat. These Corbets are usually placed for Strength's Sake, immediately under the Semigirders of a Plat-form, and sometimes under the Ends of Camber Beams; in which latter Case they are commonly placed a Foot or two below the Beam, and have a piece of Timber standing upright, close to the Wall, from the Corbet to the Beam.

Corbets, also is a Term used by some Architects, for the hollow Nicks in Walls, which are left for

Images or Figures, or Statues to stand in.

CORNAGE, in our Law fignifies a kind of grand Sergeantry; the Service of which Tenure is to blow a Horn, when an Invasion of a Northern Enemy is perceived: And by this many hold Land in the Northern-Parts about the Wall, i. e. the old Piets Wall.

CORNEA Tunica. The Figure of it is of a greater Convexity than the rest of the Globe of the Eye; and it consists of several Laminz, which are nourished by so small Blood Vessels, as to obstruct very little of the Light; 'tis of a very exquisite Sense, that on any light touch, the Tears may be squeez'd out of the Lachrimal Glands, to wash it and clean it.

CORONA, in Anatomy, is that Edge of the Glans of the Penis, where the Preputium be-

CORONARE Filios, Theancient Villains were forbidden Coronare Filios, that is, to let their Sons receive their first Preparatory Tonsure, or to begin to be ordained Priests; because after that they are Freemen, and can be by their Lords no longer claimed as Servants in Villenage.

CORPORA Pyramidalia, when the Blood hath discharg'd it self of the Seed into the Testicles, it returns by the Veins, which rifing in several Branches from the Testes, tends towards the Abdomen in the Production of the Peritoneum, the same way the Arteries came down. In their Progress, their Branches frequently inosculate and divide again, till they come near the Abdomen, and then they all unite in one Trunk; and therefore because of their Shape are called Corpora Pyramidalia.

CORPORAL of a Ship, is an Officer that hath the Charge of fetting the Watches and Centries, and relieving them; and who feesthat all the Soldiers and Sailors keep their Arms neat and clean; he teaches them also how to use them, and hath a Mate under him.

CORPUSCLES. The admirable Sir Isaac Nonton shews a way of guessing with great accuracy, at the Sizes of the component Corpuscles or Particles of which Bodies are constituted, in the second Book of his Opticks, pag. 3. See more of this under the Word Colour and Particles.

CORSNED, in the Saxon, is Ordeal Bread, Panis Conjuratus: For the Saxons had a Superstitious way of purging themselves of an Accusation, by taking a piece of Bread and eating it with solemn Oaths and Execuations, that it might prove their Poison, &c. if they were guilty; which way of speaking is retain'd in some Places to this Day, especially in Kent.

CORVUS, was a Machine invented by the Romans, in the time of their Conquests of Sicily, when they first engaged the Carthaginian Fleet, and was framed (as Polybius describes it, Lib. 1.)

after this manner.

On the Prow of their Ships they exected a round piece of Timber about 11 Foot in Diameter, and 12 Feet in Length, on the top of which was a Block or Pulley; round this piece of Timber was a Plat-form of Boards 4 Feet in Length, and about 18 Foot long, well framed and fastned with Iron: The Entrance was long ways, and it was moveable round the aforesaid upright piece of Timber, and could also be hoisted up and down within 6 Foot of the top; about this Frame was a fort of Parapet Knee high, which was defended with upright Bars of Iron, sharp at the Ends, and towards the top there was a Ring, by the help of which and a Pulley or Tackle, it was hoisted and lowered at Pleasure: With this moveable Gallery they Boarded the Enemies Ships (when they did not lie Side by Side) sometimes on their Bow, and sometimes in the after Part of the Ship; the Soldiers keeping the Boss of their Bucklers level with the top of the Parapet, &c. and by the Means of this new Engine, got the Day of the Carthaginiens, in their first Sea Fight with them, tho the Enemy were long before well skill'd in Naval Affairs, and the Romans perfectly raw and unskill'd.

COTLAND, is Land held by a Cottager.

whether in Soccage or Villenage.

COUCH, is a Term in Painting, fignifying the ground Bed, or Basis on which any Colour lies, and is distinguish'd from the Field, which is always Horizontal and upon the Flat; whereas the Couch may be upright or vertical, and in any other Po-

COVING-Cornish, in Architecture, is such a Cornish that hath a great Casement or Hollow in it, which is commonly lathed and plaistred upon Compass Sprockets or Brackets; also when Houses are built projecting out over the Ground-Plot, and then turn'd with a Semi-arch of Timber, which is lathed and plaistred, they call that Coving-

COURT-Christian, or Ecclesiastical, is so call'd in Opposition to the Civil Court, or Lay Court, or Curia Domini Regis: These Courts of Christianity were not only held by the Bishops in Synods, and the Arch-Deacons and Chancellors in Confistories: But they were also the Rural Chapters where the Rural

Rural Dean or Dean of Christianity presided, and the Clergy were Affessors and Affistants. Kennet's Glossary

CRASIN-Mill; See Craze-Mill.

CRAYONS, are Pencils of feveral Colours made purposely to paint withal: They are chiefly used in Portraicts; and Pictures done after this way of Painting, are faid to be done with Gray.

CRAZE-Mill, or Grazing Mill, is a Mill (in all refpects like a Grift Mill to Grind Corn) and is fo call'd by the Tin Miners, who use it to Grindtheir Tin, which is yet too great, after Trambling; and then its Trambled only; See Tin.

CRIMEN Ambitus, is getting into Publick OF fices by Bribing with Money or other Gifts, orthy Canvasing with Intreaties; as the Civilians De-

fine it.

Crimen Falsi, in the Civil Law, is a fraudulent Suppression or Imitation of Truth to the Prejudice of another; so that the Commission of this Crime confilts in three points, Corruption of Truth, Deceit, and Damage to another.

Crimen fraudata ennona, is the abusing Markets by raising the Price of Victuals unreasonably, by

Forestalling, Monopolizing, &c.

Crimen Peculatus, (a Pecore, Cattle, in which
Riches consisted before the use of Money) in the Civil Law, is the Crime of Stealing the Publick Treasure, or Cheating in the publick Accounts. And much of the same Nature is what they call,

Crimen Residui, which is applying the publick Money to other Uses and Purposes than those the Government orders and appoints, or else not ap-

plying to any Use at all.

CROOTES, is a Substance found about the Oar in the Lead Mines in Mendip, being a mealy,

white, foft Stone matted with Oar.

CROSS-Multiplication, is a Kind of Multipli-cation much used by Workmen in measuring their Work; and 'tis so call'd because they multiply across, Feet by Inches, &c.

As suppose it were required to multiply 5 Foot, 3 Inches and 6 Parts, or 4, of an Inch, by 2 Foot, 4 Inches and 6 Parts. They fet the Number down

thus:

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F. In. Pa. 5:3:6 2:4:6

12::6:9:9

Then say, twice 5 Feet is 10 Feet, which they write down first of all, as you 10:: see under Feet. Twice 3 Inches is 6 Inches-Twice 6 Parts is 1 whole Inch-Then working with 4, 4 times 31:8: 5 Feet is 20 Inches. Four times 3 Inches give 12 ? Primes, or one Inch Four times 6 Parts or Primes give 24 Seconds or 12th of the 12th of an Inch, which : 2 : makes two Twelfths. Six times 5 Feet gives 30 Inches—: 2:6: Six times 3 Inches is 18 Parts —: :1: - : : 1 : 6 Seco. Six times 6 Parts produce 36 : 3 Seco. thirds or 12ths of a Second, which makes.

And this Method they are very fond of (tho' it: very absord in Reality; for to multiply Inchesby Feet, & c. i.e. a thing of one Name or Denomination by another, is Nonfense;) and I believe they generally use it because of its Dispatch.

CROSS-Staff. The Description and Use of

this Instrument is as follows:

The Staff is usually above 3 Foot long, having sides fquare to one another about i an Inch over; and each is graduated like a Line of Tangents, and to every Side belongs a peculiar Crosspiece. The Staff may be divided either by a Table of Natural Tangents, or Geometrically by the Divisions in the Quadrant of a Circle. Then the Half of the Cross-pièce being supposed Radius, the Graduation on the Staff will be the Natural Co-Tangents of the half Arches.

The Uses of this Instrument are, to take the Altitude of the Sun, or of a Star; to take the Diflance between two Stars, or of any Star from the Moon, E3c. and 'tis us'd by some to take Distan-

ces by Land.

To observe the Altitude of the Sun or Stars.

There are four Crosses belonging to the Staff, one called the Toncrofs, which belongs to that Side where the Graduation begins 3 deg. andends with 10 deg. another called the Thirty-crof's, belonging to that Side of the Staff where the Divisions begin with 10, and end with 30 deg. The Third is the Sixty-orofs, which belongs to that Side where the Degrees begin at 20, and end at 60 deg. And the last is called the Ninety-cross, belonging to that Side where the Graduations begin at 30, and end at 90 deg

Now, according as you can guess the Sun's Altitude to be, you must use the proper Cross: If the Altitude be under 10 deg. use the Ten-cross; if under 30, use the Thirty-cross; if under 60, the Sixty-cross; but if above that, use the Ninety-

cross.

And the: Way of observing is thus: Having fitted on your proper Cross, place the flat End of, the Staff to the Outside of your Eye, and as near to your Eye as you can: Then look at the Sun, or Star, with the upper End of the Crofs, and at the Horizon with the lower End, moving or fliding the Cross to and fro till you can do this exactly; for then the Degrees and Minutes cut by the inner Edge of the Cross, on the proper Side of the Stuff for that Cro's, will give you the present Altitude of the Sun or Star.

Unless it be hazy and thick Weather, the Observation can hardly be made without Prejudice to the Eye: To prevent which, some put a coloured Glass on the Top of the Cross; and then they observe the upper Limb of the Sun, and subfiract

his Semidiameter from the Altitude.

There is a Way also of making a backward Observation of the Sun's Altitude with the Cross-Staff, as thus: Fix a Horizontal Vane on the Eve-End of the Staff, and a Shoe of Brass to the End of any of the Four Crosses, which will serve inflead of a Sight Vane. Having done this, and firted the Cross on upon the Staff, turn your Back to the Sun, and looking through the Slit in the Brass Shoe, lift up or down the End of the Staff, till the Shadow made by the upper End of the Cross fall on the Slit in the Horizon Vane, and that likewise at the same time you can see the Horizon through the Horizontal Vane at the End of the Brais; then will the Degrees cut on the proper Side of the Staff, be the Sun's Altitude required.

To observe the Distance between Two Stars; or the Moon's Distance from a Star.

Place the flat End of the Staff to the Edge, as in the First Observation, and looking to both Ends of the Cross, draw it to and fro, till the Ends will cut the Two Stars, or one the Moon, and the other the Star; then will the Cross cut the Distance between those Objects on the proper Side of the Staff.

Because there may be a Mistake in placing the Staff to the Eye, take this Rule to know when it is right: Put the Sixty-cross on 30 Degrees on its proper Side of the Staff, and likewise the Ninetycross on 30 Degrees on its outside; and then when, by moving the Staff higher or lower, you have placed it so, that you can see the upper End of the Two Crosses in one and the same right Line, and the Two lower Ends in another, the Staff is

placed right.
CROWNS of Colours, are certain coloured Rings which like Halo's appear, but of the Colours of the Rainbow, and at a less Distance than the common Halo's, about the Body of the Sun or Moon. These Sir Isaac Newton, in his Opt. Book 2: p.4: shews to be made by the Suns shining in a fair Day, or the Moon in a clear Night, through a thin Cloud of Globules of Water or Hail, all of the same bigness: And according as the Globules are bigger or lesser, the Diameters of these Crowns, or Rings, will be larger or smaller; and the more equal these Globules are to one another, the more Crowns of Colours will appear; and the Colours will be the more lively.

CROWN-Post, is a Post which in some Buildings stands upright in the middle, between two principal Rafters; and from it there go Strutts or Braces to the middle of each Rafter. This is also by some called the King piece, and the Jozgle-

CRUCIFORM Hyperbola, is a Curve by that Name; which is so called by Sir Isaac Newton, be-

cause it cuts its Conjugate cross-wise.

CRYPTOGRAPHY, called also Steganography, is the Art of secret Writing: On which subject many Books have been publish'd; as, by the Abbot Trithemius, in his Steganographia, Francf. 1608. 4ta. by Gustavus Selenus, in 9 Books in Fol. printed at Luneburgh, 1624. cum Fig. by Schottus, in his Schola Steganographica. Bithop Wilkin's Secret and Swift Mellenger.
CUBICAL Paraboloid. See Paraboloid and

CUL-PRIT, are Words used by the Clerk of the Arraignments, when a Person is indicted for a Criminal Matter. For after the Indictment is read in Court (which is the Crown's Charge) against the Prisoner at the Bar, he is put upon his Plea, or asked, Art thou Guilty, or not Guilty? If he pleads or answers, not Guilty, there is next a Replication from the Crown, by continuing the Charge of Guilt upon him, according to the Tenour of the Indicament; which is express'd by pronouncing the Words Cul-Prit: Cul being an Abbreviation of the Latin Word Culpabilis, Guilty; and Prift, or Prit, (now Pret) is the old French Word for Ready. From these two Assertions therefore of the Clerk of the Arraignment, that

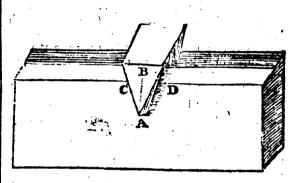
the Prisoner is Culp, or guilty of the Crime charged on him, and that the Crown is Prit or reads to prove it upon him; this Word Cul-Prit is deri-

And that this is the true Explanation of the Terms Cul-Prit, is evident from the Form of the Entry of the Record of the Trial when drawn up at large; which, as to the Replication pronounced by the Clerk, as aforesaid, in the Words Cul and Prit, run thus: Et Predictus A. (the Clerk) pro Domina Regina dicit, Quod Predict. B. (the Prisoner) est Culpabili, &cc. Et bac paratus est verisi-

care, &c.
CULVERTAIL, the same with Dovetail;

which see.

CUNEUS. The Wedge, one of the five Mechanical Powers, is in the Form of a Prism, whose Top and Sides are Parallelograms, but its Ends Isosceles Triangles; whose Altitude is called the Altitude of the Wedge, as the Base of each said Triangle is the Thickness of the Wedge. The right Line connecting the Vertices of the Two Triangles, is called the Edge; as the Parallelogram which joins their Bases, is called its Dorsun; or Back.



The Power of this Engine is easily estimated; and is (when directly applied to the Top or Dorsum of the Wedge) to the Resistance to be overcome, as the Thickness of the Wedge is to its Al. titude. In the Figure, BA is the way of Power, and CD the way of the Impediment or Resistance: So that while the Wedge is driven down into the Wood, 69c. by its whole Altitude, the Wood is di-vided by the entire Thickness of the Wedge, and this every where proportionably, as follows from the Nature of a Triangular Figure. Wherefore a Wedge, whose Thickness is to its Altitude or Length in a little greater Proportion, than as the Power applied is to the Resistance or Tenacity of

the Wood, will cleave or d vide it.

CUNETTE, See Cuvette.

CUPULO, in Architecture is an Arched Room or Turret standing on the very Top of a Dome or great Building, in Form either Circular or Polygonal; some call it a Lanthorn.

CURATOR, in the Civil Law, is a Person regularly appointed to take care of another; as suppole of a Minor, by his Consent from 24 Years of Age, to 35; on the Determination of a Trial at Law, where the Magistrate may appoint a Curator for the Minor. The Magistrate also might appoint a Curator for a Madman, a Prodigal, Deaf or Dumb Person, as also for the Estates of Debtors,

and of Persons dying without Heirs.
CURIA, a Word used formerly indifferent Senfes. . Sometimes it fignified the Perfons or Feudatory Tenants, who did their Suit and Scivice at the

Court of the Lord.

Some-

Sometimes it signified a House, as Curia Canomicorum, the Convent or Conventional House. Curia Persona Ecclesia, the Parsonage House. And sometimes it was used for the Service it self, of coming to the Court of the Lord; Curie ad-Dr. Kennet.

CURRENTS, are certain Progressive Motions of the Water of the Sea in several Places, either quite down to the Bottom, or to a certain determinate Depth; by which a Ship may happen to be carried forward more swiftly, or retarded in her Course, according to the Direction or Setting of the Current in, with, or against the Course or Way

of the Ship

The first thing therefore to be known, is, which way the Current sets; and if its Motion be swift, great and strong, this will be best discovered by keeping an exact Account of the Ships Way both outward and homeward, according to the best Method of what the Seamen call their Dead Reckoning, being very curious in observing the way the Ship makes by the Log-line; for 'tis not the correef Account, but the Dead Reckoning, that must here assist you, Therefore you must be very careful to observe how the Ship goes by it, when you Sail near the Meridian, how she is drawn from her Course: As also, when she is steered directly East and IVest, take good Notice whether she alter her Latitude.

As for those Guesses, by the Ripplings of the Water, and by the driving of Froth, Esc. along Shore, when you are in fight of it, they will be of little use. But the most usual and the most useful way of observing the setting of a Current is thus:

When there is a smooth Sea, and not much Wind, heave out the Boat, with three or four Hands in her, together with a Compass, a Log-line, and Half-minute Glass, with also a Line or small Warp of about an Hundred Fathoms long; to the End of which Line fasten a Triangular Piece of Board, as a b c, and to one of the Angles fasten

a good heavy Piece of Lead to fink it. Some use instead of this Board a Kettle tied by the Bail, (which may do tolerably well).

When you are off from the Ship, cast over your Board or Kettle, letting it sink at least 60 Fathom; and if you have Line enough, let it down 100 or 120 Fathom: Then belaying the Line fast about her Stern, it will bring her up, and make her ride as if the

were at an Anchor. Then cast over your Log, turn up the Glass, and as you veer out the Log-line, set the Drift of the Log with your Compass: So shall you know whether there be any Current or no; and if any, how it sets; as also the Rate of its driving. Only remember to add always to the Drift, if the Line she ride be of 60 Fathom, † Part; if of 80 Fathom, †; if of 100 Fathom, the ! Part, 50 c. of the Drift more, for the Drift of the Boat; for though the Boat may seem to ride or lie still, yet she is found by Experience to drive at the same Time.

N. B. Whether these Allowances be the very Truth, or not, I cannot say: They are said to agree with Experience, and therefore may be us'd till better Observations of these things may be made. Only this is certain, That the bigger the Board and Weight is that the Boat is to ride by, the less will

be her Drift. Sir J. Moor's Navig.

If a Current fet exactly with the same Direction, as is the Course of the Ship, then it must augment her Motion forward in Proportion to the Velocity of the Drift.

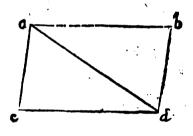
As if a Ship sail N. N. E. 20 Miles, in a Corrent fetting the same way, and in the same times 8 Miles, her true Course will be N. N.E. 28 Miles in the fame time.

But if the Corrent set directly against the Ship's Course, it will abate of her Motion forward in Proportion to the Velocity of the Drift.

As if a Ship said N. E. 49 Miles in a Current; setting S. W. 10 Miles in the same time; the Ship's Course or Distance run in that time will be but 39 Miles. So if a Ship sail N. E. 49 Miles in a certain time, in a Current that sets S. W. 59 Miles in the same time; her true Course will be S. W. 10 Miles; that is, she will fall aftern 10 Miles in that time.

But if a Ship fail a-cross any Current, her Motion will be compounded with that of the Current; and her Velocity augmented, or retarded proportionably to the Angle of her Direction, with that of the Direction of the Current; according as she

goes in Part with it or against it...
As suppose the Ship's Course were from a to c, and the fetting of the Current from a to b; the Ship will, by the Composition of those two Moti-



ons be carried from a to d in the Diagonal a d .

See Composition of Motion.

Wherefore if a Ship sails N. E. 110 Miles, in a Current which sets S. W. 30 Miles in the same time, and her true Course and Distance sailed be requird, you may proceed thus:

1 ft. Geometrically.

1. Set off .4 Points from N. towards E. and draw A Cequal to 110 Miles.

2. From C draw C B, parallel to the Line N.N.E. and equal to 30 Miles.

3. Draw A B, which will be the Ship's true Course; to find which

Trigonometrically.

In the Triangle A B C, there is AC 110
7 at C 22 30
R C 20
Sect. 4. Given

A+CBC: AC-BC::t, 1/(A+B:t,1/B-A, i.e. As the Sum of A C and B C 140 2.1461280 2.1461280

To their Difference 80 So is the Tangent of 789 45°

4.9030900 10.7013382

To the Tangent of 70 49 10.458 2002 Now 78° 45' - 70° 49' = 7° 56' = 4 C A B. Hence it appears that her true Course is NE 7º 56 Eafterly.

But for her Distance it will be by Case 1. Sect. 4. s, LA: BC::s, LC: AB. i.e.

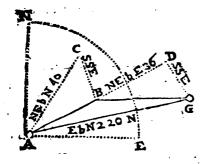
As the Sine of the Angle at A 70, 96' 9.1399445

To the Drift of the Current B C 30 1.4771212 So is the Sine of the Angle at C 22 30'-9.5828397

To the Distance run 83, 2 Miles

Ex. 2. If a Ship from the Latitude 36° 30° S Se ils NE b N 40 Miles, then NE b E 36 Miles, in a Current that fets SSE 20 Miles in the time that the Ship sails 38 Miles, and it be required to find the direct Course and Distance between the Ship and her first Place, as also the Latitude the Ship is in.

1st. Having constructed it, as in the former.



In the Triangle A CB, are

Given $\begin{cases} AC & 40 \\ L & at & C & 56^{\circ}, 15^{\circ} \end{cases}$ To find AB, and the Angles at A and B.

It will be, by Case the 4th of Sell. the 4th.

 $AC+BC:AC-CB::t,\frac{1}{2}LA+LB:t,\frac{1}{2}LB$

As the Sum of A Cand B C 61, 05 1.7856857

To their Difference 18, 95 So is the Tangent of 612, 52;

1.2776092 10.2720432

To the Tangent of 30, 08!

9.7639667

Now, 61°, 52'' - 30°, $08\frac{1}{2}' = 31°$, 44' = 4 C AB; therefore the Ship's first Course is N. E. by E. 9°, 14', Eastwardly.

For the Distance, it will be, by Case the 1st of

Sec. the 4th,

s, CAB: CB::s, ACB: AB; that is, As the Sine of the LCAB 318, 44' 9.7209581

To CB the Drift of the Current 21,05 1.3232521 So is the Sine of the Lat C 56°, 15'. 9.9198464

To the Distance run, 23, 28.

2. In the Triangle B D G, are given BD 36 Lat B 789, 45' To find BD and the L_FDBG and D G B. PG 18, 95

Wherefore, As the Sum of B D and DG 54, 95 1.7399677

To their Difference 17, 05 So is the Tangent of 500, 27

1.2317244 10.0856980

To the Tangent of 25°, 42'

9·5774547

Hence the Angle DBC, will be found 290, 55'; wherefore the Ship's second Course is E. by N. 7°, 25'. Eastwardly, and consequently the Angle ABG = 159°, 19'.

But for BG, the Distance run, it will be As the Sine of the Ang. BDG 29°, 55. 9.6978747

To DG the Drift of the Current, 18, 95 1.2776092 So is the Sine of the Angle BDG 78°, 45 9.991 5739

To BG the Distance run, 37, 27 1.5713090 3. In the Triangle ABG, are

AB 33, 28 Whence must be Given \(\begin{pmatrix} AB & 33, 28 & \ AB & 159°, 19' \\ B & 37, 27 & \end{pmatrix} \text{ Mond \$LBAG\$ and \$AG\$, and twill bey As the Sum of \$AB\$ and \$B & 70, 55 \quad 10.8484970

To their Difference 3, 99 So is the Tangent of 100, 201

c.6009**7**29 9.2612203

To the Tangent of 000, 36'

8.0136962

Hence the Angle B A G is 100, 56, and consequently the bearing of the Ship from her first Port is E. by N. 20, 20'. Northerly; and for the Distance it will be,

As the Sine of the Angle BAG 100, 56'. 9.278991 E

To the Distance run BG 37, 27 1.5713090 So is the Sine of the LAB G 1490, 19'. 95480240

To the Distance between the Ship and \ 1.8403419 her Port 69, 24 Now for the Difference of Latitude, it will be as the Radius 10.000000

To the Distance sail'd, 69, 24 1.2403571 So is the Co-Sine of the Course, 760,25' 9.3708079

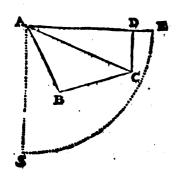
To the Difference of Latitude 16, 26 1.2111650

Hence, because she sail'd from a? South Latitude From the Latitude she sail'd from 36°, 30'—Sly Take the Difference of Lat. made 16;'——Nly – Nly Remains the Lat. the Ship is in 36°, 133'-

Admit a Ship, from a certain Head-line, in the Latitude of 34°, co'. North, fails S. E. by S. 24 Miles in 6 Hours, in a Current that fets between the North and the East; and then the Cape is found to bear W. N. W. and the Ship to be in the Lat. of 33°, 45'. North. I demand the Setting and Drift of the Current?

Geometrically.

1. Set off 3 Points from Stowards E, and-draw the Line A B equal to 24 Miles.



2. Set off two Points from E towards S, and draw the Line AC.

3. At the Distance of 15 Miles, equal to the Disterence of Latitude, draw a parallel to AE, till it intersect AC as in C.

4. From the Intersection C, draw C D parallel to AS; also the Line B C the Drift and Setting of the Current,

To find which Arithmetically.

In the Triangle ADC, Right-angled at D, are Given $\{DC : 5, 20'\}$ to find ACWherefore SLA : DC : R:AC; that is,

As the Sine of the Angle at A 22°, 30' 9.5828397

To the Difference of Latitude 15
So is the Radius

1.1760912

To the Distance run 39, 2

1.5932515

Again, In the Triangle ABC, are $\begin{cases}
AB & 24 \\
LA & 33^{\circ}, 45'
\end{cases}$ to find $\begin{cases}
LC \\
BC \\
LB
\end{cases}$ Wherefore,

AB + AC: AC - AB :: t\(\frac{1}{2}\)\(\beta\) B + LC

As the Sum of the Sum of the Sides \(\begin{align*}
\begin{align*}
\begi

To their Difference 15°, 2'
So is the Tangent of 73°, 07‡

1.1818436
10.5180608

To the Tangent of 389, 241' 98991873

Which added to 73°, 07;', gives 111°, 32'. the Angle at B. And hence the Current will be found to fet E. by N. 00°; 58' Northerly.

For BC, the Drift of the Current, it will be, s, LB: AC:: s, LA: BC; that is, As the Sine of the Ang. at B 1110, 32' 9.9685783

To AC the Distance run 39°, 2'. 1.5932515 So is the Sine of the Ang. at A 33°, 45'. 9.7447390

To BC the Drift of the Current in 6 \\ \text{13694122} \\ \text{And confequently it fets at the Rate of 3°, 9'.} \\ \text{Miles an Hour.}

Several other Questions might be propos'd relating to Currents, but these being throughly understood, are sufficient for the Purpose.

CURSOR, is a Piece or little Ruler or Label of Brass being divided like a Line of Sines, and sliding in a Groove or Notch along the middle of another Label or Ruler, representing the Horizon, and always at Right Angles to it: 'Tis used in the Analomma, which see.

CURVATURE of a Line, is the peculiar manner of its bending or Flexure, whereby it becomes a Curve of such peculiar Properties. Thus the Curvature of the Circle is such, that all Points of the Periphery are equally distant from one Point within, call'd the Centre. The Curvatures of different Circles are to one another reciprocally as their Radii.

CURVE, generating the Solid of least Resistance, See Solid.

CURVES. The incomparable Sir Isac Newton gives this following Enumeration of Geometrical Lines of the Third or Cubick Order; in which you have an admirable account of many Species of Curves which exceed the Conick-Sections, for they go no higher than the Quadratick or Second Order.

The Orders of Geometrick Lines.

1. GEOMETRICK-LINES, are best distinguished into Classes, Genders or Orders, according to the Number of the Dimensions of an Equation, expressing the relation between the Ordinates and the Abscisse; or which is much at one, according by the Number of Points in which they may be cut to a Right Line. Wherefore, a Line of the First Order will be only a Right Line: Those of the First cond or Quadratick Order, will be the Circle and the Conick-Sections; and those of the Third or Cubick Order, will be the Cubical and Nelian Parabola's, the Cission of the Antients, and the rest as below enumerated. But a Curve of the First Gender (because a Right Line can't be reckoned among the Curves) is the same with a Line of the Second Order; and a Curve of the Second Order; and a Line of an Instintesimal Order, is that which a Right Line may cut in infinite Points, as the Spiral, Cycloid, the Quadratrix, and every Line generated by the infinite Revolutions of a Radius or Rota.

2. The chief Properties of the Conick-Sections are every where treated of by Geometers; and of the same Nature are the Properties of the Curves of the Second Gender, and of the rest, as from the following Enumeration of their Principal Properties will appear.

a. For if any right and parallel Lines be drawn and terminated on both Sides by one and the same Gonick Sellion; and a Right Line bisesting any

two of them shall bisect all the rest; and therefore such a Line is called the Diameter of the Figure; and all the Right Lines so bisected, are called Ordinate Applicates to that Diameter, and the Point of Concourse to all the Diameters is called the Centre of the Figure; as the Intersection of the Curve and of the Diameter, is called the Vertex, and that Diameter the Axisto which the Ordinates are Normally applied. And so in Curves of the Second Gender, if any two right and parallel Lines are drawn occurring to the Curves in three Points; a right Line which shall so cut those Parallels, that the Sum of two Parts terminated at the Curve on one Side of the intersecting Line, shall be equal to the third Part terminated at the Curve on the other Side; this Line shall cut, after the same manner, all others parallel to these, and occurring to the Curve in three Points; that is, shall so cut them, that the Sum of the two Parts on one Side of it, shall be equal to the third Part on the other.

And therefore these three Parts, one of which is thus every where equal to the Sum of the other two, may be called Ordinate Applicates also: And the intersecting Line to which the Ordinates are applied, may be called the Diameter; the Intersection of the Diameter and the Curve, may be called the Vertex, and the Point of Concourse of called the Vertex, the Centre.

any two Diameters, the Centre.

And if the Diameter be Normal to the Ordinates, it may be called the Axis; and that Point where all the Diameters terminate, the General Contre.

'Assimptates and their Properties.

4. The Hyperbola of the first Gender has two Assymptotes, that of the second, three; that of the third, sour; and it can have no more, and so of the rest. And as the Parts of any Right Line lying between the Conical Hyperbola and its two Assymptotes are every where equal; so in the Hyperbola of the Second Gender, if any Right Line be drawn, cutting both the Curve and its three Assymptotes in three Points, the Sum of the two Parts of that Right Line being drawn the same way from any two Assymptotes to two Points of the Curve, will be equal to the third Part drawn a contrary way from the third Assymptote, to a third Point of the Curve.

Latera Transversa & Recta.

5. And as in Non Parabolick Conick Sections, the Square of the Ordinate Applicate, that is, the Rectangle under the Ordinates, drawn at contrary Sides of the Diameter, is to the Rectangle of the Parts of the Diameter, which are terminated at the Vertex's of the Ellipsis or Hyperbola, as a certain given Line, which is called the Latus Rectum, is to that Part of the Diameter which lies between the Vertex's, and is called the Latus Transversum: So in Non Parabolick Curves of the second Gender, a Parallelopiped under the three Ordinate Applicates, is to a Parallelopiped, under the Parts of the Diameter terminated at the Ordinates, and the three Vertex's of the Figure in a certain given Ratio; in which Ratio, if you take three Right Lines to the three Parts of a Diameter situated between the Vertex's of the Figure, one answering to another; then these three Right Lines may be called the Latera Resta of the Figure, and the Parts of the Diameter between the Vertices, the Latera Transversa. And as in the Conick

Parabola, having to one and the same Diameter, but one only Vertex, the Rectangle under the Ordinates is equal to that under the Part of the Diameter cut off between the Ordinates and the Vertex, and a certain Line called the Latus Rectum: So in the Curves of the second Gender, which have but two Vertex's to the same Diameter; the Parallelopiped under three Ordinates, is equal to the Parallelopiped under the two Parts of the Diameter cut off between the Ordinates and those two Vertexes, and a given Right Line, which therefore may be called the Latus Rectum.

The Ratio of the Restangles under the Segments of Parallels.

Lastly, As in the Conick Sections when two Parallels terminated on each side at the Curve, are cut by two other Parallels terminated on each side by the Curve, the first being cut by the third, and the second by the fourth; as here the Rectangle under the Parts of the first, is to the Rectangle under the Parts of the first, is to the Rectangle under the Parts of the second, is to that under the Parts of the second, is to that under the Parts of the Fourth: So when four such Right Lines occur to a Curve of the second Gender, each one in three Points; then shall the Parallelopiped under the Parts of the first Right Line, be to that under the Parts of the third; and as the Parallelopiped under the Parts of the second Line, unto that under the Parts of the Fourth.

Hyperbolick and Parabolick Legs.

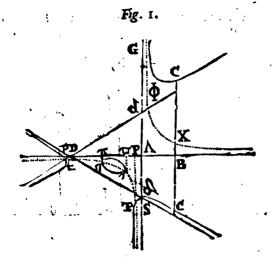
All the Legs of Curves of the second and higher Genders, as well as of the first, infinitely drawn out, will be of the Hyperbolick or Parabolick Gender; and I call that an Hyperbolick Leg, which infinitely approaches to some Assymptote; and that a Parabolick one, which hath no Assymptote. And these Legs are best known from the Tangents: For if the Point of Contact be at an infinite Distance, the Tangent of an Hyperbolick Leg will coincide with the Assymptote, and the Tangent of a Parabolick Leg will recede in infinitum, will vanish and no where be found. Wherefore the Assymptote of any Leg is found, by feeking the Tangent to that Leg at a Point infinitely distant : And the Course, Place or Way of an infinite Leg, is found by feek-ing the Polition of any Right Line, which is parallel to the Tangent where the Point of Contact goes off in infinitum: For this Right Line is directed towards the same way with the infinite Leg.

The Reduction of all Curves of the second Gender, to four Cases of Equations.

CASE I.

All Lines of the first, third, fifth and seventh Order, and so of any one, proceeding in the Order of the odd Numbers, have at least two Legs or Sides proceeding on ad infinitum, and towards contrary ways. And all Lines of the third Order have two such Legs or Sides running out contrary ways, and towards which no other of their infinite Legs (except in the Cartesian Parabola) do tend. If the Legs are of the Hyperbolick Gender, let GAS be their Assymptote; and to it let the parabel CBc be drawn, terminated (if possible) at both Ends at the Curve. Let this parallel be bi-

fected in X; and then will the Place of that Point



X be the Conical Hyperbola X o, one of whose Assymptotes is AS: Let its other Assymptote be AB; then the Equation by which the Relation between the Ordinate BC and the Abscissa AB is determined, if AB be put = x and BC = y, will always be in this Form, $xyy + ey = ax^2 + bxx + cx + d$, where the Terms e, a, b, c, and d, denote given Quantities, affected with their Signs + and -; of which any one may be wanting, so the Figure, through their Desect, don't turn into a Conick Section. And this Conical Hyperbola may coincide with its Assymptotes, that is, the Point X may come to be in the Line AB, and then the Term + ey will be wanting.

CASE IL

9. But if the Right Line C B c cannot be terminated both ways at the Curve, but will occur to the Curve only in one Point, then draw any Line in a given Position, which shall cut the Assymptote A S in A; as also any other Right Line, as B C, parallel to the Assymptote, and meeting the Curve in the Point C: And then the Equation by which the Relation between the Ordinate B C and the Abscissa A B is determined, will alway put on this Form, $xy = ax^3 + bxx + cx + d$.

CASE III.

10. But if the opposite Legs are of the Parabolick, Gender, draw the Right Line CBc, terminated at both Ends, if it's possible, at the Curve; and running according to the Course of the Legs, which bissect in B: Then shall the Place of B be a Right Line. Let that Right Line be AB, terminated at any given Point, as A; and then the Equation by which the Relation between the Ordinate BC and the Abscissa AB is determined, will always be in this Form, $yy = ax^2 + bxx + cx + d$

CASÈ W.

11. But if the Right Line C Bc meet the Curve but in one Point, and therefore can't be terminated at the Curve at both Ends; let the Point where it occurs to the Curve be C; and let that Right Line at the Point B, fall on any other Right Line given in Position, as AB, and terminated at any given Point, as A: Then will the Equation, by which Vol. II.

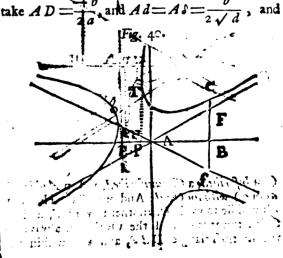
the Relation between the Ordinate B C and the Abscissa A β is determined, always be in this Form, $yy = ax^3 + bxx + cx + d$.

The Names of the Forms.

12. In the Enumeration of Curves of there Cases, we call that an inscribed Hyperbola, which lies entirely within the Angle of the Assymptotes, like the Conical Hyperbola; and that a Circumforibed one, which cuts the Assymptotes, and contains the Parts cut off within its own proper Space; and that an Ambigenial one, which hath one of its infinite Legs inscribing it, and the other circumscribing it. I call that a Converging one, whose concave Legs bend inwards towards one another, and turn both the same way; but that I call a Diverging one, whose Legs turn their Convexities towards each other, and tend towards quite contrary ways. I call that Hyperbola contrary leg'd, whose Legs are Convex towards contrary Parts, and run infinitely on towards contrary ways; and that a Conchoidal one, which is applied to its Assymptore with its Concave Vertex and diverging Legs; and that an Anguinealor Eel-like one, which cuts its Affinptote with contrary Flexions, and is produced both ways into contrary Legs. I call that a Cruciform or Cross-leks one, which cuts its Conjugate crosswise; and that Nodato, which by returning round into, desussates it self. I call that Cuspidate, whose two Parts meet and terminate in the Angle of Contact; and that Punctate, whose Oval Conjugate is infinitely small, or a Point: And that Hyperbola I call Pare, which, by the Impossibility of its two Roots, is without any Oval Node, Spike or Conjugate Point. And in the same Sense I devioininate a Parabola alfo, to be Converging, Biverging, con trary leg'd, Cruciform, Nodate, Cufpidate, Pun-

Of the redundant Hyperbola and its Affinptotes!

13. In the first Case, if the Term dx be Affirmative, then the Figure will be a tripple Hyperbola with six Hyperbolical Legs, which will run on infinitely by the three Assymptotes, of which nose are parallel, two Legs towards each Assymptote, and towards contrary Parts; and these Assymptotes, if the Term $b \times x$ be not wanting in the Equation, will mutually intersect each other in three Points, forming thereby the Triangle $D d \cdot s$. But if the Term $b \times x$ (see Fig. 1.) be wanting, they will all converge to the same Point. In the former Case



join

join D d, D s; so shall AD, D d, and D s, be the three Assymptotes. In the latter Case, draw any Ordinate, as BC, in which, both ways produced, take, on each Side, BF and Bf equal to one another, and in the same Ratio with AB that Wa hath to I; and then joining AF, Af; AB, AF, and AF, shall be three Assymptotes. And this kind of Hyperbola I call redundant, because it exceeds the Conick Sections in the Number of its Hyperbolick Legs.

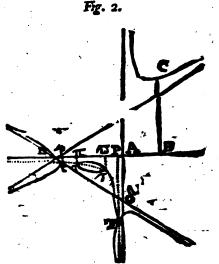
Of the Diameter of this Hyperbola, and the Polition of its infinite Legs.

14. In every redundant Hyperbola, if neither the Term ey be wanting, nor bb—4 a c equal to + a e \(\lambda \cdot

Nine redundant Hyperbola's, having no Diameter, but three Assumptions, which form a Triangle.

15. If the redundant Hyperbola have no Diameter, let the four Roots or Values of x in this Equation $ax^{4} + bx^{3} + cxx + dx + \frac{1}{4}ee^{-x}$ 0, be fought: And suppose them to be AP, Ax, and Ap. Let the Ordinates PT, x, x, and pt, be erected, and those shall touch the Curve in the Points T, τ , τ , and by that Contact shall give the Limits of the Curve, by which its Species will be discovered.

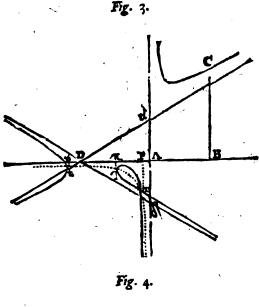
For if all the Roots AP, A = 0, A = 0, (see Fig. 1.) are real, having the same Sign, and are anequal; the Curve consists of three Hyperbola's,

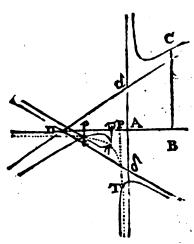


(an Inscribed, a Circumscribed, and an Ambigenial one) with an Oval: And one of the Hyperboa's will lie towards D, another towards d, and the third towards S; and the Oval will always lie within the Triangle D d S, and also within the

middle Limits 1 and τ , where it will be touch'd by the Ordinates τ 1 and σ τ . And this is the First Species.

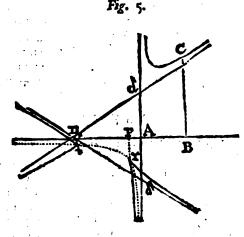
But if either the two greatest Roots, $A\pi$, Ap; or the two least, AP, $A\pi$, are equal to one ano-





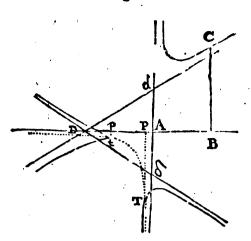
ther, and have the same Sign with the other two; then the Oval and Circumscribed Hyperbola will join with one another, the Points of Contact 7 and t, or T and τ , co-inciding; and the Legs of the Hyperbola decustating one another, will be continued in the Oval, and make the Nodate Figure. The Second Species;

If the three greatest of the Roots, A p, $A \pi$, $A \pi$; or the three least, $A \pi$, $A \pi$, A R, are equal



Fyr.

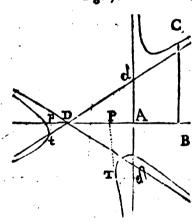
Fig. 6.



to one another, the *Nodus* will be turned into a very sharp *Cuspis*; for the two Legs of the circumfcribed Hyperbola's will then concur in the Angle of Contact, and not be produced further. And this is the Third Species;

If the two middle Roots Ar and Ar are equal, the Points of Contact τ and γ will be coin-

Fig. 7.



cident; wherefore the Oval will vanish into a Point, and the Figure will consist of three Hyperbola's, an inscribed, a Greumscribed, and an Ambigenial one, with a Conjugate Point: Which makes a Fourth Species.

If two of the Roots are impossible, and the other two unequal, and of the same Sign, (for they (See Fig. 7.))

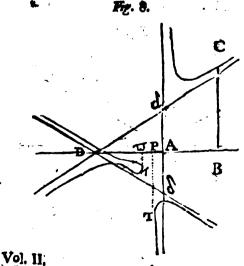


Fig. 13.

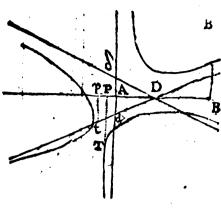
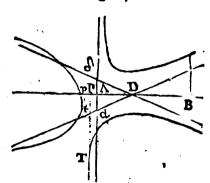


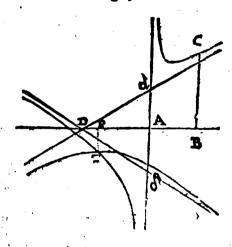
Fig. 14.



can't have contrary Signs); there will be three pure Hyperbola's, without any Oval, Node, Ca/p, or Point Conjugats; and these Hyperbola's will either lie at the Sides or the Angles of the Triangle made by the Assymptotes: Which makes a Fifth or Sixth Species.

If two of the Roots are equal, and the other two either impossible or real, with Signs contra-

Fig. 9.



Az 2

Fig.

Fig. 10.

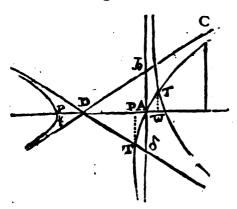


Fig. 15.

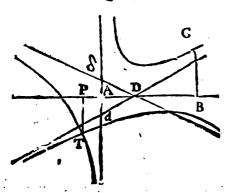
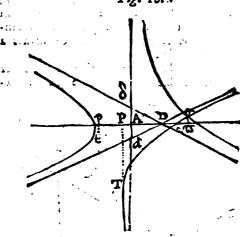


Fig. 16. N



ry to those of the equal Roots; the Cruciform Figure will be produced: For two of the Hyperboal's will decussate one another; and that either at the Vertex of the Triangle made by the Assymptotes, or at its Base; and these two are the Seventh and Fighth Species.

and Eighth Species.

Lastly, If all the Roots are impossible, or if they are all real and unequal, and two of them are Affirmative and two Negative; then there will be two Hyperbola's at the opposite Angles of the two Assymptotes, with an Anguineal or Serpentine Hyperbola about the third Assymptote. Which is the Ninth Species.

Fig. 11.

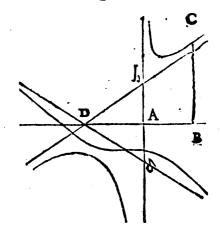
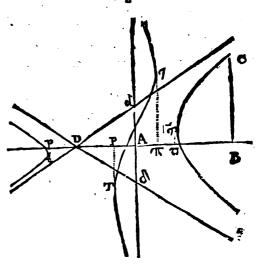


Fig. 12



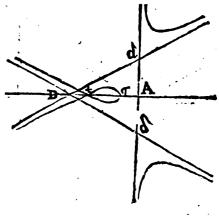
And these areall the possible Cases of the Roots; for if any two Roots are equal to one another, and the other two are equal also, the Figure will become a Conick Section with a Right Line.

Twelve redundant Hyperbola's with one only Diamater.

16. If the redundant Hyperbola have one only Diameter, let it be the Abscissa AB; and in the Equation $ax^3 + bxx + cx + d = 0$, seek that three Values of x, or the three Roots. Then,

If those Roots are all real, and have the same Sign, the Figure shall consist of an Out lying

Fig. 17.

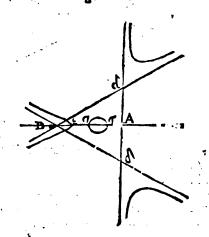


within

within the Triangle D d s, and of three Hyperbo-la's as its Angles, viz. one circumscribed at the Angle D, and the other two inscribed at d and s; and this makes a Tenth Species.

If the two great Roots are equal, and the third of the same Sign with them, the Legs of

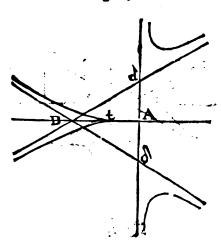
Fig. 18.



the Hyperbola lying towards D, will decuffate one another in the Form of a *Node*, by reason of the Contact of the *Oval*. Which is the *Eleventh* Species.

If the three Roots are equal, the Hyperbola be-

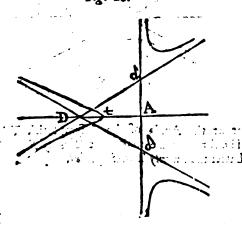




comes Culpidate, without any Oval. the Twelfth Species. Which is

If the two least Roots are equal, and the third of the same Sign with them, then the Oval va-

Fig. 20:



nishes into a Point. Which makes a Thirtseath

In the four last Species, the Hyperbola lying towards D contains its Assymptote within it; but

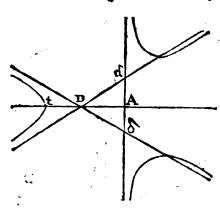
the other two are themselves contained within the

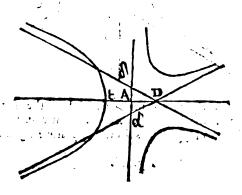
Assymptotes.

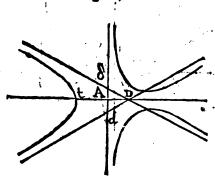
If two of the Roots are impossible, then there without any Oval. will be three pure Hyperbola's, without any Oval,

(See Fig. 20.)

Fig. 21.







Decussion, or Caspis. And there are four Cases of this Species, viz. a Fourteenth, if the circumscribed Hyperbolic towards D, and a Fifteenth, if the infaith I Unaphala lie towards D. if the inscribed Hyperbola lie towards D, a Sixteenth, if the circumscribed Hyperbola lie under the Base $D \cdot S$ of the Triangle $D \cdot S$, and a Seven-teenth, when the inscribed Hyperbola lies under the same Base.

If two Roots are equal, and the third of a different Sign from them, the Figure will be Cruci-form; for two of the three Hyperbola's will decuffate one another, either at the volume.

Base of the Triangle made by the Assymptotes.

Which fate one another, either at the Vertex, or at the

Which two Species are the Eighteenth and Nine-teenth.

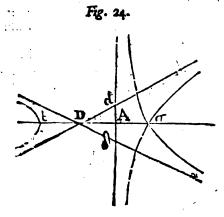
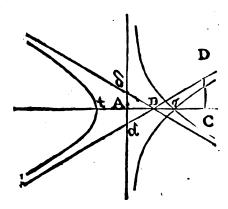
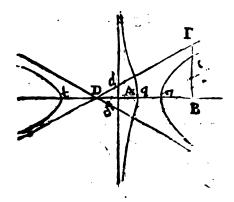


Fig. 25.

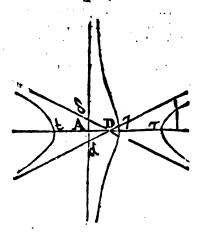


If two Roots are unequal, and of the same Sign, and the Third be of a different one, there will be two Hyperbola's in the opposite Angles of

Fig. 26.



Eig. 27.



the two Assymptotes, with an intermediate Conchoidal one. And this Conchoidal Hyperbola will either lie on the same Side of its Assymptote that the Assymptotick Triangle doth, or contrarily: And these two Cases constitute two other Species, which are the Twentieth and Twenty first.

Two redundant Hyperbola's with three Diameters,

17. The redundant Hyperbola which hath three Diameters, confits of three Hyperbola's lying within the Allymptotes, and that eigher at the Sides,

Fig. 28.

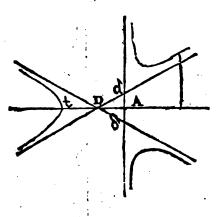
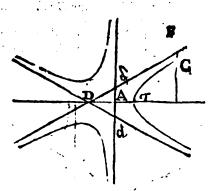


Fig. 29.



or at the Angle of the Assumptotick Triangle, The former Case makes the Twenty Second, this Latter the Twenty Third Species. Nine redundant, Hyperbola's with three Affymptotes, converging towards one common Point.

18. If the three Affymptotes do interfect one another in one common Point, the 5th and 6th Species will be changed into a Twenty Fourth, the Seventh

Fig. 30.

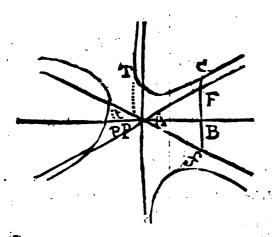


Fig. 21.

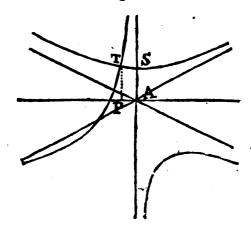


Fig. 32.

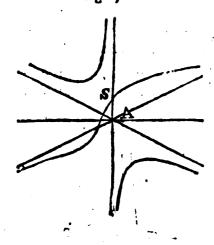
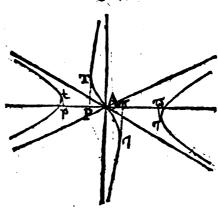


Fig. 37



and Eighth into a Twenty Fifth, and the Ninth into a Twenty Sixth Species, where the Anguinsal doth not pals through the Concourse of the Assymptote, and into a Twenty Seventh, where it doth so; in which Case the Terms b and d are wanting, and the Concourse of the Asymptotes is the Centre of the Figure, equally distant from all its opposite Parts. And these sour Species have no Diameter.

The Fourteenth and Sixteenth Species may be changed also into a Twenty Eighth Species, and the Fifteenth and Seventeenth into a Twenty Nintb.

Fig. 34.

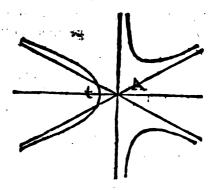
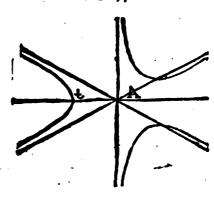
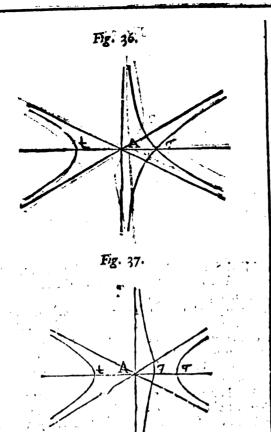
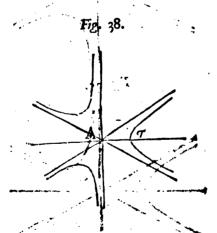


Fig. 35.





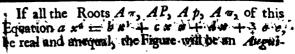
The Eighteenth and Mineteenth into a Thirtieth, and the Twentieth and Twenty First into a Thirty First. And all these Species have but one only Diameter. And finally, the Twenty Second and Twenty Third Species, may be changed into a Thirty Second, which hath three Diameters passing through the Point of Concourse of the Assymptotes.

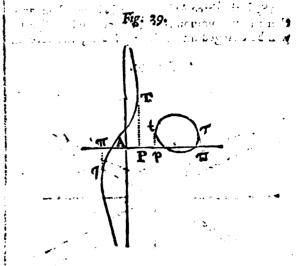


All which Changes will be easily understood, if you suppose the Assymptotick Triangle to be diminished till it vanish into a Point.

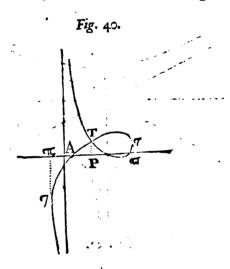
Six deficient Hyperbola's, having no Diameter.

19. If, in the first Case of the Equations, the Term ax^3 be Negative, the Figure will be a deficient Hyperbola, having one only Assymptote, and only two Hyperbolick Legs running out infinitely towards the Side of the Assymptote, but quite contrary ways; and this Assymptote is the first and principal Ordinate AG. If the Term ey be not wanting, the Figure will have no Diameter; but if it be wanting, it will have but one: In the former Case the Species are thus enumerated:



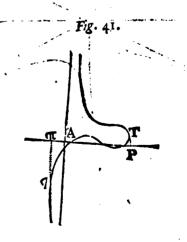


neal Hyperbola approaching towards the common Assymptote by a contrary Flexion, and with a Conjugate Oval. Which makes the Thirty Third Species. If the two middle Roots AP and Ap be equal one to another, then the Oval and the Anguineal



will be joined, decustating one another in the Form of a Node. And this is the Thirty Fourth

If three of the Roots are equal, the Node will be changed into a most Acute Cuspis in the Ver-



tex of the Anguineal. And this constitutes a Thirty Fifth Species.

If of the three Roots, having the same Sign, the two greatest, Ap and $A\pi$, are equal to one another; then the Oval vanishes into a Point. Which makes a Thirty first Species. (See Fig. 42.)

Which makes a Thirty fixth Species. (See Fig. 43.) If any two Roots are imaginary, there will remain the Anguineal alone, and this Pure, without any Oval, Decussation, Cuspis, or Conjugate Point.

Fig. 42.

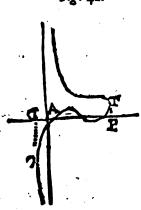
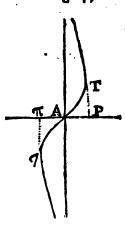


Fig. 43.

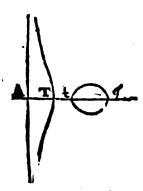


If the Anguineal don't pass through the Point A, it makes the Thirty seventh Species; but if it doth pass through A, (as it will do when the Terms b and d are wanting) then that Point will be the Centre of the Figure, bisecting all Right Lines drawn through it, and terminated both ways by the Curve. And this is a Thirty eighth Species.

Seven defective Hyperbola's, having a Diameter.

20. In the other Case, where the Term σ y is wanting, and consequently the Figure hath a Diameter, if all the Roots A T, A t A τ , of the

Fig. 45.

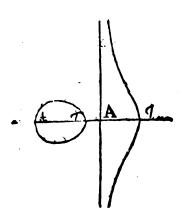


· Vol. IL

Equation $a x^3 + b x x + c x + d$, are real, unequal, and of the same Sign; then the Figure will be a Gonchoidal Hyperbola, with an Oval on its convex Side. And this is a Thirty ninth Species.

If two of the Roots are equal, and of the same Sign, but the Third with a contrary Sign, the Oval

Fig. 44.

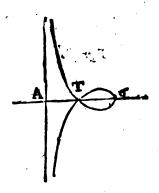


will lie on the Concave Side of the Conchoided.

Hyperbola. And this makes a Fortieth Species.

If the two leffer Roots A T, At, are equal, and the third A_T , be of the same Sign with them,

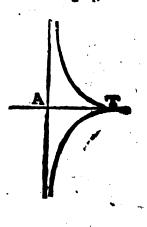
Fig. 46.



then the Oval and the Conchoidal will be joined, decusiating one another like a Node. Which is a Forty first Species.

If the three Roots are equal, the Nodus will be changed into a Cuspis, and the Figure will be the

Fig. 47.

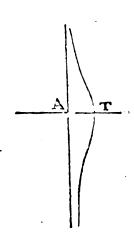


Bb

Cifford of the Ancients. And this makes a Forty. fecond Species.

If the two greater Roots are equal, and the Third of the same Sign with them, then the Con-

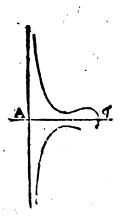
Fig. 49.



choidal Hyperbola, will have a Conjugate Point at its Convexity. Which is a Fortythird Species. If two of the Roots are equal, and the Third have a contrary Sign; the Conchoidal Hyperbola will then have a Conjugate Point at its Concavity. Which makes a Forty fourth Species.

If two of the Roots are impossible, there will be a pure Conchoidal without either Oval, Node,

Fig. 48.



Cusp, or Conjugate Point. And this is a Forty fifth Species. (See Fig. 49.)

Seven Parabolick Hyperbola's, baving no Diameter.

21. If in the first Case of the Equations, the Term a x^3 be wanting, but the b b x be not wanting; then the Figure will be a Parabolick Hyperbola, having two Hyperbolick Legs to one Assumption of the Sign. If the Term a be not wanting, the Figure will have no Diameter; but if it be wanting, it will have one only: In the former Case the Species will be these.

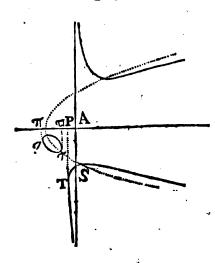
If the three Roots AP, $A\pi$, $A\pi$, of this Equation $bx^3 + cx^2 + dx + \frac{ee}{4} = 0$, be unequal, and have the same Sign, the Figure will confist of an Oval, and of two other Curves, which

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are partly Hyperbolical, and partly Parabolical; that is, the Parabolick Legs, by being continually

CUU

Fig. 50.

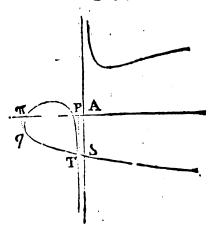


drawn out, are joined with the Hyperbolical Lege which are next to them. And this is the Forty first Species.

fixth Species.

If the two leffer Roots are equal, and the Third of the same Sign with them; then will the Oval,

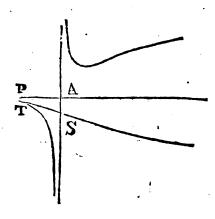
Fig. 51:



and one of those Hyperbola Parabolick Curves be joined, and intersect one another in the Form of a Node. Which is the Forty seventh Species.

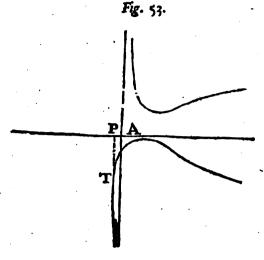
If the three Roots are equal, the Node will turn

Fig. 52.



into a Cusp. Which makes a Forty eighth Species.

If the two greatest Roots are equal, and the Third hath the same Sign with them, the Oval

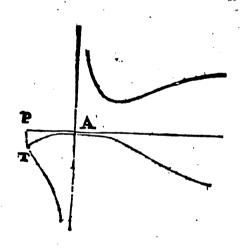


will vanish into a Conjugate Point. Which is the

Forty ninth Species.

If two of the Roots are impossible, the two
Hyperbola Parabolick Curves will remain pure, (See Fig. 53.)



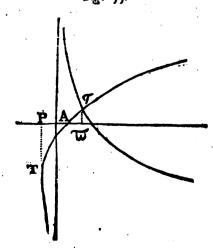


without any Oval, Decussation, Cusp, or Conjugate Point. And this will make a Fiftieth Species.

If two of the Roots be equal, and the Third

have a contrary Sign to them, then the Hyperbola

Fig. 55.



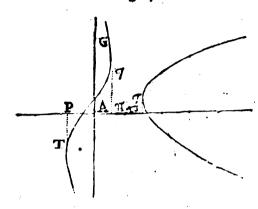
Yol. IÌ.

Parabolick Curves will be joined, decussaring one another in the Form of a Cross. And this is the

Fifty first Species.

If the two Roots are unequal, and of the same Sign, and the Third have a contrary Sign, the Figure will become an Angineal Hyperbola about the

Fig. 56.

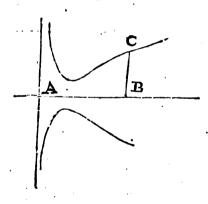


Assymptote AG, together with a Conjugate Parabola. And this will be a Fifty second Species.

Four Parabolick Hyperbola's which have a Diameter.

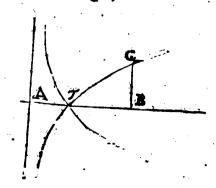
22. In the other Case, where the Term øy is wanting, and the Figure hath a Diameter, if the two Roots of this Equation bxx + cx + d = 0

Fig. 57.,



are impossible, there will be two Hyperbola Parabolick Figures equally distant from the Diameter AB, and one on one Side, and the other on the other, which will constitute a Fifty third Species. If the two Roots of this Equation be impossible, the Hyperbola Parabolick Figures will join, and

Fig. 58.



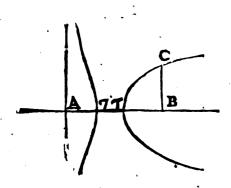
Bb 2

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intersect one another in the Form of a Cross. And this will be a Fifty fourth Species.

If the Roots are equal, and have the same Sign, there will be a Conchoidal Hyperbola with a Para-

Fig. 59.

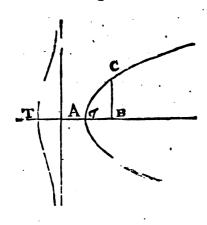


bola on the same Side of the Assymptote. And

this makes a Fifty fifth Species.

If the Roots have contrary Signs, there will be a Conchoidal Hyperbola on one Side of the Assymp-

Fig. 60.



tote, and a Parabola on the other. And this makes 2 Fifty sixth Species.

Four Hyperbolisms of the Hyperbola.

23. Whenever in the first Case of the Equations, the Term axi and bxx are both wanting, the Figure will be a Hyperbolism of some Conick

Section I call that the Hyperbolism of a Figure, when the Ordinate comes out by dividing the Rectangle under the Ordinate of that Figure and a given Right Line, by the common Abscissa. By this means a Right Line is changed into a Conick Section, and every Conick Section into some one of those Figures which I here call the Hyperbolisms of the Conick Sections. For the Equation for the Figure, of which we now speak, viz. x yy + ey = cx + d, gives the Ordinate $y = e + \sqrt{ee + 4dx + 4cxx}$; which is gene-

rated by dividing the Rectangle under the Ord. of the Conick Section, $\frac{e \times \sqrt{ee + dx + 4c \times x}}{}$

and a given Right Line m, by the common Abseissa x. Whence it is plain, that the Figure pro-

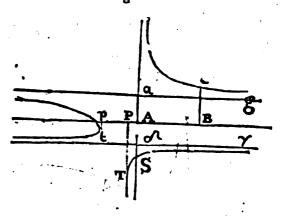
duced will be the Hyperbolism of an Hyperbola, Ellipsis or Parabola, according as the Term c x is Affirmative or Negative, or quite wanting.

The Hyperbolism of an Hyperbola hath three Assymptotes, of which one is the first and principal Ordinate A d, the other two are Parallels to the Abscissa AB, and equidistant from it on each Side

In the principal Ordinate A d, take A d, A s equal both ways to the Quantity $\checkmark : c$; and thro' the Point d and s, draw dg, s as Assymptotes, parallel to the Abscissa A B.

When the Term e_j is not wanting, the Figure hath no Diameter. In this Case, if AP and Ap, the two Roots of the Equation $c \times x + d \times z$ $+\frac{e e}{l} = 0$, are real and unequal (for equal they cannot be, unless the Figure be a Conick Section;) then will the Figure consist of three Hyperbola's opposite to one another; of which, one lies be-

Fig. 61.

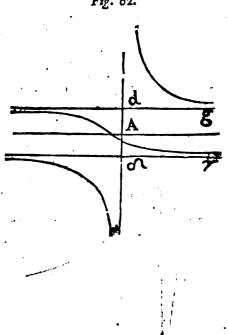


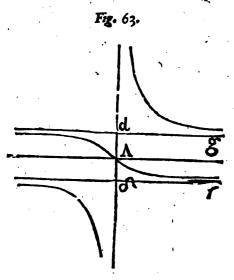
tween the parallel Assymptotes, and the other two without them. And this is a Fifty fenenth Species.

If the two Roots are impossible, there will be

two opposite Hyperbola's without the parallel Asspmptotes, and an Hyperbolical Anguineal within them. This Figure is of two Species; for it hath

Fig. 62.



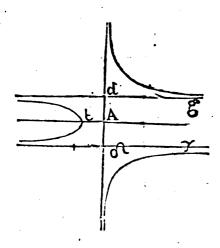


no Centre when the Term d is not wanting, but if d be wanting, the Point A is its Centre. The former of these makes a Pifty eighth, the latter a Fifty ninth Species.

Fifty ninth Species.

But if the Term ey is wanting, the Figure will confift of three opposite Hyperbola's, of which one will lie between the parallel Assymptotes, and

Fig. 64.

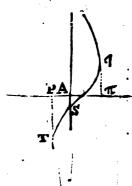


the other two without, as in the 54th Species: And besides this, it will have a Diameter, which is the Absciss A B. And this constitutes a Sixtieth Species.

Three Hyperbolisms of the Ellipse.

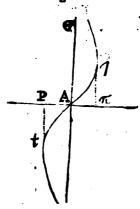
24. The Hyperbolism of an Ellipsis is determined by this Equation xyy + ey = cx + d; and hath only one Assymptote, which is the principal Ordinate Ad. If the Term ey be not wanting, the Figure will be an Anguineal Hyperbola without any Diameter, and even without any Centre, if the Term d be not wanting. Which makes the Sixty first Species.





But if the Term d be wanting, the Figure will have a Centre without any Diameter, which will

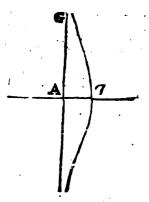
Fig. 66.



be the Point A. And this makes a Sixty Second Species.

And if the Term ey be wanting, and not id, the Figure will be a Conchoidal Hyperbola to the

Fig. 67.



Affymptote AG, and will have a Diameter without any Centre, that is, the Abscissa AB. Which makes a Sixty third Species.

Two Hyperbolisms of the Parabola.

25. The Hyperbolism of a Parabola is determined by this Equation xyy + ey = d; and hath two Assymptotes, the Abscissa AB, and the first and principal Ordinate AG. But the Hyperbola's in this Figure are two, not lying in the opposite Angles of the Assymptote, but in the contiguous or adjoining ones, and that on each Side the Abscissa

Fig. 68.

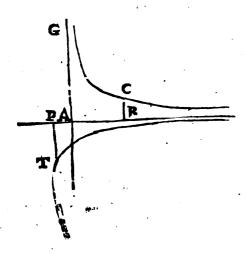
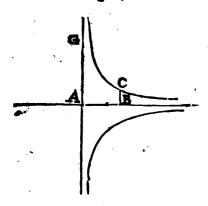


Fig. 69.

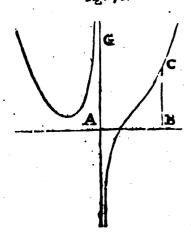


A B; and even without any Diameter, if the Term s y be there, but with one if that be wanting. Which two Species are the Sixty fourth and Sixty fifth.

A Trident.

26 In the fecond Case of the Equation there is $xy = ax^3 + bx + cx + d$: And the Figure in this Case will have four infinite Legs, of which

Fig. 76.



two are Hyperbola's about the Assymptote A G tending towards contrary Parts, and two converging Parabola's, and, with the former, making as

it were the Figure of a Trident. And this Figure is that Parabola by which Des Cartes constructed Equations of fix Dimensions. This therefore is the Sixty sixth Species.

· Five Diverging Parabola's.

27. In the third Case the Equation was $yy = ax^3 + bx + cx + d$; and designs a Parabola, whose Legs diverge from one another, and run our infinitely contrary ways. The Abscissa A B is its Diameter, and its five Species are these:

If, of the Equation $ax^3 + bxx + cx + d$ = 0, all the Roots $A\tau$, AT, At, are real and unequal; . en the Figure is a diverging Parabola

Fig. 70.

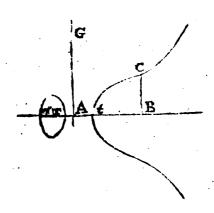
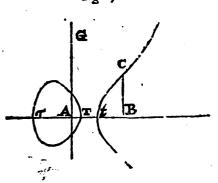


Fig. 71.



of the Form of a Bell, with an Oval as its Vertex. And this makes a Sixty seventh Species.

If two of the Roots are equal, a Parabola will be formed, either Nodated by touching an Oval,

Fig. 72.

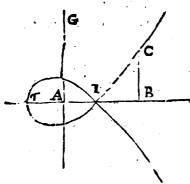
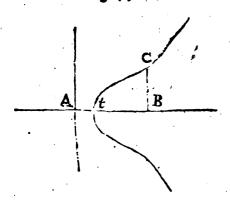


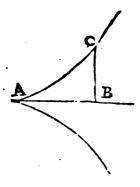
Fig. 73.



or Punctate, by having the Oval infinitely finall. Which two Species are the Sisty eighth and Sixty ninth.

If three of the Roots are equal, the Parabola will be Guspidate at the Vertex. And this is the

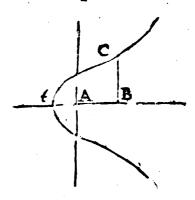
Fig. 75.



Neilian Parabola, commonly called Semi-cubical. Which makes the Seventieth Species.

If two of the Roots are impossible, there will (See Fig. 73.)

Fig. 76.

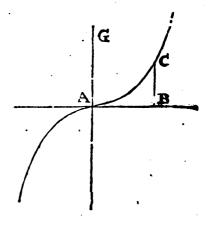


be a pute Patabola of a Bell-like Form. And this makes the Seventy first Species.

The Cubical Parabola.

28. In the fourth Case, let the Equation be y = ax + bx + cx + d; then will it denote

Fig. 77:



the Cubical Parabola with contrary turn'd Legs. And this makes up, or completes the Number of the Species of these Curves, to be in all Seventy two.

Of the Genesis of Curves by Shadows.

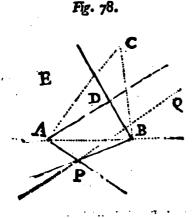
29. If the Shadows of Figures are projected on an infinite Plane illuminated from a lucid Point, the Shadows of the Conick Sections will always be Conick Sections; those of the Curves of the Second Gender, will always be Curves of the Second Gender; and the Shadows of Curves of the Third Gender, will themselves be of the same Gender, and so on in infinitum. And as a Circle, by the Projection of its Shade, generates all the Conick Sections; so will the five diverging Parabola's spoken of in ch. 28. by their Shadows generate and exhibit all Curves of the Second Gender; and so some more simple curves of other Genders may be found, which, by the Projection of their Shadows from a lucid Point upon a Plane, shall form all other Curves of the same Kinds.

Of the double Points of Curves.

30. I said above, that Curves of the Second Gender might be cut by a Right Line in three Points; but two of those Points are sometimes coincident. As when the Right Line passes by an Oval infinitely small, or by the Concourse of two Parts of a Curve mutually interfecting each other, or running together into a Cuspis. And if at any time all the Right Lines tending the same way with the infinite Leg of any Curve, docut it in one only Point, (as happens in the Ordinate of the Cartesian, and in the Cubical Parabola, and in the Right Lines which are parallel to the Abscissa of the Hyperbolisms of Hyperbola's and Parabola's;) then you are to conceive that those Right Lines pass through two other Points of the Curve (as I may say) placed at an infinite Distance; and these two co-incident Intersections, whether they be at a finite or an infinite Distance, I call the double Point. And such Curves as have this double Point, may be described by the following Theoremś.

Theorems for the Organical Description of Curves.

31. Theor. I. If two Angles, as P A D and PBD, whose Magnitude is given, be turned round the Foles A and B, given also in Position; and their Legs AP, BP, by their Point of Concourse



P, describe a Conick Section passing thro' their Poles A and B; except when that Right Line happens to pass through either of the Poles A or B; or when the Angles BAD and ABD vanish together into nothing; for in such Cases the Point will describe a Right Line.

II. If the first Legs AP, BP, by their Point of Concourse P, do describe a Conick Section pasfing through the Pole A; then will the two other Legs AD, BD, by their Point of Concourse D, describe a Curve of the Second Gender, passing through the other Pole B, and having a double Point in the first Pole A, through which the Conick Sections, except when the Angles B AD, ABD, vanish both away together; for then the Point D will describe another Conick Section passing through the Pole A.

III. But if the Conick Section which the Point P describes, pass through neither the Pole A, nor B; then the Point D will describe a Curve of the Second or Third Gender, having a double Point;

and that double Point will be in the Concourse of the describent Legs AD and B D, when the Angles B A P, AB P vanish together: And the Curve described, will be one of the Second Gender, if the Angles B AD, AB D vanish together, otherwise 'twill be one of the Third Kind, and then it will have two other double Points in the Poles A and B.

The Description of the Conick Section by five given Points.

22. A Conick Section is determined by having five of its Points given; and may be thus described by them: Let the five Points be A, B, C, D, and E; join any three of them together, as suppose A, B and C, and form the Triangle ABC, and suppose any two of its Angles, as CAB and CBA, to revolve round their Vertices A and B; and when C, the Intersection of the Legs AC, BC, is successively applied to the other two Points D, E, let the Intersection of the other Legs AB and BA, fall in the Point P and Q. Let also the Line PQ be drawn, and infinitely produced; and let the moveable Angles be for turned round, that the Interaction of the Legs AP and BP, may describe the Right Line PQ: And then will the Intersection of the two other Legs, C, describe the proposed Conick Section, by Theor. I.

The Description of Curves of the Second Gender baving a double Point, by Jeven given Points.

33. All Curves of the Second Gender which have a double Point, are determined from their feven given Points, of which one is that double Point. And by means of those Points they may be thus described: Let there be given any seven Points of the Curve to be described, as A, B, C, D, E, F, and G, of which A is the double Point. Join A with any two other Points, as suppose B and C; and then let both the Angles C AB, and also either of the other two Angles of the Triangle ABC (as the Angle ABC) revolve round the two Vertexes A and B. And when the Point of Concourse C, of the Legs AC, BC, is successively applied to the four remaining Points D, E, E, and C, let the Concourse C. D, E, F, and G; let the Concourse of the two other Legs A B and B A, fall in the four Points P, Q, R, S. Through these four Points, and the fifth Point A, describe a Conick Section; and let the aforesaid A poles C A B and C B. A G results the aforesaid Angles C A B and C B A, so revolve, that the Point of Concourse of the Legs A P, P B, may describe that Conick Section: Then shall the Point of Concourse of the other Legs A C, B C, describe the Curve proposed, by Theor.

If instead of the Point C, the Right Line B C be given in Position, and which shall touch the Curve to be described in B; then the Lines AD, AP, will be coincident; and instead of the Angle D AP, there will be a Right Line revolving round the Pole A.

If the donble Point A be infinitely distant, the Right Line will perpetually tend with a Direction towards that Point, and will be carried with a parallel Motion, while the Angle ABC revolves about the Pole B.

These Curves may also be described after another manner, by the Third Theorem; but 'tis enough to shew you the most simple way of their Description.

After

After the same Method may Curves of the Third, Fourth, and yet higher Genders, be describ'd; not at all indeed, but such as by some commodious Ratio may be describ'd by local Motion: For how commodiously, to describe some Curves of the Second or higher Genders, when they have no Common Point, is a Problem that must be reckoned amongst the more difficult ones.

The Construction of Equations by the Description of Curves.

The Use of Curves in Geometry u, that by their Intersections Problems may be solved. Let an Equation be proposed to be constructed having Nine Dimensions, as $x^9 + b x^7 + c x^6 + d x^5 + c x^4 + f x^5 + g x x + b x + k = 0$; where b, c, +m d, &c. signify any given or known Co-efficients, adsected with the Signs + and -. Let an Equation to a Cubical Parabola $x^3 = y$ be assumed:

adjected with the Signs + and -. Let an Equation to a Cubical Parabola $x^3 = y$ be affumed: Then will the former Equation, putting y for x^3 , fland thus, $y^3 + b xyy + cyy + dxxy + cxy + my + fx^3 + gxx + bx + k = 0$, be an Equation to another Curve of the Second Gender, where m or f may either be wanting or affum'd at pleasure. And by the Descriptions of these Curves and their Intersections, there will be found the Roots of the Equation at first given to be confiructed.

Note, 'Tis enough to describe the Cubical Parabola once.

It the Equation to be constructed, by reason of the two last Terms h x and k being wanting, is depressed to seven Dimensions; the other Curve, by expunging m, will have a Double Point in the Beginning of the Abscissa, and therefore may easily be described as above.

If the Equation to be conftructed hath the three last Terms $g \times x + h \times + k$ wanting, and therefore is but of fix Dimensions, the other Curve, expunging f, will become a Conick-Section.

And if the fix last Terms being wanting, the Curve be reduced to three Dimensions, its Construction will fall in with Dr. Wallin's, by the Cubical Parabola and a Right Line.

Equations may also be constructed by the Hyperbolism of a Parabola with a Diameter. Suppose this Equation of nine Dimensions, and wanting its last Term save one, were to be constructed, a + $c \times x + d \times^3 + e \times^4 + f \times^5 + g \times^6 + b \times^7 +$

 $kx^2 + lx^9 = 0$. Let there be an Equation affumed to that Hyperbolium; thus, xxy = 1;

and substituting y for $\frac{1}{x}$ the Equation to be

conftructed will be changed into this Form, $ay^3 + cyy + dxyy + cy + fxy + mxxy + g + bx + kxx + lx^4 = 0$, which denotes a Curve of the fecond Gender, by whose Description the Problem may be solved, and of the Quantities m and g, either may be wanting or assumed at pleasure.

at pleasure.

By the Cubical Parabola and Curves of the Third Genders, all Equations may be constructed not exceeding twelve Dimensions; and by the same Parabola, and a Curve of the Fourth Gender, all Equations not exceeding fisteen Dimensions, and to on infinitely. And these Curves of the third, fourth, and superior Genders, may al-Vol. II.

ways be describ'd by finding their Points by plain Geometry.

As if this Equation were to be conftructed, $x^{x^2} + a x^{10} + b x^9 + c x^8 + d x^7 + e x^6 + f x^5 + g x^4 + b x^3 + i x x + k x + l = 0$, and the Cubical Parabola be supposed to be described; let the Equation for that Cubical Parabola be $x = y^3$: Wherefore substituting y for x^2 , the Equation will put on this Form,

$$y^{4} + ayy^{3} + cxxy + fxxy + ixx = 0$$

+ $b + dx + gx + kx$
+ $e + b + l$

Which is an Equation to a Curve of the Third Gender, by whose Description the Problem may be solved. And this Curve may be described by finding its Points by plain Geometry, because the indeterminate Quantities relate not to above Two Dimensions.

In the Memoires of the French Academy of Sciences for the Year 1699, there is a Method for finding the Curves, which Bodies rifing towards, or alcending from the Horizon, will describe, let the Ratio of the Time of the Descent or the Ascent, and the Acceleration or Retardation be what it will. Communicated by Mr. Varignon.

CUSPIDATED Hyperbola, is a kind of Hyperbola whose Two Parts concur and terminate in the Angle of Contact.

CUSTUMARIUS, was an inferior Tenant in Soccage or Villenage, who, by Custom, is obliged to pay such and such Service of Work and Labour for his Lord. Dr. Kennet.

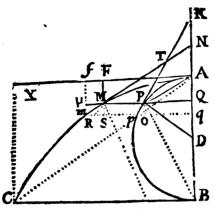
CUTTER of the Tallies, is an Officer in the Exchequer, that provideth Wood for the Tallies, and cuts the Sum paid upon them, and then casteth the same into the Court to be written upon.

CYCLOID. Besides the Segment of the Semicycloidal Space, first found quadrable by Sir Christopher Wren, and afterwards by Mr. Huygens, and also the Trilinear Part of it, which is plainly so; Dr. Wallis, in Phil. Tranf. N. 217. P. 111. produces, from his Tracts de Cycloide and de Morn, some other Portions of the Cycloid which are capable of being squared. And the same Excellent Author, in N. 229. P. 561. shews, That this Figure of the Cycloid was confidered long before the Time of Mersennus and Gallileo, tho' not throughly understood 'till this present Age: For in the Math. Works of Bovillus, publish'd at several times between 1501. and 1510. the Curve which we now call the Cycloid, was then confider'd; and yet not first by Bovillus neither, for Cardinal Cusanus, as appears by an Antient Manuscript of his Works, transla ed by J. Scoblant in the Year 1451. 'had taken it into Consideration besore. Indeed the Figure, both in the Manuscript, and in the Basil Edition of his Works, is ill drawn; but being correcled by the Cardinal's own Words, it plainly represents the Modern Cycloid.

In Philef. Trans. N. 94. you have a Demonstration of the Synchronism of the Vibrations made in a Cycloid; that is, of a Pendulum of a due Length, vibrating between Two Cycloids: For such a Pendulum will move in a Cycloid, and consequently its Vibrations will be Synchronal.

To investigate the Area's of Cycloidal Spaces.

Let A M C be a Vulgar Semi-cycloid, and the Generating Circle A P B from any Point in the Ordinate, v. g. Q. Draw Q M parallel to the Base B C, cutting the Periphery of the Circle in



P; make the Parallelogram A F M Q, and draw f m infinitely near F M, cutting Q M produc'd in μ , and the Curve in m. Put A B := 2 r, A Q = F M = x, $\mu m = x$, Q P = r; then (by the Property of the Circle) 2 r x - x x = r.

Whence
$$r \times - \times x = jj$$
, and $j = \frac{r \times - \times x}{j}$

And because the Triangles $DP \mathcal{Q}$, pPO are similar, therefore PQ(r): Dp(r)::PO(x)

 $P p = \frac{r \dot{x}}{r}$. Now it is the Nature of the Vulgar

Cycloid, that the Arch AP + the Right Sine of that Arch P are equal to $\mathcal{D}M$: Therefore it is manifest, that the Fluxion of the Ordinate of the Cycloid $\mathcal{D}M$, viz. MS, is equal to the Aggregate of the Fluxions of the Arch AP, and the Right Sine P \mathcal{D} ; that is, mS = Pp +

$$p_0 = \frac{r\dot{x} - x\dot{x}}{y} + \frac{r\dot{x}}{y} = \frac{2r\dot{x} - x\dot{x}}{\sqrt{rx - x}}, \text{ and}$$

consequently the Rectangle $F\mu$ is equal to $FM \times$

consequently the Received
$$= \frac{2r \times x - x \times x}{\sqrt{2r \times - x \times x}} = \frac{2r \times x - x \times x}{\sqrt{2r \times - x \times x}}$$

 $x\sqrt{2rx-xx}$ to the Fluxion of the Area AMF. But the Fluxion of the Portion of the Circle $APQ=x\sqrt{2rx-xx}$; therefore the Area AMF and the corresponding Portion of the Circle APQ are always equal.

CONSECTARY I.

The Parallelogram AC is equal to the Semi-periphery $APB \times AB =$ Four times the Semi-circle APBA, and the Complement of the Cycloidal Space AMCB to the Parallelogram, viz. AMCX is equal to the Semi-circle APBA; therefore the Area of the Semi-cycloidal Space AMCB, is equal to three times the Area of the Semi-circle APBA.

CONSECTART II.

The Cycloidal Space AMCB, is to the Circumscrib'd Parallelogram AC, 25 3 is to 4.

CONSECTARY III.

The Space comprehended between the Chord AC, and the Curve AMC, is equal to the Area of the Semi-circle APB. For AMCB is equal to $\frac{1}{2}$ Parallelogram AC, and the Triangle ACB is equal to $\frac{1}{4}$ Parallelogram AC; therefore the Space AMCA is equal to $\frac{1}{4}$ Parallelogram AC, which is equal to the Area of the Semi-circle APB, and the Space AMCA is equal to the

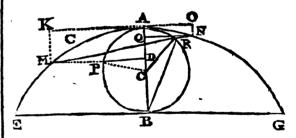
CONSECTART IV.

Though the Quadrature of the whole Cycloidal Space, or any indefinite Portion thereof, depends on the Quadrature of the Circle; yet an infinite Number of Segments of the Vulgar Cycloid, may be squard without supposing the same.

Let E A G be a Vulgar Cycloid, the Bale E G, and A B the Axis, and the generating Circle A P B. I say, if the Point 2 be taken at pleasure in the Axis A B, and if C D be taken equal to A 2 and the Ordinates D M, 2 N, and the Line M N connecting their Extremities be drawn, the Segment of the Cycloid M E N M = Rectangle Triangle P B D + Rectangle Triangle R B 2.

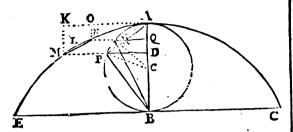
Draw O A X parallel to the Base, and N Q, M K parallel to the Axis AB, and draw the Radij C P, C R.

First, If the Ordinates D M 2 N be on the contrary Sides of the Axis A B, then the Segment Me M N is equal to the Trapezium MKON — Trilineal Figures A K M and A O N. Now



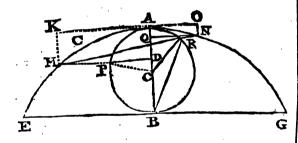
the Trapezium M K O N is $= \frac{1}{2} M K + \frac{1}{2} N O \times KO = (because NO is = A 2 = C D, and <math>KM = AD) \frac{1}{2} CA \times K O = \frac{1}{2} CA \times A K + \frac{1}{4} CA \times AO$. And by the Property of the Cycloid, $\frac{1}{2} AC \times A K$ is $= \frac{1}{2} CA \times A \text{ch} AP + PD$ = Sector ACP + Triangle BCP = Sector ABP. In like manner it may be demonstrated, that $\frac{1}{2} CA \times AO$ is = Sector ABR; therefore the Trapezium MKON is equal to Two Sectors PBA = RBA. But, by the known Property of the Cycloid, the Trilineal Figure AKM is equal to the Segment of the Circle ADP, and the Trilineal Figure AON is equal to the Segment ADP, and the Trilineal Figures AKM, AON be subtracted, and if from the Sectors ADP, ADN be subtracted, and if from the Sectors ADP, ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be subtracted, there will remain the Segment of the Cycloid ADR be secondly,

Secondly, But if the Ordinates QN, DM be on the same Side of the Axis AB, then the Segment of the Cycloid Me NM = Trapezium MKON+ Trilineal Figure AON - Trilineat Figure AKM. Now the Trapezium MKON $= \frac{1}{2} M K + \frac{1}{2} O N \times O K = \frac{1}{2} C A \times A K - \frac{1}{2} C A \times A O = \text{Sector } P B A - \text{Sector } R B A$



therefore if we substitute the Circular Segments ADP, AQR in the place of the Trilineal Spaces AKM, AON, we shall have the Cycloidal Segment MeNM := Sector PBA - Sector RBA + Segment <math>AQR - Segment ADP := Rectangle Triangle <math>PDB - Rectangle Triangle PBRO

5. If the Points D and Q coincide, then it is manifest that BD or $BQ = \frac{\pi}{4}BC$, and the Chord MN is perpendicular to the Axis AB, and the Segment Me ANM will be equal to

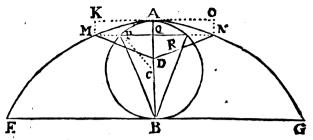


an Equilateral Triangle inscrib'd in the Generating Circle, and Space MPBAM will be equal to three times the Area of the Triangle CP B. Which was first discover'd by the Excellent Mr. Hugens.

6. But if the Point D fall in the Center, then Q will be in A, and the Segment Me N M will degenerate into that which the Celebrated Mr. Leibnitz first squar'd, without having Recourse to the Area of the Circle. And the laid Segment MeNM will be equal to the Rectangular Triangle P B D = 1 the Square of the Radius.

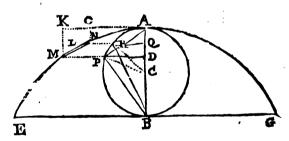
7. And to square an infinite Number of Sectors of the Cycloid: Assume any Point, Q, in the Axis AB; and draw the Ordinate MQN, and take CD = AQ; and draw the Lines DM, DN: Then, I say, the Sector of the Cycloid DMAND is equal to the Isosceles Triangle PBR. For the Sector of the Cycloid DMAD is equal to the Trapezium DMKAD—Trilineal Figure AKM. But the Trapezium DMKA is===DQ+AQ×AK==AC×AK= $\frac{\pi}{4}$ AC × Arch AP+PQ=to the Sector PBA,

Segment APQ; therefore the Sector of the Cyloid DMAD is equal to the Triangle



PBQ; and consequently the Sector of the Cycloid DMAND is equal to the Isosceles Triangle B P R.

8. And as we have thus squar'd an infinite Number of Cycloidal Segments and Sectors, so an infinite Number of Cycloidal Zones, (viz. Spaces comprehended between the Portion of the Curve MN, the Portion of the Axis QD, and the Ordinates QN, DM) may be squar'd from the same Principles: For if we consider that the External Space AKM is equal to the Segment of the Circle A P D, and that A P = MP, we may find the Value of any Cycloidal Space in Rectilineal Figures and Circular Segments; and therefore if it be requir'd that the said Cycloidal Space shou'd be squarable, it is plain that those Terms which confift of circular Segments, must destroy one another, and consequently be put =0; from which Supposition the Quantities which were assum'd at first may easily be determin'd. Ex. gr. Let it be requir'd to determine the Right Lines CQ, CD in the Axis AC, so that the Cycloidal Zone DMNQ be squarable. Suppose AC = a, CQ = x, CD = z, QR = p, DP = q, AR or NR = u, AP or MP = e; then the Sector A C R = 1 au, and the Sector A C P



 $=\frac{1}{2}ac$, and consequently the Segment A Q R, or the Figure AON, is $=ACR-CQR=\frac{1}{2}au-\frac{\pi}{2}px$; and the Segment ADP, or the Figure AKM, is $=ACP-CPD=\frac{\pi}{2}ac$ $\frac{1}{2}qz$. But the Cycloidal Segment A Q N is = QO - AON = QO - AQR = AQX $QR + RN - AQR = AQ \times QR + AR AQR = a - x \times p + u - \frac{1}{2}au + \frac{7}{2}px = ap - \frac{7}{2}px + \frac{1}{2}au - xu.$ And in like manner the other Segment ADM

 $= aq - \frac{1}{2}q \chi + \frac{1}{2}ac - \chi c.$ And consequently the Zone DMNQ = ADM

 $- AQN is = aq - \frac{1}{2}qz - ap + \frac{1}{2}px + \frac{1}{2}ac - zc - \frac{1}{2}au + xu.$ Whence it appears, that the Four first Members consist of Recilineal Figures only, and that

and the Trilineal Figure A K M is equal to the the other Terms affected with u and c, hinder the Vol. II.

Zone from being squarable. Whence it is evident, that if we suppose the Terms affected with u and c mutually to destroy one another, then the Cycloidal Zone DMNQ will be $= aq - \frac{1}{2}qz - ap + \frac{\pi}{2}px$. And the remaining Terms must be = 0, that is, $\frac{\pi}{2}ac - zc - \frac{\pi}{2}au + zc = 0$; and if we suppose the Ratio of c to u be given (they is as one Number is as constant.) be given (that is, as one Number is to another, that so one Arch being given, the other may be constructed Geometrically) we may destroy the Quantities c and u, and find the Relation between z and x. V. gr. If it be u: c:: I: 2, then the Equation $\frac{1}{2}ac - zc - \frac{1}{2}au + xu = 0$, becomes $a - 2z - \frac{1}{2}a + x = 0$; and consequently $z = \frac{a+2x}{4}$. And if u:c::1

:3, then $z = \frac{2a+2x}{6}$; or if it be u: c::

1: 4, then $z = \frac{3a + 2x}{8}$, &c. in the same

Progression. And to find the Value of z in other Terms; if we suppose $C \ Q$ the Sine Complement of the Arch AR to be given, then CD the Sine Complement of Double, Triple, Quadruple, &c. that Arch may be found by common Algebra. There-

fore if c be = 2 u, then $z = \frac{2 xx - 4a}{4}$; if c

$$= 3 u, \text{ then } \zeta = \frac{4 x^3 - 3 a a x}{a a}; \text{ or if } c =$$

4 u, then $z = \frac{8x^4 - 8aaxx + a^4}{a^4}$, &c. and comparing these Values of z with those formerly found, we may find the Value of x in any Sup-

position. V.g. If c be = 2 u, then $z = \frac{a+2x}{a}$

$$= \frac{2 \times x - a^a}{a}; \text{ and consequently } 8 \times x + 2 \times a \times a$$

$$= 5 \times a \text{. Whence } x \text{ is } = \frac{1}{2} \cdot a + \sqrt{\frac{1}{2} \cdot a \cdot a + \frac{1}{2} \cdot \frac{1}{2} \cdot a \cdot a}$$

= 5 a a. Whence x is = 1 a + 1 1 a a + 37 a a

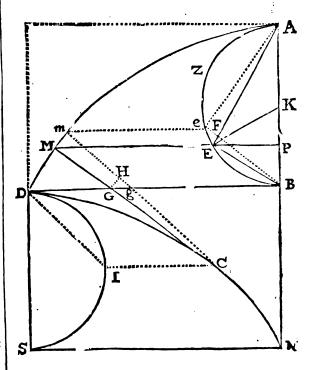
 $= \frac{1}{8}a + \sqrt{\frac{21}{64}}aa = \frac{1}{8}a + \frac{1}{8}a\sqrt{41}.$ Hence it is manifest, that if CQ be taken = $\frac{1}{8}a + \frac{1}{8}a\sqrt{41}$. And if the Ordinate QN be applied to the Axis in the Point Q, and if the Arch RP be taken = AR, and the Ordinate MPD be drawn; then the Cycloidal Zone DMNQ will be $= aq - \frac{1}{2}q - ap + \frac{1}{2}px$ = the Recilineal Triangles $CAP + DAP - \frac{1}{2}q - \frac{1}{2}$ CAR-AQR.

And thus an infinite Numbers of Cycloidal Zones may be determin'd, which admit of a Quadrature, when the Proportion between the Arches AR, RP is express'd in given Numbers.

If the Curve Line A M D be a simple Semi-cycloid, whose Base BD is equal to the Semi-periphery of the Generating Circle BEA. Tis required to find the Value of the Ray of the Evoluta M C.

Suppose AP = x, PM = y, the Arch AE= n, and the Diameter AB = 2a; then, by the Property of the Circle, PE is $= \sqrt{2 ax - xx}$ and by the Property of the Cycl. y=u+\sqrt{24x-xx}; therefore $y = u + \frac{ax - xx}{\sqrt{2ax - xx}}$: But u equal

$$\frac{ax}{\sqrt{2ax-xx}}, \text{ therefore } y = \frac{2ax-xx}{\sqrt{2ax-xx}} = \frac{x}{x} \times \frac{2a-x}{\sqrt{2ax-xx}} = \frac{x}{\sqrt{x} \times \sqrt{2a-x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x} \times \sqrt{x}} = \frac{x}{\sqrt{x}} = \frac{x$$



(dividing by $\sqrt{2 a - x}$) $x \times \frac{\sqrt{2 a - x}}{x}$; whence $y = (\text{supposing } x \text{ invariable}) \frac{-a x^2 \sqrt{x}}{x x \sqrt{2a - x}} =$ $\frac{-ax^2}{x\sqrt{2ax-xx}}$; and substituting this Value in the General Theorem $\frac{x^2+y^2\sqrt{x^2+y^2}}{x^2+y^2}$, or $\frac{x^2+y^2|^{\frac{1}{2}}}{x}$ we shall have (because $y=x\sqrt{\frac{2a-x}{x}}$) $\frac{\frac{2 \cdot 4 \cdot x^{2}}{x}}{\frac{x}{x}} = \frac{\sqrt{\frac{8 \cdot a^{3} \cdot x^{6}}{x^{3}}}}{\frac{x^{3}}{x}} = \frac{\sqrt{\frac{8 \cdot a^{3} \cdot x^{6}}{x^{3}}} \times x \sqrt{2ax - xx}}{a \cdot x^{3}}$ $\frac{\sqrt{\frac{8 \ a^{3}}{x^{5}}} \times x \sqrt{2ax - x_{x}}}{\sqrt{\frac{16 \ a^{4} x^{5} - 8 \ a^{5} x^{4}}{x^{3}}} = \frac{\sqrt{\frac{16 \ a^{4} x^{5} - 8 \ a^{5} x^{4}}{x^{3}}}$ $2\sqrt{444-24x} = MC = (2\sqrt{EPq + PBq})$ = 2EB) = 2MG, because MC perpendicular to the Curve in the Point M is parallel to

the Chord B E. CONSECTARY L

If x be supposed = 0, then is $AN = 2\sqrt{4.44}$ = 4.4 = 10 the Ray of the Evoluta in the Vertex A; aud if we suppose x = 2 a, then MC $=2\sqrt{444-444}=0$; that is, the Ray of the Evoluta in D, is equal to nothing; and in A it is equal to twice the Diameter of the generating Circle; and hence 'tis evident, that the E-voluta begins in D and ends in N, so that B N is = B A.

CONSECTART II.

The Evoluta DCN is a Semi-cycloid equal to the given Semi-cycloid DMA: Compleat the Parallelogram BS, and on the Diameter DS describe the Semi-circle DIS, and draw DI parallel to MC parallel to EB; then is the Angle BDI = EBD, and consequently the Arches DI, BE are equal; but EB = MG = GC; therefore GC = DI, and if IC be drawn, it will be equal and parallel to DG. Now by the Nature of the Cycloid DG = Arch BB = Arch DI; therefore IC is = Arch DI, and consequently the Evoluta DCN is a Semi-cycloid, whose Base is SN = ½ the Periphery of the Generating Circle DIS; that is, the Evoluta is equal to the given Cycloid, and the same with it, only placed in a contrary Position.

CONSECTARY III.

The Length of the Curve of the Cycloid DCN is = 2 A B (= twice the Diameter of the Generating Circle) and any Portion of the Cycloid, as DC, is = 2 CG = 2 DI = twice the corresponding Chord in the Generating Circle.

Another Solution.

The Length of the Ray of the Evoluta MC may be determined without any Calculation,

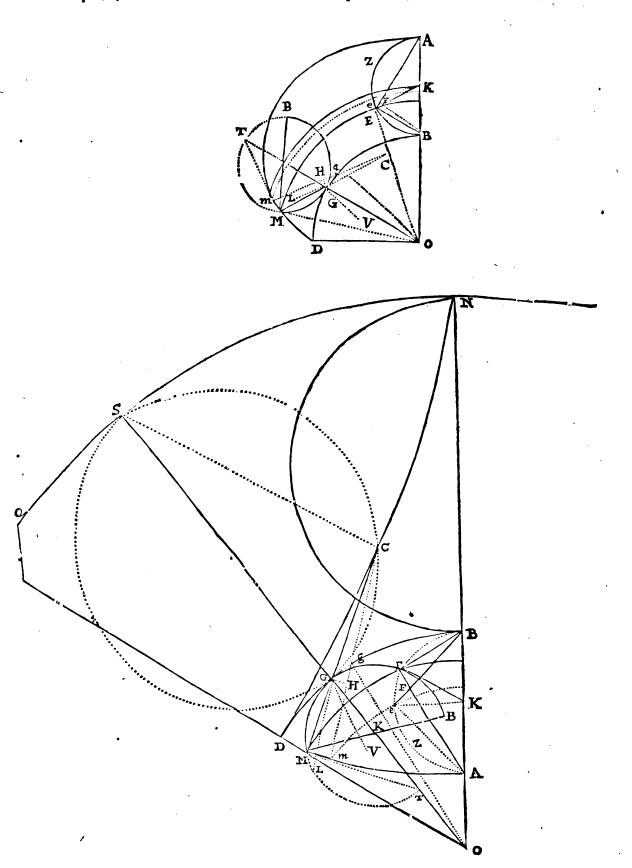
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thus: Draw another Perpendicular, mC, infinitely near the former, and another Ordinate me parallel to ME, and another Chord Be; and on the Centers C and B describe the little Arches GH, EF; then the Rectangular Triangles GHg, EFe will be similar and equal; for Gg is Ee (because EFE or EFE and EFE and EFE and EFE or EFE or EFE and EFE and EFE and EFE and EFE and EFE and EFE and EFE and EFE and EFE and EFE are also equal; therefore the Radii EFE are also equal; therefore the Radii EFE are also equal, and consequently EFE are Evoluta EFE are evident, that the Ray of the Evoluta EFE is EFE are evident, that the Ray of the Evoluta EFE is EFE are twice the Choard EFE and EFE are also expressed as EFE.

CONSECTARY.

We have proved before, that the Area of the Cycloid is triple the Area of the Generating Circle: This Truth may be proved from other Principles, as thus; the Space MGgm, or the Trapezium MGHm (the Difference being incomparably little) is $=\frac{1}{2}\frac{Mm+\frac{1}{2}GH}\times MG$ $=\frac{1}{2}EF\times BE$; that is, the Trepezium MGgm is = three times the Sector EBF or EBe; therefore the Sum of all the Trapezia, $vi\chi$. the Cycloidal Space MGBA is equal to three times the Sum of all the Triangles, $vi\chi$. the Circular Space $BE\chi A$; and the whole Cycloidal Space AMDBA is = thrice the Area of the Semi-circle AEBA.

If the Curve AMD be a Semi-cyloid describ'd by the Revolution of the Semi-circle AEB, on the Periphery of another immovable Circle BDG. 's is requir'd to describe the Evoluta of the said Curve.



The Movable or Generating Circle may be supposed to move either on the Convex or Concave Side of the Periphery of the immovable cave Side of the Periphery of the immovable concess the Base BD in G, and the describing Point

Point A, is in M, in the Curve of the Cycloid; then, from the Genesis of the Curve, I inser,

1. The Arch GM is \Longrightarrow Arch GD, and the Arch GD of the movable Circle is equal to the Arch GB of the immovable Circle.

2. MG is perpendicular to the Curve A MD; for if we consider the Semi-circumference MGB, or AEB, and the Base BGD, as being compos'd of an infinite Number of little streight Lines, and every one is one, equal to the corresponding one in the other, 'twill be manifest, that the Semi-cycloid AMD is compos'd of an infinite Number of Circular Arches, which have for their Centers all the Points of Contact G successively, and are all describ'd by the same Point M.

3. If on O, the Center of the immovable Circle, the Concentrick Arch ME be described, then the Arches of the movable Circle, viz. MG, and EB will be equal, and also the Chords MG and EB, and the Angles OGM, OBE will be equal between themselves; for in the Triangles OKM, OKE, the three Sides of the one are equal to the three Sides of the other respectively; therefore the Angles MKO is EKO, and the Arch EE and the Chord EE and EE are EE and EE and EE are EE and EE and EE and EE are EE and EE are EE and EE and EE are EE and EE

Having drawn the Radii OG, Og, K, E, K, e, suppose OG or OB = b, KE = a, tis evident that the Angle EBe is = OBe - OBE (or OBE - OBe) = OGm - OGM (or OGM - OGm) = (having drawn GL, GV parallel to Cm, Og) LGM = OGV = GCH = GOg; therefore the Angle GCH is = Angle EBe + GOg. Now the Arches Gg, EE being equal, it is, GOg: EKe or 2EBF: KE (a): OG(b); and consequently the Angle GOg is $= \frac{2a}{b}EBF$, and GCH is = (EBF) + GOg $= \frac{b+2a}{b}EBF$; therefore GCH: EBF (:: AE: CG):: $\frac{b+2a}{b}$: I, and consequently the unknown Quantity CG is $= \frac{b}{b-2a}$ = BE: Which gives this

CONSTRUCTION.

Say, As $OA(b \pm 2a) : OA(b) : : BE$ or MG:GC; then the Point C will be in the Evoluta requir'd.

CONSECTARY I.

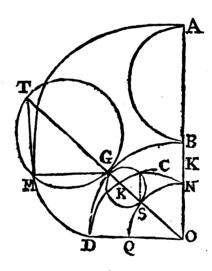
The Evoluta begins in the Point D, and touches the Base BGD in D; for the Chord GM (the Third Term in the Analogy) vanishes in that Point.

CONSECTART II.

The Evoluta D C N terminates in the Point N, so that then $O A : O B :: A B : B N :: O A <math>\pm A B (\pm O B) : O B + B N (= O N)$; that is, O A, O B, O N are continually proportional.

CONSECTARY III.

If the Arch of the Circle N S Q be described on the Center O, I say the Evoluta D C N may be describ'd by the Revolution of the movable Circle G C S (whose Diameter is G S = B N) about the immovable Circle N S Q; that is, the Evoluta D C N is a Semi-cycloid, similar to the given Semi-cycloid A M D (because the Diameter)



ters AB, B N of the movable Circles, are proportional to the Radii of the immovable Circles OB, ON; for AB:OB:BN:ON) and in an inverted Position, having its Vertex in D; for suppose the Diameters of the movable Circles to be in OT (drawn at pleasure from the Center O) it will pass through the Points of Contact S and G; then if we say, AB or TG:BN or GS:MG:GC, the Point C will be in the Evoluta, (by Construction) and in the Circumference of the Circle GCS (Prop. 31. Elem. 3. Prop. 6. Elem. 6.) because the Angle GMT being a Right Angle, the Angle GCS is also; and because MGT = CGS, therefore the Arch TM (GCC) GCC0 GCC1 GCC2 GCC3 is therefore the Arch GCC3 GCC3 GCC4 GCC5 GCC

CONSECTART IV.

Hence 'tis evident, that the Portion of the Curve of the Cycloid DC is = Right Line CM, and consequently that DC: Tang. GC::AB +BN:BN::OB+ON:ON; that is, the Sum (or Difference) of both Diameters (of the movable and immovable Circles) is to the Semi-diameter of the immovable Circle, as DC

And because it is AM: Tang. TM:: OA + OB: OB; therefore in the Vulgar Cycloid, AM: Tang. TM:: 2:1.

CONSECTARY V.

The Trapezium MGHm is $=\frac{1}{2}GH+\frac{1}{2}Mm$ $\times MG$; but CG ($=\frac{b}{b\pm2.4}MG$: CM($=\frac{2b\pm2.4}{b\pm2.4}MG$):: GH: $Mm=\frac{2b\pm2.4}{b}GH$; therefore (because) GH is =EF, and MG=EB) MGHm is $=\frac{3}{2}\frac{b\pm2.4}{b}\times EF\times EB$;

that is, the Trapezium MGHm: corresponding Triang. $EBF:: 3b \pm 2a:b$. And because the Proportion universally obtains, 'tis evident, that the Cycloidal Space MGBAM (See Fig. 2. in Page the last but one) (comprehended under the Right Lines MG, AB, the Base GB, and the Portion of the Curve AM) is to the corresponding Segment of the moveable Circle BEZAB, as $3b \pm 2a$ is to b; and the whole Cycloidal Space AMDBA is to the Area of the Semi-circle AEBA, as $3b \pm 2a$ is to b.

CONSECTARY VI.

If we imagine OB, the Radius of the immovable Circle, to become infinite, the Arch AGD will become a streight Line, and the Curve AMD will be the Vulgar Cycloid; and in this Case AB, the Diameter of the movable Circle, is = 0, in respect of that of the immoveable Circle: Whence, 1. because $b \pm 2a$ is = b, it is MG:GC:b:b:b; that is, MG is = GC, and consequently if BN be taken = AB, and NS be drawn parallel to BD, the Evoluta DCN will be generated by the Revolution of a Circle (on the Base NS) whose Diameter is = AN.

2. The Portion of the Cycloid AM, is to the corresponding Chord of the Circle AE:2b:b; this is evident from G. 4. of Hayes's Fluxions.

3. The Space MGBA is to the Segment BEZA C:3b:b; which is also evident from G. 5. of the same Book.

CONSECTARY VII.

The Length of the Semi-cycloidal Curve is proportional to the Rectangle B K O, if the Semi-diameter of the immovable Circle be the same. Let B A be the Diameter of one, and B A the Diameter of another movable Circle; and let O B be the Radius of the immoveable Circle common to both: Then, by §. 4.

OB: OA + OB:: AB: AMD;

And OB: Oa + OB :: aB: amd;

And by Proportion of OA + OB: Oa + OB: Equality and Div. BX AMD: AB × Amd

That is, 2 OK: 2 ok:: AB × AMD: AB × amd

Whence OK × AB: ok × AB:: AMD: Amd;

And dividing by 2, BKO: BkO:: AMD: amd.
Q. E. D.

CONSECTARY VIII.

Because the Arches GD, GM are always equal between themselves, it follows that the Angle DOG: Ang. GKM: GK: OG; therefore if the Point D (where the Cycloid begins) the Radii OG, GK, and the Point of Contact G be given, the Position of the Point M, which describes the Cycloid, is found by drawing the Ray KM; so that GK: GO:: DOG: GKM; and all the Points of the Curve AMD may be determin'd Geometrically, when the Proportion between the Radii OG, GK can be express'd in Numbers; and consequently, in that Case, this Cycloid is a Geometrical Curve, and the said Creloid is a Transcendent (or Mechanick) Curve, when the Relation of OG to OC cannot be express'd by any finite Number of Terms.

CONSECTARY IX.

If in Concentrick Spheres similar Cycloids be describ'd, their Perimeters will be proportional to the Semi-diameters of the said Spheres.

CONSECTARY X.

And because the Length of the Curve of the Cycloid AMD is proportional to the Rectangle BKO, 'tis plain, that in Vulgar Cycloids the Curve is proportional to the Diameter of the Generating Circle.

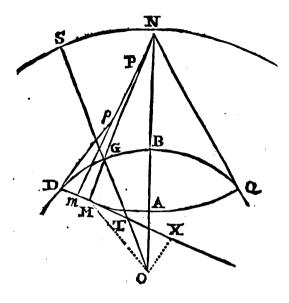
SCHOLIUM.

By help of such Principles as these, the Great Sir Isaac Newton has advanced several wonderful Conclusions concerning the more exast measuring of Time by Pendulums: As for Instance,

- 1. If within the Globe BGD the Cycloid DAQ be described, being bisected in A, and terminating in the Surface of the Globe in D and Q, and if OA be produced (bisecting DQ in B) unto N, so that OA, OB, ON := and the Globe NS be described on the Center O, and the Semicycloids ND, NQ be described within the said Globe; then a Periodulum suspended to the Point N, and equal to NA, will vibrate in the Cycloid DAQ, the same being described by the Evolution of the Cycloidal Checks ND, NQ. And thus a Pendulum may be made to vibrate in any such given Cycloid.
- 2. If the said Pendulum vibrate in the Cycloid DAQ by the sole Force of its own Gravity, and if the Force of Gravity in every Point of the Curve DAD be as its Distance from the Center O, then the Vibrations (equal or unequal) of the Pendulum, will be performed in equal times.

Let MT touch the Cycloid in M, and draw O X perpendicular to MX; then, because the Force

Force of Gravity is as O M, it may be resolved into the Parts O X, M X. Now tis evident, that the Force O X, being parallel to the Thread P M, has no other Effect but to diftend the same, and is



totally destroyed by its Resistance; therefore the Force MX only accelerates the Motion of the Pendulum M in the Cycloid, and the Acceleration of she Pendulum in the Cycloid is always proportional to this Accelerating Porce. Now the Triangles OXT, MGT are similar, and OT and GT are invariable Quantities; therefore MX is always proportional to MT, and MT is proportional to the Curve of the Cycloid MA: Therefore if two Pendulums NPM, NPm be demitted from M, m at the same Instant of Time, they they will be accelerated in proportion to the Arches M A, m A, they have to describe; and consequently the Portion of the Curve which they describe in the Beginning of their Motion, will be proportional to the Arches MA, mA; and the Portions yet to be described, or the accelerating Forces, will be proportional to the said Arches M A, m A. Whence its manifest, that the Portions to be describ'd, being always in the same Proportion of MA to mA, must vanish at the same time; that is, the Pendulums demitted from M, m, at the same Instant of Time, and descending in the Curve MA, mA, by the Force of their own Gravity, will arrive in the Point A together. And again, If we suppose the Pendules to ascend from Atowards 2, with the Velocities which they have acquir'd m A, they will then be retarded every where, whereby the same Forces which accelerated their Motions before, and consequently the Velocities of the Pendulum's ascending and descending in the same Arches, will be the same, and the Arches themselves will be describ'd in the same time; whence it appears, that the whole Vibrations, as well as the Semi-vibrations, will always be scochronal.

And if O, the Center of Attraction, be suppoled at an infinite Distance from B, then the Curve DA 2 (in which the Pendulum vibrates) will be a Vulgar Cycloid, and the Force of Grawill be a valgar Cycloid, and the Force of Gravity will always be the same in all Places of the Curve. And the Vibrations in this also will be Rochronal, for DB \mathcal{Q} will become a streight Line, and GT and MO will be parallel to BA; whence, if MO be a determinate Quantity, and Vol. II.

OG g, their Sum will be equal to two Right Angles) = GKg + GOg.

Now if we suppose OG = b, KG = a, GM, or Gm = r, and GI or Ig = q, then it will be, i. OG : GK :: GKg : GOg, and OG(b) : OG + GK(= OK = a + b) :: GKg : OG + GK = a + b)

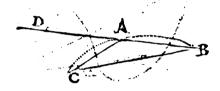
represent the Force of Gravity, then M X, or MT, or MA, will represent the accelerating Force in the Cycloid, &c. Ergo,

The same Excellent Person has enrich'd this Theo. ry with many more sublime Discoveries, which, for Brevity's sake, I omit; this being sufficient to give the unacquainted Reader a Taste of the Usefulness of the Doctrine concerning the Rectification of the Curves.

LEMMA.

In every Triangle BAC, if the Angles ABC, ACB, and CAD the Complement of the Obtuse Angles CAB to two Right Angles, be infinitely little; I say, they are proportional to their opposite Sides A C, A B, B C.

For if a Circle be circumscrib'd about the Triangle ABC, the Arches AC, AB, BAC, which measure double the said Angles, will be infinitely little also, and consequently they will be equal to heir Chords or Subtendents.



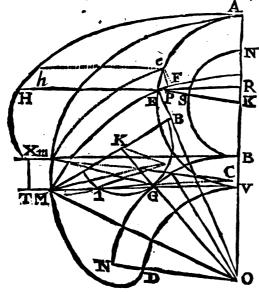
And if the Sides AC, AB, BC of the Triangle ABC be finite Quantities, 'tis plain that then the circumscrib'd Circle must be infinitely great, that so the Arches AB, AC, may be infinitely little in respect of the whole Circumserence.

PROP. XIII.

If A M D be a Semi-cycloid describ'd by the Semi-circle BSN, revolving on the immovable Arch BG N, so that the Evoluta or Arches BG, BG be always equal to one another; and if A, the Point which describes the Curve, be in the Diameter B N, within or without the Periphery of the movable Circle: 'The requir'd to investigate the Value of the Ray of the Evoluta M C.

Imagine another Perpendicular mg infinitely near MG, intersecting MG, produced in C, the Point requir'd. Draw the Right Line Gm, and Foint required. Draw the Right Line G m, and take G g on the movable Circle = G g on the immovable Circle, (fee the following Fig.) and draw the Lines M g, I g, K g, O g. Now if we consider the little Arches G g, G g is perpendicular to the Radii K g, O g, then 'tis manifest that the little Arch G g of the movable Circle falling the Arch G g of the immovable Circle, the Point M will fall on m, so that the Triangle C M g will exactly cover the Triangle C M g: Whence it is evident, that the Angle M G m is = g G git is evident, that the Angle M G m is = g G g, = (because, adding to both the same Angles K G g. OGg, their Sum will be equal to two Right

GKg+GOg or gGg or MGm= G Kg. 2. Ig: MI:: GMg: MGI, and by Composition Ig + MI or MG(r): Ig(q):: GMg + MgI or $GIg = \frac{1}{3}GKg: GMg$ or $Gmg = \frac{q}{2r} GKg$. 3. M C m or M G m, M G m $-Gmg\left(\frac{2ar+2br-bq}{2br}GKg\right):Gmg$



$$\left(\frac{q}{2r}GKg\right)::Gm(r):GC:=\frac{bqr}{2ar+2br-bq},$$
and consequently the Ray of the Evoluta MC is

$$=\frac{2 \operatorname{arr} + 2 \operatorname{brr}}{2 \operatorname{ar} + 2 \operatorname{br} - \operatorname{b} \operatorname{q}}.$$

And if we suppose O G (b) the Radius of the immovable Circle, to become infinite, the Circumference BGN will become a streight Line, and the Terms 2 arrand 2 ar will vanish in respect of the others, and the Value of the Ray

of the Evoluta MC will be
$$=\frac{2brr}{2br-bq} = \frac{2rr}{2r-q}$$

CONSECTART

Hence to find the Area of the Cycloidal Space MCB, the Quadrature of the Circle being supposed, because Sectors of Circles are in a Ratio compounded of the Duplicate Ratio of the Radii and the simple Ratio of their included Angles;

it is, Angle G
$$Mg\left(\frac{g}{2r}GKg\right)$$
: Angle MGm

 $\left(\frac{a+b}{b} G Kg\right)$: the little Triangle (or Sector) MGg (whose Base is Gg m the movable Circle) : to the little Triangle or Sector G Mm. Whence

the Sector GM m is
$$=\frac{2r}{q} \times \frac{a+b}{b} M G g =$$

(inpposing
$$MI = s$$
, and consequently $r = s + n$) = $\frac{2a + 2b}{b}MGg + \frac{2as + 2bs}{bq}MGg$.

the Ratio of the Angle G Kg to the Angle G Mg. consequently the little Triangle MGg is $=\frac{r q}{2 a a}$ KGg, and substituting this Value in place of the Triangle M Gg in $\frac{2as+2b}{bq} \times M$ Gg, we shall have the Sector G M $m = \frac{2a+2b}{b} M$ Gg $+\frac{a+b\times sr}{aab}$ KGg; but by the Property of the Circle, $GM \times MI(sr) = BM \times MN =$ (supposing K N := c) c = c - a a, which is an invariable Quantity, and is always the same in whatfoever Point of the Curve the describing Point M be found; whence G M m + M G g or m G g, that is, the Trapezium $GMmg = \frac{2 + 3b}{L}$ $M G g + \frac{a + b \times c c - a a}{a \cdot b} KGg$. Now because G Mmg is the Fluxion of the Cycloidal Space MGB A and MGg, that of the Circular Space MGB (comprehended between the Right Lines MB, MG, and the Arch BG) and KGg, that of the Sector K B G; it is manifest that the Cycloidal Space M G B A is $= \frac{2a + 3b}{b} M G B$ $+\frac{a+b\times c\,c-a\,a}{}\times KGB.$ Q.E.I.

LEMMA II.

The same things being supposed, if on the Center K, with the Radius KA, the Semi-circle AEV be described; and if on the Center O, with any Radius between O V and O A, the Arch E M be describ'd, and the Radius K S E be drawn; I Say, the Arch E M: Arch S N:: O E: O B.

Suppose the movable Circle BS N to come into the Position BG N, then the Point A which describes the Curve will be in M. Connect the Centers of the Generating Circles with the Line OK, which will pass through the Point of Contact G; then 'tis evident that the Triangle MOK' and EOK are equal and fimilar, because the Sides of one are equal to the respective Sides of the other; therefore the Angles MKO, EOK are equal, and the Arches that measure those Angles, viz. G N, BS, and their Complements to two Right Angles BG, SN, are also equal. And because the Angles MOK and EOK are equal, therefore the Angle MOE is = Angle GOB, and Arch EM: Arch GB:: OE, the Radius of that: OB the Radius of this. But it has been demonstrated that the inferior Arch G B == superior Arch G B is = S N; therefore the Arch E M : Arch S N :: O E : B B. Q. E. D.

CONSECTARY.

If the Radius OB be supposed infinite, then tis evident that the Right Lines OB and OE will be Parallels, and the Concentrick Arches VD, Now the little Triangle or Sector KGg is to the little Triangle MGg, in a Ratio compounded of the Square of KG to the Square of MG, and MG, and MG, and MG, and MG are MG and MG and MG and MG and MG and MG and MG and

Whence the Arch EM: EH :: | are equal. 0 E : 0 B.

SCHOLIUM.

The Semi-cycloid A H T, into which the other Semi-cycloid AMD degenerates, when the Radius O B is infinite, is the same with that generated by the Revolution of the Semi-circle BSN on the Right Line BX, the describing Point A being in the Diameter BN produc'd.

PROP. XIV.

The same things being supposed, let it be required to investigate the Area of the Cycloidal Space AEM, comprehended under the Arches A E, E M, and the Portion of the Cycloid A M.

Imagine another Concentrick Arch ME infinitely near to the Arch E M, and eb parallel and infinitely near to EH, and the Lines EF and EP perpendicular to the Arch ME and the Right Line EH (produced if need be); then are the Angles F E e, O E K equal, because each added to the Angle K E F makes a Right Angle, and the Angle PE e is = Complement of OKE to Two Right Angles, because P E e + e E K + KER is = to Two Right Angles = KER + $E \times R + E \times R$; therefore the Sine of the Angle F E e is to the Sine of the Angle P E e, as the Sine of the Angle $O \times E$: That is,

Fe: Pe:: OK: OE;

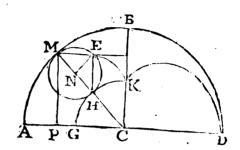
And by the Corol. EM:EH::OE:OB.

Therefore FexEM: PexEH::OK:OB.

And because the infinitely little Spaces EMme, EHbe are equal to the Products or Rectangles Fe X E M, Pe X E H respectively, and the said

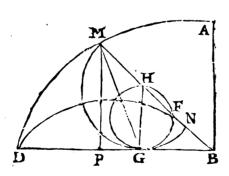
one another, that is, the Space E Mme is always to the corresponding Space EHbe, as OK is to OB; 'tis plain that the Sum of all the EMme is to the Sum of all the EH be, that is, the Space A ME is to the Space A E H, as O K is to OB.

I shall only add further, as to this Figure of the Cycloid; That, if a Caustick Curve, as AFK, were to be drawn to a Semi-circle, as AMD, whose Diameter is AD, and its Centre C: And when the Rays of Incidence, as PM, are supposed to be perpendicular to the Diameter AD:



Then the Caustick AFK will be a Semi-Cycloid; which will be described by the Revolu-tion of the Little Circle MFH on the Periphery, or the Base KHG. For the Circle MFH is described on half MC, as on a Diameter; and the Angle C M F is equal to C M P, which is equal to HC K: And confequently the Angle HNF is equal to twice HC K. Therefore the Arch HF is equal to the Arch HK; and the Curve KFA must be a Semi-cycloid, whose Beginning is in K, and its Vertex in A.

Let the Vulgar Semi-cycloid AMD be given, and described by the Revolution of the Semicircle NGM on the Right Line BD: And let the Rays of Incidence PM, be parallel to the Axis AB: 'Tis required to draw a Caustick by Re-Rectangles are always in the same Proportion to flexion to the said Semi-cycloid A MD.



Because MG is $=\frac{\pi}{2}$ the Ray of the Evoluta, and GP perpendicular to PM: Therefore MF $=\frac{1}{2}a=PM$. Whence if GF be drawn perpendicular to the reflected Ray MF, the Point F will be in the Curve required.

If the Rays HM, HG, be drawn from H, the Center of the generating Circle, to the de-scribing Point M, and the Point of Contact G; 'tis evident that HG will be perpendicular to the Caustick DFB is a Cycloid, and describ'd by BD; and that the Angle GMH = MGH the Revolution of the Circle GFH on the Right = GMP; whence it appears, that the reflected Line BD. Q. E. D.

Ray MF passes through the Centre H. Now the Circle whose Diameter is G H passes also through the Point F; because G F H is a Right-Angle: And therefore the Arches G N, and half G F, which measure the Angle G HN, are proportionable to the Diameters MN, GH, of their respective Circles: And consequently the Arch G F = Arch GN = GB. Whence it is manifest, that

Vol. II.

Dd 2 COROL-

DAN

DEA

AKIR, by the Statute of 23 H. 3. de com-positione Ponderum, &c. was a Number of Ten Hides, as a Last was of 20 Dakirs: But fince, by 1 Jac. 33. 2 Last of Hides is 12

DAMNUM, did formerly fignifie the Bounds or Limits of a Man's private Property or Juris-diction; as is plain by Bratton, lib. 2. de Coron. c. 37. And perhaps our Word Dam, for a Boundary or Confinement came from hence.

DAMPS, in Mines, are noxious Exhalations, which in some Mines have proved very suffocating, and otherwise fatal to the Workmen. They reckon sour Sorts of Damps.

The First is the most ordinary; they know when 'tis coming, by the Flame of their Candles becoming orbicular, and by the Flames lessening by degrees, 'till at last it quite go out; as also by their Shortness and Difficulty of Breathing. Those that escape Swooning, seldom suffer any great Harm by it; but such as swoon away, tho' they mils of downright Suffocation, are on their first Recovery tormented with very violent Convultions. Their Way of Cure is to lay the Person down on the Earth in a prone Posture, with a Hole dug in the Ground under his Mouth; if this fail, they fill him full of good Ale; and

if that won't do, they conclude him desperate.

2. The Pease-Bloom Damp, which is so called from its Smell; this Damp they say always comes in the Summer Time, and it hath not been known to be Moreal. The Miners in the Peake of Derby fancy it arises there from the Multitude of Red Trefoil Flowers, called by them Hony-Juckles, with which the Lime-stone Meadows of the Peake do much abound. Perhaps the Smell of this gives

timely Notice to get out of the Way.
3. The Third is the most Pestilential and the most Strange of all, if what they say of it be true: They which pretend to have seen it, (for its visible they say) do thus describe it: In the highest Part of the Roof of those Passages in a Mine which branch out from the main Grove, they see a round Thing hanging about as big as a Foot-ball, covered with a Skin of the Thickness and Colour of a Cobweb: If this Bagg by a Splinter, or any other Accident, become broken, the Damp immediately flyes out and suffocates all the Company: The Workmen, by Help of a Stick and a long Rope, have a Way of breaking this at a Distance; and when they have done this, they purific the Place well with Fire: And they will have it, that it gathers from the Steam of their Bodies and Candles, ascends up into the highest Part of the Vault, and there condenses, and in Time bath a Film grows over it, and then corrupts and becomes Pestilential.

The Fourth is the Fulminating or Fire-Damp, whose Vapour being touch'd by the Flame of the Candles, presently takes fire, and hath all the Effects of Lightning or fired Gunpowder. These are found frequently in the Coal-Mines, and sometimes, the rarely, in the Lead ones.

DANEGELT, or Geld, was a Tribute which the Danes, on their frequent incursions imposed upon the English as the Arbitrary Terms of Peace and Departure. It was first imposed as a continual yearly Tax upon the whole Nation under so there are Two Ways of Creating these Deans.

K. Ethelred, A. D. 991. Alfred and Ingulgh report, that King Edward the Confessor remitted and abrogated this Tax: But William the Conqueror, tho' he would not re-induce the Annual Payment, yer he ordered the raising of it, as often as the Necessities of Invasion or Expedition did require: And it was severely exacted and augmented by William Rufus. In the Reign of Hen. L it was computed amongst the King's standing Revenues: But K. Stephen, upon his Coronation-Day, promised that Danegels should be for ever remitted; from which Time some date the Expiration of this Tax. But it seems rather to have continued upon extraordinary Occasions, 'till it was abrogated by Time; or swallowed in Tillage and Parliamentary Impositions. The Laws of Edward the Consessor, c. 11. rate this Tax at 12 d. on even ry Hide: Henry Huns computes it at 2 s. on each Hide; and John Brampton at 3 d. on a Bovate or Oxgange. And no doubt it varied according to the different Exigencies on which it was levied. Dr. Kennet's Gloffary.

DANGER, Dangerium, in some Places called Lief-Silver and Lef-Silver, was formerly a Payment of Money made by the Forest Tenants to their Lords, that they might have Leave to plow and fow in Time of Pannage or Mast-seeding.

DARREINE, in the Common Law, seems to be a Corruption from the French Dernier, i. e.

Last; for 'tis now used in that Sense, in DARREINE, Continuance: And DARREINE, Presentment.

DATIRE Tutelage, is a Term in the Civil Law, for such a Tutelage of a Minor as is appointed by the Magistrate either Ex Officio, or by Petition, when a Guardian by Will, or by Law, is not al.

ready provided.

DAY, in our Common Law, is sometimes used for the Day of Appearance in Court, either Originally or on Affignation; and sometimes for

the Return of Writs. Thus

DAYES in Bank, are Days set down by Statute or Order of Court, when Writs shall be return'd, or when the Party shall appear on the Service of the Writ. They say also, That if a Person be dismifted without Day, he is finally discharged the Court.

DAYWERC of Land, was anciently as much could be plowed up in one Day's Work or as could be plowed up in one Day's Work or Journey, as the Farmers in some Places still

call it.

DAZE, is one of the Weeds, as they call them, which are found in our Tin Mines; 'tis a kind of glittering Stone enduring the Fire; and is of different Colours, as White, Black and Yellow. It seems to be a Spar.

DEAN. Originally the Decanus, was so called, because he was an Ecclesiastical Magistrate, which had Jurisdiction and Power over Ten Canons at least. He is next under the Bishop, and ordinarily Chief of the Chapter in a Cathedral Church.

As there are Two Foundations of Cathedral Churches, the Old and the New, (the New being those which Henry the Eighth founded on the Suppression of the Abbots and Priors, and turned their Convents into Dean and Chapter;) For those of the Old Foundation, are brought to their Dignity much like a Bishop: The Prince first sending out his Conge d' Estire to the Chapter; the Chapter there chusing, the King yielding his Royal Assent, and the Bishop confirming him, and giving his Mandate to install him.

Those of the New Foundation are installed by a shorter Courie; only by the King's Letters Patent, without either Election or Confirmation.

The Word Dean is also apply'd to divers that are the Chief of some peculiar Churches or Chapels; as Dean of the King's Chapel, of Paul's, of Westminster, of the Arches, of Battel, of Boking, &c.

DEAN Rural, or Urban, call'd Decanus Christianitatis, was formerly an Ecclesiastical Person, who had the District of ten Churches either in the Country or City, within which he exercised a useful Jurisdiction. These Rural Deans were sometimes called Archipresbyteri, and at first were both in Order and Authority above the Archdeacons. Theywere elected by the Clergy, and bytheir Votes again deposed; but afterwards they were appointed and remov'd at the Discretion of the Bishop: And hence they were called Decani Temporarii, to distinguish them from the Cathedral Deans, who were called Decani perpetui.

DEADS, in the Tin-Miners Language, are such Parcels of common loose Mould or Earth lying above the Shelf, as usually contain the Shoad, which they find when they are training a Load. They call also that part of the Shelf which contains no Oar or Metal, but encloseth the Load as a Wall between two Rocks, by this Name. See Tin.

In the Mendip Lead-Mines; when a Vein of Oar breaks off abruptly in an Earth, they call it a Deading-Bed; and Earth without an Oar they call Dead Earth.

DEAD Ropes in a Ship, are such as are not running, i. e. which do not run in any Block.

DECIMAL Scales, (Vide Leybourne's Curfu, p. 1.74.) are in the General any Scales that are divided Decimally. But for the expediting of Decimal Arithmetick, there are in use some Scales of Money, Weights, Measures, which are made from Tables bearing those Names, and serve readily, by Inspection only, to shew you the Decimal Fraction which properly belongs to any part of Money, Weight, or Measure, &c. These Scales are usually placed on a square Ruler, and are about Nine in Number:

1. One of English Coin, 2 Shillings being the

Integer. 2. Troy Weight, 2 Peny-weight being the Integer.

3. Averdupois Great Weight, 28 lb. being the Integer.

4. Averdupois Little Weight, 16 og or 1 lb. being the Integer.

5. Liquid Measure, 36 Gallons being the In-

6. Dry Measure, 8 Bushels being the Integer. - 7. Long Measure, one Ell or Yard being the

Integer. 8. Foot Measure, where 12 Inches is the Integer. And,

2. 9. Time and Motion, where one Hour, Mi-

nute, &c. may be the Integer.

To every one of these there is joined another Division, or part of a Division, answers to it in sured on the Chords.

the adjacent Decimal Scale: And consequently it will very readily shew you what Decimal Fraction answers to any Part of Money, Weight, Time, Measure, &c. as well as it will give the Value of any Decimal Fraction in the Corre-fponding Parts of any Integer. Thus if in the Money Scale you take out any Part of a Shillings, as suppose 8 Pence 3 Farthings, you will find the Corresponding Decimal to be .364. Or if in the Decimal Scale contiguous to it, you would know what Part of 2 Shillings answers to this Decimal Fraction .771, you will find the Corresponding Point in the Money Scale to be 18 Pence 2 Farings. And so for the rest.

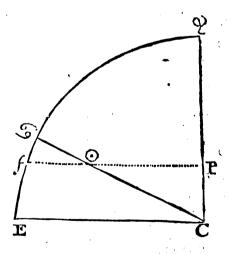
DECINERS, or Decenniers, or Definers. De-

cennarii, in our Old Law, where such as had the Jurisdiction over 10 Friburghs for keeping the King's Peace; and the Limits or Compass of their Jurisdiction was called a Decenna, saith Braction, Lib. 3. Tract. 2. Cap. 15. In the Saxons Times, these teems to have had large Authority, taking Cognisance of Causes within their Circuit, and redreffing Wrongs by way of Judgment. In latter Times, the Word came to fignifie such an one, as by Oath of Loyalty to his Prince was settled in the Combination or Society of such a Dozein; and a Dozein seems then to be extended as iar as a Leet, because in Leets only this Oath is administred by the Steward, and taken by all from 12 Years old and upward that dwell with-

Leets. DECK Nails, are such as are used for fastening Decks of Ships, doubling of Shipping, and for Floors laid with Planks: They are of two Sorts, Dye-headed and Clasp-headed. Their Sizes are from 4 to 9 Inches.

in the Leet. Now there are no Decenniers, but

DECLINATION of the Sun. To find it readily by Projection of Part of the Analemma; having his Place in the Ecliptic, and his greatost



Declination: Draw E C for the Equinoctial, and P C for the Azimuth of East and West, and with 60 Deg. of the Chords sweep the Ark EP. Set 23 Deg. 30 Min. the Sun's greatest Declination, from E to 5, and draw 5 C for one Quadrant of the Ecliptic. Set the Sine of the Sun's Longitude, or Distance from the next Equinoctial Point from C to in the Ecliptic C 5, being, Decimal Scale, divided into 100 or 1000 equal suppose. 42 Deg. then will the nearest Distance from © to EC, be the Sine of the Sun's present any of the Nine Scales, you may easily see what

DECRE-

tion that the Emperor pronounces, upon hearing a particular Cause between Plaintiff and Defendant.

DECRETALS, are a Volume of the Canon Law, containing the Decree of fundry Popes; or else a Digest of the Canons of all the Councils pertaining to one Matter and under one Head.

DEDI, is a Warranty in Law to the Feoffee and his Heirs; as if it be said in a Feofiment, A. B. has given and granted, &c. they call it a War-

ranty

DEEMSTERS, are a kind of Judges in the Isle of Man, chosen from among and by themselves, who without Process, Writing, or Charge, decide all Controversies there.

DEFAULT, is a Neglect or Omission of Appearance before a Court of Justice, for which Judgment may be given against the Defaulter.

DEFEND, in our Ancient Laws and Statutes, fignified to prohibit and forbid: Leg. Edw. Confess. c. 37. and 5 R. 2. c. 7. And in this Sense Chaucer allo ules it.

DEFERENTIA Vasa. See Vasa Deferentia. DEFICIENT Hyperbola, is a Curve of that Name, having but one Asymptote, and only two Hyperbolick Legs running out infinitely towards the Side of the Asymptote, but contrary Ways.

ays. See Curves.
DEFLECTION of the Rayes of Light, is a Property which Dr. Hook observed 1674, and read an Account of it before the Royal Society, March 18. the same Year. He saith, he found it different both from Reflection and Refraction, and that it was made towards the Surface of the opacous Body perpendicularly. This is the same Property which Sir Isaac Newton calls Inflection; of which, see an Account under that Word.

DEFORCEMENT, in the Law Sense, is with-holding Lands or Tenements by force from Wherefore a the Right Owner.

DEFORCEOR, is he that overcometh and

cafteth a Person out by Force.

DEFORCIATIO, is a Distraint or Seizure of Goods for Satisfaction of a Lawful Debt. In Alfizes and Trials formerly, the Claimer or Plaintiff was called Querens, and the Possessor or Defendant was called Deforcians: Tho' indeed the Original Sense of the Verb Deforciare is to keep Possession ones self, or to turn another out of his by Violence and Force.

DEGRADING, or, as it has sometimes been writter, Difgrading, is the Punishment of a Clerk, that being deliver'd to his Ordinary, can't purge himself of the Offence whereof he was convicted by the Jury; and it is the Privation of him from those Holy Orders which he had, as of Deacon, Priest, &c.

Formerly also Knights have been degraded.

Scc 18 E. 2.

In the Common Law also there are two Sorts of Degrading; one Summars, by Word only; the other Solemn, by divesting the Party degraded of those Ornaments and Rites, which are the Enfigns of his Order and Degree. See. 13 Car. 2. c. 1

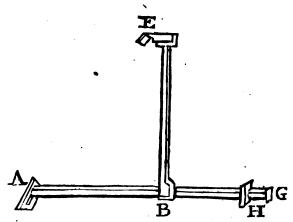
DEGREE of a great Circle, on the Surface of The Earth (supposing it be of a Spherical Figure) is 69 English Miles and 288 Yards; as appears by the Concurrent Mensurations, nearly, of Mr. Norwood and the French Mathematicians. The French make a Degree 365184 Feet English,

DECREE, in the Civil Law, is a Determina- and Mr. Norwood 367196, the Difference being only 597 Yards, or 1791 Feet: And from hence, the Circumference of the Earth will be 24899 English Miles.

DÉLEGATION, in the Civil Law is a kind of Novation, whereby a Debtor appoints one that is Debtor to him, to answer a Creditor in his Place

DEMANDANT, is the Plantiff in a real Action, and so called because he demandeth Lands, &c.

DEMICROSS, is an Instrument, used by the Dutch to take the Sun's Altitude, or that of a Star at Sea; but 'tis not used by us, but the Cross-staff or Fore-staff supplies its Place. The Demicross is of this Figure;



The Staff AG is graduated easily, being only a Line of whole Tangents, whose Radius is EB, the Length of the Cross-piece or Transum: It hath three Vanes; a Horizon-Vane, as A; a Sight-Vane, as H; and the Shade-Vane, as E.
When the Vanes are on the Staff and Cross.

piece, to take the Sun's Altitude, hold the Instrument with the Transum as upright as you can, and looking through the Sight-Vane, as H, look for the Horizon through the Slit in the Horizon-Vane, and then slide the Cros-piece or Transum to and fro, 'till you cause the Shade of the Vane at E to sall at the same Time upon the Slit of the Horizon-Vane also at A; then are the Degrees cut on the Staff by the Edge of the Croispiece, the Sun's Altitude required. But to take the Height of a Star; you must remove the Horizon-Vane A, and put it on the End G, and transfer the Sight-Vane H to A; then holding up the Instrument upright, as before, looking through the Sight-Vane, see for the Horizon through the Horizon-Vane, and for the Star by the Shade-Vane, sliding the Transum to and fro, 'till the Horizon and Star are both seen by their respective Vanes, and then the Transum will cut the Degrees of the Star's Altitude on the Staff, allowing about & or 10 Minutes for your Height above the Level of the Water, as must be done in all such Cases.

DENARII de Caritate, were the Pentecostals or Whitlun-Farthings, being anciently customary Oblations made to the Cathedral Church at the Time of Pentecost, when the Parish Priests and their People used to go visit the Mother Church. In process of Time this voluntary Oblation came to be claimed as a settled Due, and was charged on the Parish Priest, and it is now annually paid to the Bishop in some Dioceses.

DENARIUS. See Penny.

DE deoneranda pro Rata Portionis, is a Writ that lieth where one is distrained for a Rent that ought to be paid by others proportionably with him.

DEPARTURE, in Navigation, is the Easting or Westing of a Ship with respect to the Meridian it departed or fail'd from. Or 'tis the difference of Longitude (either East or West) between the present Meridian the Ship is under, and that where the last Reckoning or Observation was made: This Departure, any where but under the Equator, must be accounted according to the Number of Miles in a Degree proper to the Parallel the Shipis under. See Mercator's Sailing.

DEPOSITUM, in the Civil Law, is a Contract of the Law of Nations, by which a Thing is committed to the Custody of one to be kept,

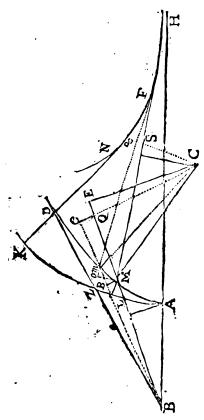
without any Reward, on Condition to be returned truly again on Demand.

DERELICKS, in the Civil Law, are such as are wilfully thrown away and abandoned by

the Owners.

DESIGN, in Painting or Sculpture, is the Expression of the Images or Ideas that the Painter hath conceiv'd in his Mind on the Picture, &c. and it is Good, when the Author has a good Gusto and correct Judgment: This is the Basis and Foundation of all other Parts, and may be compared to the Stile of a correct Writer. But the Painters call Designs chiefly such Draughts as they usually express on Paper, in order to the Performance of some considerable Piece of Work: A feint impersect Defign is usually call'd a Sketch.

DIACAUSTICK Curve, or the Caustick by Refraction. If you imagine an infinite Number of Rayes, BA, BM, BD, &c. issuing from the



same Luninary Point B, to be resracted from or to the Perpendicular M C, at the Curve A M D; and fo that C E, the Sines of the Angles of Incidence C M E, be always to C G, the Sines of the refracted Angles C M G, in a given

Ratio; then the Curve Line HFN, which touches all the refracted Rays, is called the Dias caustick, or Caustick by Refraction. How to find these Causticks by Refraction to all Sorts of Curves. see Hayer's Fluxions, p. 243, &c. where also the Doctrine of the Foci of Spherical Glasses of all Sorts, exposed either to diverging, converging, or Parallel Rayes, is deduced from the Principles of the Caustick Curves. Vid. p. 249. Of the Relation of this Diacaustick Curve to the Evoluta, see a Discourse of Mr. James Barnoulli in the

Leipfick Acts of May, 1693.
DIACENTROS, is a Word used by Kepler, to fignify the shortest Diameter of the Elliptical

Orbit of any Planet.
DIAGLYPHICE, is the Art of Cutting, or otherwise making hollow or concave Figures in Metals; such as Seals and Intaglias's

DIALLING. Some Authors on this Subject are, J. Bapt. Benedicti, de Re Gnomonica.

Kercheri, Ars magna Lucis & Umbra. Rom. 1646.

Marignani Perspectiva Horaria.

Leybourn's Dialling.

Colling's Geometrical Dialling. Cir. Clavii Gnomonices, Libri 8. Fol. Voellus de Sciotericis Horologiis.

Castii Horologiographia Plana. Hollwell's Dialling. 4to.

Fr. Comondini de Horologio Descriptione. 4to. Sargue's Universal Way of Dialling. Fester's Elliptical Horologiography.

Fale's Art of Dialling.

Wells's Art of Shadows. 8ve.

DIALLING in a Mine, which they call also plumming, is using a Compass (which they call a Dial) and a long Line, to know which Way the Load or Vein of Oar inclines, or where to link an Airshafe, or to bring an Adit to a defired Place. See the Manner of it under the Word Tin.

DIALLING Lines or Scales, are such graduated Lines as being placed on Rulers or the Edges of Quadrants, and other such like Instruments, are defigned to expedite the Constitution of all Kind of Dials.

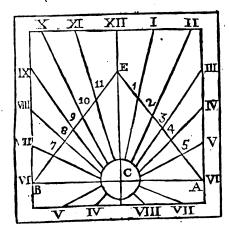
These Lines are,

1. A Scale of fix Hours; which is only a dou-ble Tangent, or 2 Lines of Tangents, each of 45 Deg. set together in the Middle, and equal to the whole Line of Sines, with the Declinations set against the Meridian Altitudes, in the Latitude of London, suppose, or whatever Place else it is made for. The Radius of which Line of Sines, is equal to the Dialling Scale of fix Hours.

2. A Line of Latitudes; which is fitted to the Hour Scale, and is made by this Canon: As Rad.: to the Chord of 90 Deg. :: So are the Tangents of each respective Degree of the Line of Latitudes . to the Tangents of other Aiks. And then the natural Sines of those Arks are the Numbers, which taken from a Diagonal Scale of equal Parts, shall graduate the Divisions of the Line of Latitudes

to any Radius.

The Line of Hours and Latitudes is general for pricking down all Dials with Centres: As suppose. 1. an Horizontal Dial for the Latitude of London, 51 Deg. 30 Min. Draw C E for the Hour Line of 12, and cross it at Right Angles with AB. Then out of the Scales of Latitudes fer off C Band C A each equal to 51 Deg. 30 Min. or the Stile's Height. Then take the whole Scale of fix Hours, and let it from A to E, and from B to E, dividing those two Lines A E and BE with the CompaiCompasses accordingly; as you see in the Figure :



Then Lines drawn from C, the Center of the Dial, through those Points 1, 2, 3, 4, 5, and 11, 10, 9, 8, 7, &c. shall be the true Hour Lines. And this is a very ready and easy way to describe the Hour Lines on any Plane.

See Collin's Sector on a Quadrant.

The other Scales are particular, and give the several Requisites for all upright declining Dials by Inspection.

They are these:

3. A Line of Chords.

4. A Line for the Substile's Distance from the Meridian.

5. A Line for the Stile's Height.

6. A Line of the Angle of 12 and 6.
7. A Line of Inclination of Meridians.
When these are placed all together on a Ruler

in order as they should be;
Count the Plane's Declination in the Line of
Chords, and then a Square laid over it will inzersect all the other Lines in their proper Points : Or you may open the Compasses to the Planes Declivation in the Chords, and then that Distance will find all the rest in the other Scales. Suppose a Plane decline 35 Deg. from the Meridian, then all the Requilites by these Scales will be

Journa thus.		Min.
The Substile's Distance from the Meridian	24	30
The Stile's Height	30	38
The Inclination of Meridians	41.	.49
The Angle of 12 and 6	84	,10

All which previous Requisites being found, the Dial may be drawn easily and readily by applying in the Hour Scale by the Help of the Line of Latitudes and the Substilar Line, as Collins shows how to do in his Sector on a Quadrant, p. 268. or by any other Method of describing Hour Lines on a given Plane.

DIAMETER of Gravity, in any Surface, Body, or Solid, is that Right Line in which the Center

of Gravity is placed.
DIHELIOS, in the Elliptical Astronomy, is that Ordinate of the Ellipsis which passes through that Focus in which the Sun is supposed to be

placed. Kepler.
DILAPIDATION, is a wasteful destroying, or letting of Buildings run to Ruin and Decay for want of Reparation, 13 Eliz. c. 13. And the Vol. II.

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shall be employ'd in the Repair of the same Houses.

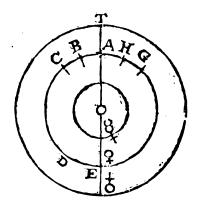
DILVING, is a Word used in the dressing of Tin Oar; and means, taking the Forehead of what is in the 2d Buddle after the 2d Trambling, and putting it into a Canvals Sieve, to shake it lustily about in a large Tub of Water, so that the Filth goes over the Rim of the Sieve, leaving the Black Tin behind. See Tin, Buddle, and Trambling

DIAZEUTICK Tone, in the Antient Greek Musick, was that which disjoin'd two Fourths, one on each Side of it, and which being join'd to either, made a Fifth. This was in their Musick that from Mese to Paramese; that is, in our Musick, from A to B, supposing Mi to stand in Bfabmi, which is accounted its natural Polition. They allowed to this Diazeutick Tone, which is our La, Mi, the Proportion of 9, to 3, as being the unalterable Difference of Diapente and Diatessoron, or of the Fifth and Fourth.

DICASTRICK Muscles, sometimes called Bia

ventres, are such as have a double Belly.
DIMISSORY Letters. When a Candidate for Holy Orders hath a Title in one Diocese, and is to be ordain'd in another, the proper Diocesan gives his Letters Dimissory directed to some other Bishop, giving Leave that the Bearer may be ordain'd to such a Cure within bis District.

DIRECT Motion of a Planet. To any Eye placed at the Earth's Surface, Venus and Mercury, which move round the Sun in lesser Orbits than it doth, will sometimes appear direct, and sometimes Stationary and Retrograde.



For let the Earth be at T, moving round the Sun in the Orbit T & from West to East. Let ACDF be the Orbit of & revolving the same Way, but performing its Revolution in a shorter Time. It will then be plain, that when Venus is in that Part of her Orbit expressed in the Figure by DEF, and which is most remote from the Earth, supposed to be in T, I say, Venus will then appear to move forward directly, according to the Order of Signs, or in Consequentia, as the Aftronomers speak, and so is said to be Direst. And when she comes to such a Position, in respect of the Sun and Earth, as to be in G; then while she moves from G to H, she will feem to move with equal Celerity with the Sun, for then she tends directly towards the Earth: Nor can the appear to have any other Motion, than as if her Orbit were carry'd by the Sun mo-ving towards the East. Therefore now the will Money recover'd for Dilapidations, by 14 Eliz.11. appear to move flower than before, but still she

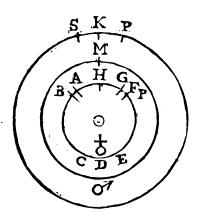
will be direct. But when the gets beyond H towards A, and then to B, the in reality moving swifter than the Earth, (because nearer to the Sun) she will pass by between the Earth and the Sun; and therefore to an Eye placed at the Earth must appear to change her Place among the fix'd Stars, but yet contrary to the usual Order of the Signs: That is, she will appear to move in Antecedentia, and so is said to be Retrograde; tho', if viewed from the Sun, the would always appear to move Direct. And in the Part of the Orbit about H, she will appear Stationary, as they call it, because then Right Lines drawn from the Sun to the Earth and Her, will appear to be parallel to one another for a confiderable Time. Allo after her Retrogradation, and before she be-gins to Direct again, we will be again Stationary, as about B; and then she is said to be Stationar, towards her Direction, as before the was so towards her Retrogradation.

And 'tis the lame Cale, with respect to the Earth consider'd, as moving on in her Orbit; for the Directions, Stations, and Retrogadations, above describ'd, and referred to Venus, will after the same manner appear to belong to the Earth; in the several Parts of her Orbit, to an Eye placed in Venus, or on the Surface of some Superior

Planet.

And from what has been here said, it appears, that Venus will appear Retrograde when she is nearest to the Earth, and consequently then also appears bigger; and on the other hand, will be Direct, and appear leaft, when she is remotest from

After much the same manner will the Phænomena of the Directions of the Stations and Retrogradations of the superior Planets be accounted for by the following Figure:



Let M & be the Orbit of one of the Superiors, suppose of Mars; let AC & G be the Orbit of the Earth, and nearer to the Sun than that of Mars; let that Planet be supposed at M, and the Earth in that Part of her Orbit design'd by the Letter A: Then will Mars appear Stationary, and that towards his Direction; because the Right Lines drawn from Mars, and from the Earth to the Sun, will for a while appear to be Parallel, altho' if Mars were seen from the Sun, his Motion would then appear to be Progressive, as at other Times. And while the Earth moves from A towards B, C, D, E, and F, to G, Mars will appear to move forward directly among the fixed Stars, for a double Reason; both because it is in reality carry'd about the Sun in Consequentia; and also because the Earth is carry'd the same

way in the opposite Simicircle, and about the same Centre. Mars therefore being now most remote from the Earth, will appear to be direct. But the Earth coming at length to G, and Mars being supposed to be in M, (which in process of Time will come to pass) then he will appear Stationary again, and now towards his Retrograda-tion, for he will appear Retrogade in his Motion from G to A.

And the very same Phænomena must happen to Jupiter and Saturn; only the Retrogradations of Saturn will be more frequent than those of Jupiter, and his than those of Mars: Because the Earth will oftner follow, overtake, and get between Saturn and the Sun, than he will between Jupiter and him; and oftner also between Jupiter and the Sun, than between Mars and him.
DISCONTINUANCE, in the Common Law,

fignifies the same as an Interruption or Breaking

off; and is of two Kinds, either

DISCONTINUANCE of Possession; the Ffect of which is, that Man may not enter on his own Lands or Tenements alienated, what soever his Right be to them, of his own self, or by his own Anthority; but must bring his Writ, and seek to recover Possession by Law. Or it is

DISCONTINUANCE of Plea or Process; the Effect of which is, that the Instant is lost, and may not be regain'd, but by a new Writ to begin the Suit afresh; for to be discontinued, and to be put sine die, signifies to be dismissed the Court

finally.

DISGRADING. See Degrading.

DISPARAGEMENT, in the Law Sense is used especially for matching an Heir in Marriage un-

der his or her Degree, or against Decency.

DISPAUPERED. When any Person, by reason of his Poverty, attested by his own Oath of not being worth 51. (his Debts being paid) is admitted to sue in Forma Pauperis; if afterwards, before the Suit be ended, the same Party have any Lands or Personal Estate sallen to him; or that the Court, where the Suit depends, think fit for that or any other Reason to take away that Privilege from him, he is then said to be Dispanpered, i. e. put out of the Capacity of suing any longer in Forma Pauperis.

DISPENSATION of a Law, is a Thing di-

ftinct from the Equity of it, or from an equitable Conftruction of it: For Equip is only the Correction of a Law that is too Universal or General; but a Dispensation suspends the Obligation of the Law itself. A Dispensation therefore must be from the Legislative Power, and should be but very

rarely and sparingly used.

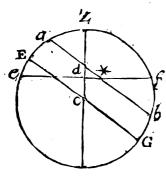
DISTANCE of Places on the Earth, are easily found by the Analemma. Thus:

Having the Longitudes and Latiudes of any two

Places on the Earth; to find their Distance.

Let London be one Place at Z, and let the other be in 20 Deg. Latitude North, and whose Difference of Longitude from London is 82 Deg. 30 Min. East. Take from the Chords Z E = 51 Deg. 30 Min. and draw E C 2 for the Equator; and to it, at 20 Deg. Distance draw a b for the Paral-lel of the other Place: Then from b, where the Meridian of London intersects that Parallel, set b* = 82 Deg. 30 Min. the Difference of Longitude, and that will find the Point * in the Parallel representing the Place. Thro' * at Right Angles to Zc, draw ed, croffing the Vertical Circle in d; measure e d on the Sines, it will be aabout

bout 20 Deg. whose Complement 70 Deg. is the Places Distance from London, or Z. Multiply 70 by 70, you have 4900 Miles, the Distance required.



DISTANCE of the Eye, in Perspective, is a Line drawn from the Foot of the Line of Altitude of the Eye, to the Point where a Line drawn

at Right Angles to it will intersect the Object.
DISTRIBUTIVE Justice. See Justice.
DIVERGING Hyperbola, is one whose Legs turn their Convexities towards one another, and run towards quite contrary Ways. See Curves.

DIURNAL Parallax of the Sun. See Parallax, and Sun

DOCKET, in the Law Sense, is a Brief in Wrising. It hath been formerly written Dogget; and seems then to have been some small Piece of Paper or Parchment, containing the Effect of a larger Writing.

DOG-DRAW, is one of the four Kinds of an Apparent Deprehention of an Offender against Venison in the Forest: And it is, when a Man hath stricken or wounded a Deer, &c. by shooting at him with a Cross-Bow or Long-Bow, or otherwise, and is found with a Hound or other Dog drawing after him to receive the same. See

Manwood's Forest-Laws, c. 18. N. 9.

DOGGER, is a small Ship built after the Dutch Fashion with a narrow Stern, and commonly but

one Mast. See 31 Ed. 3. Stat. 3. c. 1.

DOG-NAILS, are such as are used for fastening Hinges.

DOM-BOC. See Domes-day Book. DOMES-DAY Book. When King Alfred divided his Kingdom into Counties, Hundreds, and Tithings, he had an Inquisition taken of the several Districts, which were digested into a Regifter, which was called Dom. Boc; ie. the Judicial or Judgment Book, reposited in the Church of Winchester, and thence call'd the Winchester-Book, to which King Edward, Sen. seems to refer in the first Chapter of his Laws. The General Survey taken afterwards by William the Conqueror was after this Precedent of King Alfred, and seems but a Corruption of, or rather an Addition to, the same Name, Dom-Boc into Domes-day Book: And it implying no more than Doom-Book, or a Register from which Sentence might be given in the Tenure of Estates; (whence by Latin Writers 'tis called Liber Judicialis) 'tis a trifling Etymology to derive the Word from either Domus Dei, or Domes-day, that is, the final Day of Judgment. And it is not improper to observe (because no. Notice hath yet been taken of so small a Matter) that the Addition of Dez, or Day, in forming Dooms-day Book from Dom-Boc, doth not augment the Sense of the Word, but only doubles and confirms it. For the Word Day, in all Idioms, fignifies Judgment: And in the North, to this Day,

a Daysman is an Arbitrator, Umpire, or Judge; and so 'ris translated in our English Bible, in 30b. ix. 33. Domes-day Book therefore is no more than the Book of Judicial Verditt, Decretory Sentence, or Dooming of Judgment. Kennet's Paroch. Antiq. in

DORMANT Tree, is a Word used in Architecture, by some Workmen, sor a great Beam lying a-cross the House; which is usually called

DORMER, in Architecture, is a Window made in the Roof of an House, and it stands upon the Rafters

DONATIVES. See Benefices.

DOUBLE Quarrel, is a Complaint made by any Clerk or other to the Archbishop of the Province against an inserior Ordinary, for his delaying of Justice in some Cause Ecclesiastical; as to give Sentence, to institute a Clerk presented, Sc. The Effect whereof is, That the Archbishop taking Knowledge of the Delay, directs his Letters, under his Authentick Seal, to all and fingular Clerks in his Province, thereby Commanding and Authorizing them, and every of them, to admonish the said Ordinary, within a certain Number of Days (viz. 9.) to do the Justice required; or otherwise to cite him to appear besore him or his Official, at a Day in the said Letters prefixed, and there to alledge the Cause of his said Delay. And lastly, to intimate to the Ordinary, That if he neither perform the Thing enjoyned, nor appear at the Day assign'd, he himself will, without further Delay, proceed to perform the Justice required. And this seems to take its Name of Duplex Querela, from its being most times made both against the Judge and him at whole Petition Justice is delayed. Camel's In-

DOUBLE Aspect, a Term in Painting. See

Aspect Double.

DOUBLE Point. When all the Right Lines tending the same Way, with the Infinite Leg of any Curve, do cut it in one only Point (as happens in the Ordinates of the Cartesian, and in the Cubical Parabola, and in the Right Lines, which are parallel to the Abscisse of Hyperbolism-Hyperbola's and Parabola's) then you are to conceive, that those Right Lines pass thro' two other Points of the Curve (as I may say) placed at an Infinite Distance. And those Coincident Interasections, whether they be at a Finite or at an Infinite Distance, Sir Isaac Newton calls the Double Point: And how such Curves as have a Double Point are describ'd, see under Curves.

DOUBLING the Cape or a Point of Land, in Navigation, fignifies to come up with it, pass by it,

and so to leave it behind the Ship.

DOVETAILING, in Architecture, is a Way of fastening Boards or Timber together, by letting one Piece into another indentedly, with a Dovetail Joint, or with a Joynt in the Form of a Dove's Tail.

DRAGON Beams, in Architecture, are two strong Braces, or Struts, which stand under a Breast Summer, and meet in an Angle on the Shoulder

of the King-piece.

DRAGGS, in a Ship, are by the Seamen accounted whatever hangs over the Ship in the Sea, or is towed after the Ship in the Water, &c. Such

as Cloches, a Boat, &c.
DRAUGHT-Hooks, are large Iron Hooks fixt on the Checks of a Cannon Carriage, two on E e 2

each Side, one near the Trunion Hole, and the other at the Train. Large Guns have Draughthooks near the middle Transum, to which are fix'd the Chains which serve to ease the Shasts of the

Limbers on a March.

DRAW-Bridges, are made after feveral Fa-fhions, but the most common are made with Plyers twice the Length of the Gate, and a Foot in Diameter: The inner Square is travers'd with a St. Andrew's Cross, which serves for a Counterpoile, and the Chains which hang from the other Extremities of the Plyers, to lift up or let down the Bridge, are of Iron or Brass.

DRENCHES, or Drenges (Lat. Drengi) some ancient MS. fay, were Tenants in Capite: Such as at the Conquest being put out of their Estates, were afterwards reftor'd by King William, because they being Owners thereof, were neither against him by their Persons or Councils. Co. on Lit. Fo. 6. lays, these Drenches are Free Tenants of a

Manor.

DRENGAGE, was the Tenure by which the Drenches held their Lands.

DRIFT WAY of a Ship, the same with Lee-

DUCTILITY. Captain Halley, in Philosoph, Trans. N. 194, gives this further Account of the extreme Ductility, and exceeding Minuteness of the Patts of Gold. Tis evident, that Gravity is in all Bodies proportional to the Quantity of Matter in each; this is known by undoubted Experiment, so that there is no such Thing as a Propension of some more, others less, towards the Barth's Centre, fince the Impediment of the Air being remov'd, all Bodies descend, be they never so loose or compact in Texture, with equal Velocity. It follows therefore, that there is 7 times as much Matter in a Piece of Gold, as in one of Glass of the same Magnitude, (their specifick Gravities being as 7 to 1 nearly) and consequently, that at least 6 Parts in 7 of the Bulk of the Glass must be, Pore or Vacuity. This some Favourers of the Atomical Philosophy have endeavour'd to solve, by supposing the Primary or Constituent Atoms of Gold to be much larger than those of other Bodies, and consequently the Pores fewer. In order to examine this, he inform'd himself by the

Wire-drawers, that every best Double-gilt Wire was made out of Cylindrick Ingots of Silver, four Inches in Circumference, and 28 Inches long, weighing 16 lb. Troy. To gild these, they befrow 402. of Gold; that is, to every 4802. of Silver, one of Gold. They inform'd him also, that two Yards of superfine Wire weighs just one Grain. Hence at first Sight it appear'd, that the Length of 98 Yards of Wire is in Weight 49 Grains, and that a fingle Grain of Gold covers the said 98 Yards; and further, that the 10000th Part of a Grain is above one 3d of an Inch in Length, (or longer than a Barley Corn) which Length may actually be divided into 10 Parts, and consequently the 100000th Part of a Grain of Gold be visible without a Microscope: And by reason of the Specifick Gravities of the Metals, viz. Silver 10 1 and Gold 18 1; he found the Diameter of such Wire to be Takth Park of an Inch, and its Circumference Isid Part of an Inch; but the Gold did not exceed in Thickness TITISOOTH Part of an Inch. Whence it may be concluded, that the Cube of an hundredth Part of an Inch would contain above 2433000000 (or the Cube of 1345) such Atoms. And yet rho' the Gold be firetch'd to such a prodigious Degree as is here demonstrated, it still shews itself of to even and united a Texture, as not to let the white Colour of the Silver that lies under it appear even by a Miscroscope) thro' any the least Porcs. Which argues, that even in this exceeding Thin, ness, very many of those Atoms may still lie one over the other.

DULEDGE, in Gunnery, is a Peg of Wood, which joyns the Ends of the 6 Fellows, which form the Round of the Wheel of a Gun-Carriage; and the Joint is strengthen'd on the Out-side of the Wheel by a strong Place of Iron call'd the Duledge

Plate

DUPLEX Querela. See Double Quarrel. DUPLICATE, is used by Crompton for Second Letters Patents granted by the Lord Chancellor in a Case wherein he had formerly done the same, and was therefore thought void. But any Transcript or Copy of a Writing may be call'd a Duplicate.

EALDER-

EAR

E ALDERMAN, was a Title among the Saxons, of the same Import as Earl among the Danes, and fignified an Elder or Statesman; fuch an one as the Romans call'd Senator: And to this Day we use the Word Alderman in the same Sense for an Affociate to the Chief Officer in the Common Council of any Town or City, and sometimes for the Chief Officer himself.

EAR. The former Account (in Vol. L) of this Curious Organ not being so satisfactory as I could wish it, I have here inserted Dr. Keill's

Anatomy of the Ear.

The Ear is divided into the External and Inter-The External Ear (whose Parts have already been describ'd) is composed of the Skin, a Cartilage, and a little Fat. The Skin of this Part is thin and smooth, it slicks close to the Cartilage by means of a fine Membrane. lage is in that Part of the External Ear call'd the Pinna; and the Fat in that Part call'd the Lobe. The Vessels of the External Ear, are Arteries from the Carotidale Veins, which go to the Jugulares, and the Nerves from the Portio Dura, and second Pair of the Neck.

The External Ear is tied to the Os Petrofum by a strong Ligament, which comes from the Back-side of the Pinna. Though the Ear has but a very obscure Motion, yet it has two Muscles: The first arises from the Outside of the Frontal Muscle, where it joins the Crotaphise, and is inferted into the Upper and Back-part of the Pinna. second arises from the upper and foremost Part of the Processus Mamillaris, and is inserted into the middle and back Part of the Concha. The first should draw the Ear upwards, and the second downwards and backwards; but the continual binding of our Ears when young, deprives us of their Ule. The Ule of the External Ear is to gather the Sounds, and to carry them to the Internal. Its Inequalities and Circles do moderate the Violence of the Air.

The Internal Ear begins at the Conduit which goes from the Middle of the Concha to the Tympanum : it is call'd Meatus Auditorius. It is cartilaginous from the Coneba till within a little of the Tympanum, where it is bony; yet this Cartilage goes not compleatly round, for towards the Temple its Edges do not meet by above a Line. The Passage is crooked, running first upwards and then downwards to the Tympanum. It is covered within by a pretty thick Membrane. Betwixt this Membrane and the Cartilage, especially where it is slit, there are a great Number of little Glands, whose Execretory Chanels piercing this Membrane, carry a yellow fort of Excrement into the Meatus, which hinders Infects or any other

thing to enter the Ear.

At the further Extremity of this Conduit, there is a thin transparent Membrane stretch'd out like the Head of a Drum, upon a bony Circle, which wants about half a Line of being compleat. The Handle of the Malleolus is tied to this Membrane, which it draws somewhat in-wards, making it a little Concave towards the Meatus Auditorius: And there tuns a small Twig of a Nerve from the fifth Pair upon its Infide, call'd Chorda Tympani; for the Membrane it self is called Tympanum.

EAR

Behind this Membrane there is a pretty large Cavity called the Barrel; it is about three or four Lines deep, and five or fix wide. It is lined with a fine Membrane, on which there are several Veins and Arteries. It is always full of a purulent Matter in Children. In this Cavity there are four small Bones, of which,

The first is the Malleolus, or Hammer, so called because of its Shape. Its Head has on its lower Side two Protuberances, and a Cavity whereby its joyned to the Incus by Ginglymus: Its Handle, which is pretty long and small, is fastened to the Tympanum. Near its Head it has two small Processes, and it is moved by three

The first is called the Externus; it arises from the upper and external Side of the Meatus Auditorius, and is inserted into the upper and longer Process of the Malleolus, which it draws outwards. This is necessary when Sounds are too great, which might break the Tympanum.

The Second is the Obliques; it lies in the External Part of the Conduit which goes to the Palate, and entring the Barrel, it is contained in a Sinusofity of the Bone by the upper Edge of the Tympanum, and is inferted into the stender Process of the Hammer, assisting the former Muscle

in its Action.

The Third is the Internus, which arises from the Extremity of the bony Part of the Conduit which leads to the Fauces, and lies in a Sinus of the Os Petrofum, till it passes over a little Rising of the Bone at the Fenestra Ovalis, to be inserted into the posterior Part of the Handle of the Malleolus. This Muscle, by pulling the Hammer inwards, distends the Tympanum.

The Second small Bone is call'd Incus, the An-

vil: It has a Head, and two Legs. Its Head has a Protuberance, and two Cavities, whereby it is articulated with the Hammer; the shorter of its Legs is tied to the Side of that Conduit which goes to the Processus Mamillaris, and its longer Leg to the Head of the Third Bone, called, The Stapes or Stirrop, because of its Resem-

blance. 'Tis of a Triangular Figure, being made of two Branches set upon a flat Basis, which stands upon the Foramen Ovale. The Space between the two Branches is fill'd up by a fine transparent Membrane; the Union of the two Branches is called the Head of the Stirrop, in which there is a small Cavity, in which lies the Fourth Bone. There is a small Muscle which arises out of a small Canal in the bottom of the Barrel, and which is inserted into the Head of the Stirrop.

The Os Orbiculare, which is a very small Bone, being Convex on that Side which is received in the Cavity of the Head of the Stirrop, and hollow on the other Side, where it receives the long Leg of the Anvil, which is only joyned to the Stirrop by means of this Fourth Bone.

Befides these Bones, there are several Holes in Barrel. The First is in its Fore-part nearest the Barrel. the Tympanum. It is the Entry to the Sinus in the Mammillary Process. The Second is the Orifice of a Conduit, which opens behind the Palate of the Mouth. The Beginning of this Conduit is bony; and its Extremity, which is near the Dulva, Vulva, is membranous. Part of the Air which we breath, enters by this Conduir into the Ear. The Third and Fourth are in the Internal Process of the Os Petrosum. The one is called Fenestra Ovalis; the Basis of the Stirrop stands upon it; it is the Entry to the Vestibulum. The other is called Fenestra Rosunda; it is covered by a fine Membrane, inchased in a Rist of this Hole; it leads to the Cochlea.

The Vestibulum is a Cavity in the Os Petrosum, behind the Fenestra Ovalis; it is covered with a fine Membrane: In it open the Semi-circular Pipes of the Labyrinth. The upper Turning of the Cochlea, and the Auditory Nerve, pierces in-

to it also.

The Labyrinth is made of three Semi-circular Pipes excavated in the Os Petrosum; they open by five Orifices into the Vestibulum. That which is called the Superior Pipe, joins one of its Extremities with one of the Extremities of that which is call'd the Inserior Pipe; and these two Extremities open by one Orifice, but the middle Pipe opens at each End by it self into the Vestibulum.

The last Cavity of the Ear is the Cochlea; it resembles a Snail's Shell. Its Canal, which winds in a Spiral Line, is divided in two, the Upper and Lower, by a thin Lamina Spiralis. The Edge of this Lamina is membranous, where there are several Holes, through which Twigs of the Auditory Nerve pass from the one Canal to the other. The Upper Canal opens into the Vestibulum, and the Lower into the Barrel, by the Fenestra Rotunda.

The Vessels of the Internal Ear are Arteries and Veins from the Internal Carotides and Jugulars. The Nervus Auditorius enters by the Hole in the Internal Process of the Os Petrosum. It consists of two Bundles, of which one is hard, the other soft. Its Portio Mollis is distributed through all the Cochlea and Labyrinth, and the Portio Dura is bestowed on the External Patts

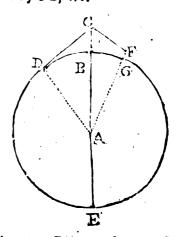
about the Ear.

Sounds being gather'd by the External Ear, pass through the Meatus Auditorius, and beat upon the Tympanum, which moves the four little Bones in the Barrel. In like Manner as it is beat by the External Air; these little Bones move the Internal Air which is in the Barrel and Vestibulum: which Internal Air makes an Impression upon the Auditory Nerve in the Labyrinth and Cochlea, accordingly as it is moved by the little Bones in the Barrel. So that, according to the various Resractions of the External Air, the Internal Air makes various Impressions upon the Auditory Nerve, the immediate Organ of Hearing: These different Impressions represent different Sounds.

See Maria Valtalva de Aure Humana Trastatu. EARL, anciently was the Title given to such as were Associates to the King in his Councils or Martial Expeditions; as Comes was to those who followed the Magistrates of Rome, as their Deputies to execute their Offices for them; and this Title died always with the Man. The old Way of making Earls was only Cincturam Gladii Comitatus, without any formal Method of Creation. But William the Conqueror, saith Cambden, gave this Dignity in Fee to his Nobles, annexing it to this or that County, and allotting them a Proportion of Money, arising from the Prince's Profits, for the Pleadings and Forseitures of the Province: Now, and long since, Earls are made by the

Kings of England, by their Charters; but without any Authority over any County, and without any Profit arifing from thence, but some Annual Stipend out of the Exchequer for Honour's Sake. The Solemnity of their Creation you may find at large in Stow's Annals. Their Place is next after a Marquis, and before a Viscount.

EARTH. There have been several Methods thought of to find the Magnitude of the Earth: As, 1. To find its Diameter, by baving the Height of some very eminent Mountain, and the Length of a Visual Ray, that shall be a Tangent to the Earth's Surface at some considerable Distance from the Top of the Hill: For the Square of such a Tangent being (by 35 E. 3.) equal to the Rectangle, under the whole Line made by the Earth's Diameter, and the Height of the Mountain together, if you divide DCA by CB, i.e.



the Square of the Distance, from the Top of the Hill to the Earth's Surface, by the Hill's Height, the Quotient will be the Line C E, (viz.) the Aggregate of the Earth's Diameter and the Mountain's Height; the latter of which being given, the former is so.

2. Let a Spectator on the Top of a high Hill, as at C, with an Inftrument, take the Angle DCB; which may best be done by the Help of the Sun or Moon's being in the Horizon; for that Way the Horizon will be the most accurately determin'd. Then the Length of the Tangent CD, being some-how known, in the Right angled DCA, the Line DA = to the Earth's Semidiameter may easily be drawn, and its Length sound by Calculation.

3. The Angle DCA being taken, and the Mountain's Height CB known; the Earth's Radius BA may be had without knowing the Diftance CD: For in the $\triangle DCA$ all the Angles are known, and the Length BC is only the Excess of the Secant CA above the Radius BA or AD; wherefore by the Tables of Sines, Tangents, and Secants, the Radius AD will be known.

There is also another way a-kin to these, of finding a Part of the Circumference of a great Circle on the Earth, by having the Altitude of two high Mountains, and their Distance from each other. But none of these Ways can be depended upon, tho' they are built upon Geometrical Principles, and are great Instances of the due Thought and Penetration of the Inventers; because there will be so many unavoidable Dissipulties in the different Refraction of the Atmosphere, in taking the exact Height of the Mountains, or the Distance of their Tops from the Earth's Surface in D, that there can nothing certain be determin'd from hence.

The best Method therefore to gain this Point, is that which Mr. Norwood here in England, and Mr. Picart in France, proceeded in; which was to measure the Distance, in Miles, or rather in Yards or Feet, between two Places situate under the same Meridian, and at least a Degree one from another; that so the Number of Miles contain'd in one Degree of a great Circle of the Earth, being exactly known, the Earth's Circumference will be easily had by only multiplying those Miles by 360. And this the French Mathematicians feem to have done so nicely, that hardly any thing more exact is to be expected. They make the Ambit of the Earth to be 123249600 Paris Feet; that is, nearly, 131630573 English

Whence Feet, or 24930 of our Statute Miles. Whence the Diameter must be 41899310 English Feet, and nearly 7935 Statute Miles.
EARTH. Dr. Hook, in Op. Post. p. 467. saith,

that the Semidiameter of the Earth, from the most accurate Observations that ever were made, is 3962 3 Statute Miles; or more exactly

209235003 Statute Feet.

Since 'tis known that the Orbit of the Earth is Elliptical, and that its Motion round the Sun is flowest in the Aphelion, and swiftest in the Peribelion; the Consequence is, that the Places of the Earth's Aphelion and Perihelion may be found by Observation of her slowest or swiftest Motion. And the Places of these Aspides, as they are called, may be found also by the Sun's Apparent Diameter; which will be least when the Earth is in her Aphelion, and greatest in the Perihelion: But their being some Difficulty in measuring this accurately, the former Way of finding the Place of the Earth's Absides is the best.

The Motion of the Earth's Aphelion is only

Apparent, and not Real; but it answers to the Procession of the Equinoxes, which is annually

about 50 Seconds.

EARTH. In the Year 1679, an Experiment being suggested to try, whether the Earth moved with a Diurnal Motion or not, by the Fall of a Body from a confiderable Height, alledging it would fall to the East of a true Perpendicular: Dr. Hook read before the R. Society a Discourse on that Subject, wherein he endeavoured to explain what Curve the falling Body would describe; and in particular, he afferted, that the Fall of the Body would not be directly East, but to the South-East, and more to the South than the East. And on several Trials made, the Ball did always fall to the South-East. Hook's Life, in

Op. Post. p. 22.

EARTH. If you suppose an heavy Body to descend 15 Feet in the first Second of Time, Mr. Keill faith, it follows by Calculation, (See Exam. of Burnet's Theory, p. 117, 118.) That the Force of Gravity, to the Centrifugal Force, in a Body placed at the Equator of our Earth :: is as 289 to 1. So that by the Centrifugal Force arising from the Earth's Rotation, any Body placed in the Equator will lose a 289th Part of its weight which it would have were the Earth at Rest.

And fince there is no Centrifugal Force at the Poles, a Body there weighs 289 th. which, at the

Equator would weigh but 288 tb.

And p. 123. He thews; That on our Earth, the Decrease of Gravity, in going from the Pole towards the Equator, is always as the Square of the Cosine of the Latitude.

EARTH. According to Sir Isaac Newton's

doth, in every Annual Revolution of the Earth round the Sun, swice incline towards the Ecliptic, and twice return to its former Polition; and on this Nutation of the Earth's Axis depends the Recession of the Equinoctial Points; and, as Mr. Flamstead thinks, the Annual Parallel of the fixed Stars.

The Annual Regression of the Earth's Nodes. is about 50 Seconds, and the Nutation of her

Axis, about 42 Thirds.

EARTH. Dr. Gregory, Astron. Phys. & Geom.
p. 76. That by reason of the Figure of the Earth, the Equinoctial Points do recede; and that the Axis of the Earth, in every one of its Annual Revolutions round the Sun, doth twice change its Inclination to the Ecliptic, and as often return again to its former Inclination of 66 Deg. and half.

EASEL-Pieces, in Painting, are such small Pieces, either Portraits or Landskips, which are painted on the Easel; (the Frame on which the Painter places his strain'd Canvass) and are so called to diftinguish them from larger Pictures, which are drawn on Cielings, Roofs, or the Walls of Rooms.

EASEMENT, (Aissumentum) in the Law, is a Service which one Neighbour hath of another, by Charter or Prescription, without Profit; as a Way through his Cround, a Sink, &c. and

this, in the Civil Law, is called Servicus Predii:

EAVESLATH, in Architecture, is a thick scather-edg'd Board, nail'd round the Eaves of a House, for the lowermost Tiles, Slate, or Shin-

gles to rest upon.

EBDOMADARIUS, was formerly an Officer, so called in Cathedral Churches, appointed Weekly to supervise the Regular Performance of Divine Service, and other Duties of the Choir; and at the Beginning of each Week he drew up a Bill (which was called Tabula) of the Respective Persons attending the Service of the Choir, and of their Duties allotted them; and those Persons which were entered in this Bill were called Intabulati.

ECCENTRICITY of the Earth, in the new Aftronomy, is the Distance between the Focus and the Centre of the Earth's Elliptick Orbit: How to find which, Mr. Whifton shews, p. 90. of his Prelect. Aftron. from the Apparent Motion of the Sun, compared with the two Extreams of the Apsides. For fince the True Velocity of the Earth in her Aphelion and Perihelion is in a Reciprocal Ratio of her Distances from the Sun; and that the Apparent and Angular Velocity is in a duplicate Ratio of her Distances reciprocally; from the Apparent Difference of these two Velocities, the Difference of the Distances, or the double Eccentricity, will easily be known. The Eccentricity of the whole Distance is, at a mean, about a 60th Part, or, more accurately, \(\frac{3486}{10000} \).

ECHO. Dr. Plot, in his Natural History of Oxfordshire, Cap. 1. distinguishes Echoes into such as are, 1. Single, which return the Voice but once; and of these, some may be called Tonical; because they will not return the Voice but when modulated into some peculiar Musical Note: And others Polyfyllabical; because they will return many Syllables, Words, and Sentences; and sometimes a whole Hexameter Verse.

2. Manifold or Tautological, which return Syllables and Words the same oftentimes repeated.

In the Polysyllabical and Articulate Echoes, the Place where the Speaker stands is called the Cen-Principles, Lib. 3. Prop. 21. The Axis of the Earth | trum Phonicum; and the Object or Place that returns the Voice is called the Centrum Phonocamp-He saith, he experienced what Blancanus writes in his Echometria, Theor. 5. That no one Syllable can be distinctly and clearly returned under the Distance of 24 Geometrical Paces, or 120 Feet. But by some Experiments I have made, I judge that Distance to be too large, as well as that of Mersenus, of 69 Feet, to be too little : And perhaps some Places may return the Voice fooner, and some later, than others; which it would be worth while to try, where there is a Convenience of measuring perpendicularly from the Centrum Phonocampticum. When I was about 16 Years of Age, having Dr. Plot's Book to direct me, I remember well, that I found an Echo, whole Centrum Phonicum was on the North Side of Shipley Church in the Wild of Suffex; and which would repeat distinctly these Words, in the Night;

> Os Homini sublime dedit, Calumque tueri Juffit & Ereflos----

especially, if you spoke the first Syllable very strong, and all the rest pretty fast. I measured then also the Distance very accurately, but the Papers are lost, and I can pronounce nothing certainly about them; but only that it was much the finest and most distinct Echo that ever I tried; tho' I tried the famous one at Woodstock several

Times, after I went to Oxford.

ECLIPSE of the Sun. In order to observe an Eclipse of the Sun accurately, Mr. Flamsted directs to cast the Species of the Sun through a good Telescope, of a tolerable Length, on an extended Paper behind the Eye-Glas; and so far as that the said Species may appear at least 6 Inches over. And then to divide both the Periphery of a Circle, equal to that, and drawn on the Paper, into 560 gr. for the better observing the Cusps of each Phasis; and also the Diameter into Digits, and their Parts, by Concentrick Circles, for measuring the Quantity of the obscured Parts. When you look at an Eclipse of the Sun, the best and readiest way to save the Eye, is to take a Piece of plain Looking-glass Plate, and black one side of it over the Flame of a Candle; and then look through it at the Sun. And if you use a Telescope, such a black'd Glass must be between your Eye and the Eye-glass.

To determine the Moment of the Immersion, Duration, and other Requisites of a Solar Eclipse: Vid. Whiston's Pralett. Astron. p. 160. and of a Lu-

nar, p. 150. ECLIPSES. 'Tis now discovered, that Lunar Ecliples do not arise from the Interposition of the Earth's Body between 1 and her, but only from the Interpolition of her Atmosphere.

Of which, and all the Phanomena of Eclipses,

fee Whiston's Pralett. Astron. p. 135.
EDICT, in the Civil Law, is any thing that the Emperor establishes of his own Accord, that it may be generally observed by every Subject. And this differs both from a Decree, or a Pragmatick Sanction

ELASTICITY. The Cause of the Elasticity of Fluids, such as our Air, may easily be acounted for, from their Particles being all endowed with a Centrifugal Force, like what Sir Isaac Newton mentions in Prop. 23. lib. 2. of his Excellent Principia. And to solve the Springiness or Elasticity of solid and firm Bodies, we must have Recourse to another universal Law of Nature, Attraction; by which the Parts of solid and firm

Bodies are caused to cohere together. therefore hard Bodies are either bent or fruck, fo that the Component Particles are a little moved from one another, but not quite disjoined and broken off, nor separated so far as to be out of the Power of that Attracting Force, by which they cohere together; they certainly will, on the Cessation of the external Violence, spring back with a very great Velocity to their former natural State: Supposing, as I said before, that the Particles are not separated by the Flexure, or the Shock, so far from one another, as that the Atoms of any foreign Fluid can get in between them, and hinder the Attractive Force; for then, as soon as ever the separating Force ceases, the Attractive will act, and bring them back to their former State.

ELECTION, in Numbers, with Regard to Combinations, is the several Ways of taking any Number of Quantities given, without having respect to their Places. Thus the Quantities a, b, c, may be taken 7 Ways; as abc, ab, ac, be, and a, b, c.

See Schooten in his Miscellanea; and Strode of Combinations. See also the Word Combination.

ELECTRICITY. In Phil. Tran. N. 308, there is an Account of an Experiment made before the R. S. at Gresham College, touching the extraordinary Electricity of Glass, produceable by a smart Attrition of it, with some odd Phænomena thereon depending: As, that Moistness will at any Time hinder the Electrical Attraction: That the Interposition of the finest Lawn or Muslin between the Body heated by rubbing, and the Light Bodies to be attracted, will deprive it of all Electrical Force: That when the Electrick Body (which was a Tube of Glassof 11 in Dia 1 meter, and 30 in Length) became hottest by the greatest Rubbing, it sent forth Effluvia that might sensibly be felt to strike against your Face, when the Tube was held near it: That exhausting the Tube of Air by the Pump, did almost total-ly deprive it of its Electrical Force, tho rubb'd never so much, &c. All which Experiments I have often made myself, and find to be very truly related there. 'Tis observable, that on rubbing the Tube in the Dark, a Light would be produced; which was greater when the Tube was exhausted of Air, and then seem'd to be all within the Tube; and when another Hand, or ones Finger was held near the Tube in the dark, a Light was seen to break from it, with a snapping Noise like that of a green Leaf in the Fire, but not so smart and loud.

He got also a Cylindrical Glass, and caused it by the Contrivance of a Wheel to be briskly turned round in an Horizontal Position: When this Glass, being exhausted of Air, was turn'd round its Axis, a confiderable Light would be produced, by the Attrition of ones Hand on the Outside; and when the Air was let in, it was surprising to see, that on the Application of ones Finger towards the Glass, a vigorous Light would be produced, which began at the Finger first, and seem'd to gravitate on it, and was sensibly to be felt there, at half an Inch distance from the revolving Glass. And this Purple Light was visible, even by Day, or in the Light. Mr. Hawksbee contrived also, that some loose Threads should be fasten'd at one End to a Circle of Wire, which was fasten'd at Right Angles to the Axis of the Glass, and within it; and then we observ'd several times, that when the Glass was swiftly moved round, and, by that means, strongly rubbed and heated, all those loose Threads would stand upright, and point directly towards the Axis of the revolving

He afterwards fix'd the Lower Ends of Threads into a Circle of Cork, which was placed at Right Angles to the Axis as before, but the upper Ends of the Thread hang loose; but as soon as the Glass was turn'd round as before, rubbed and warmed, the Threads would stand up an End in the same Plane with the Circle they were fastened to; and would point directly from the Axis towards the inward Surface of the Glass; unless when moved by the Application of ones Finger without; which would, surprisingly, make them bend and point towards it.

To describe this Figure readily ELLIPSIS. by means of the Sector, see Analemma, Vol. 1.

EMBER-WEEKS, are those Weeks in which the Ember-Days fall. In the Laws of K. Alfred, c. 39. and in those of Canute, c. 16. they are called Imbren, i. e. Circular Days; from whence they are corrupted into Ember-Days: And by the Canonists they are called, Quatuor Anni Tempora, the Four Cardinal Seasons on which the Circle of the Year turns: They are the Wednesday, Friday, and Saturday, after Quadragesima Sunday; after Whitsunday; after Holy-rood Day, in September; and after Sti Lucy's Day, in December: Which four Times answer well enough to the four Quarters of the Year, Spring, Summer, Autumn, and Winter. And Mr. Somner thinks, they were Fasts instituted to beg God's Blessing on the Fruits of the Earth. These Ember-Weeks are now chiefly taken notice of on the Account of the Ordinations of Priests and Deacons; because the Canon now appoints the Sundays next succeeding the Ember-Week, for the Solemn Times of Ordination. Tho' the Bishops, if they please, may ordain on any Sunday or Holyday. EMBRACERY, is the Offence of an Embra-

ceur ; to pre-instruct the Jury.

EMBRE, or Embring-Days, are those by the Antients call'd Quatuor Tempora, and are of great Antiquity in the Church; being observed on the Wednesday, Friday, and Saturday next after Quadragesima Sunday, Whitsundy, Holy-Rood Day,
in September, and St. Lucy's Day, in December,
2 & Bdward VI. c. 19.

EMENDATIO, in the Law, is the Power of

amending and correcting Abuses according to

stated Rules and Measures: As,

EMENDATIO Panni, is the Power of Aulnage, or Ulnage, or looking to the Affize of Cloth, that it be of the just Ell, or due Measure. EMENDATIO Panis & Cervisiae, is the Affize

of Bread and Beer; or the Power of supervising and correcting the Weights and Measures belong-

ing to them. EMETICKS. Dr. Cheyne, in his Book of Fevers, says, the Action of vomiting by a Medicine is produced thus: The Particles of the Vomitory, by wedging themselves into the Orifices of the Emissaries of the Glands which are placed adjacent to the Surface of the Stomach, do Dilate the same (which by some extrinsical Cause had been contracted) and after the same Manner do Diffolve (at least in some Degree) the Cohesion of the Stagnant Morbifick Matter, rendring it more fluid, and consequently, making its Resistance less. Now the natural and constant Action of the Glands being Secretion; and the Impediment (by the Dilatation of the Orifice, and the Attenua-

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made less than the natural Momentum of the Glands, the Matter must necessarily slow into the Cavity of the Stomack, till it be heap'd up in such a Quantity (which not being to be done in an Instant, must require some Time) as is sufficient (by the united Loathsomness, and the Vis Stimulans of the Emetick) to villicate and force the Fibres of the Stomach, Abdomen, and Diaphragm (by the Communication of the Nerves of the First with the two last) into a violent Contraction, and thereby, throw all out by the Oesophagus; and this makes all quiet for a while, till a new and sufficient Quantity be excerned from these Glands to reproduce the aforesaid Contraction. And thus there happens a Fit of Vomiting and Quiet alternately, till either all the Morbifick Matter be thrown out, or the Force of the Emerick is so dilated, that it is no longer able to elicit the Morbifick Matter from the Glands. And the Strong Contraction in so many Muscles and Muscular Canals as are at work in the Action of Vomiting, and the Violent Concussion which is produced over the whole Body, by a Power which, by just Computation, is not inferior to that of 26000 th. Weight, may, and often does take away the Obstructions in many other Canals besides those which are adjacent to the Stomach and Gullet; as we may plainly see by those vast Sweats which plentiful Fits of Vomiting occasion. Emeticks and purgative Medicines differ only in this, that the Particles of the latter do not immediately vellicate the Fibres of the Stomach, dilate the Orifices, and attenuate the Matter contain'd in the Glands of the Stomach, but act gently, and affift the natural Motion of Di-gestion, and so are carried down into the Intestines; and how they operate there, see under Purgatives.

EMINENTIAL Equation, is a Term used by the Algebrists in their Investigation of the Areas of Curvilineal Figures; and is so called, because 'tis an Artificial Equation, which contains another Equation eminently. See Hayes's Fluxions,

p. 97, &c. EMISSARY of a Gland, is the common Conduit, Canal, or Pelvis, in Which all the little Secretory Canals of a Gland do terminate. See Gland and Animal Secretion

EMPHYTEUSIS, in the Civil Law, is a Contract made by Consent, but created by the Roman Law, and not the Law of Nations; by which Houles or Lands are given, to be possess'd for ever, upon Condition that the Lands shall be improved, and that a small yearly Rent shall be paid to the Proprietor. The Tenant is call'd,

EMPHYTEATA, because of his being under an Obligation of planting and improving the Land.

EMPTIO-Venditio, in the Civil Law, is that Contract, by Consent only, which we call Buying and Selling, whereby the Seller is bound to deliver the Goods, and the Buyer to pay the Price for them, according to the Bargain. EMPYREUMA, is that Tast and Smell of Fire,

which some Things, too hastily distill'd, retain.

ENCAUSTICE, is the Art of Enameling. ENCHESON, is a French Word often used in our Law-Books; and feems to fignify, the Occasion, Reason, or Cause of any Thing's being done

ENCOLAPTICE is the Art of making Plates of Brass, and cutting in the Figures or Letters for tion of the Fluid) being taken away, or at least | Monumental Inscriptions and Laws.

ENGINE

ENGINE for Rowing Ships: The Figure of this Engine being omitted in Vol. I. is here added.

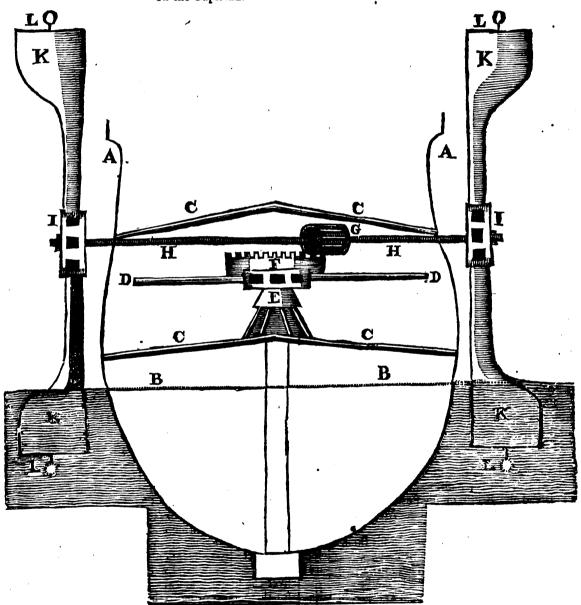
Description.

- B. The Water Line.
- C. The Decks.

- D. The Capstand Barrs.

 E. The Capstand.

 F. A Wheel on the Drumhead of the Capstand.
- G. A Trundle-head on the Wheel.
- H. An Iron Bar going through the Trundle-head, and thorough the Sides of the Ship.
- I. Two Drum-heads like those on the Capstand.
- The Line the Ship makes. | K. Paddles, of which Six, or Eight on each Side the Ship, are with Ease Fixed and Unfixed into the said Drum-heads.
 - L. A Piece of Iron, to which a Luff-Tacle may be Fix'd, to lift those that are too Heavy for Mens Strength, round each of which, by taking half Turns with a Cord, you make a Com-pleat Wheel on each Side the Vessel.



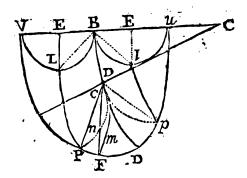
fignifying to be an Englishman: For in the Time of the Danes, if a Man were privily flain or murdered, it was accounted Fracigena, which Word then comprehended every Alien, until Englecers was provid, that is, 'till it was made manifest that he was an Englishman. Vid. Braston, Lib. 3. Trast. 2. Cap. 15. Fol. 134. But there being many Abuses and Troubles about this Engle-

ENGLECERY, Engleceria, is an old Word | cerr, it was taken away by 14 E. III. cap. 4.

ENURE, in the Law Sense, signifies to take Place, or Effect, or to be Available. As a Re-lease shall Enure by way of Extinguishment;

Convex

Convex or Concave Part of another Circle; which Part of this other Circle is call'd the Base of the Epicycloid; as in this Figure, DB is the Base of



the Epicycloid; V its Vertex; VB its Axis; DPV half of the Exterior Epicycloid; made by the Revolution of the Semicircle V L B, (which is called the Generant) along the Convex Side of the Base DB: As DP U is the Interior Epicycloid, formed by the Generant's revolving along the Concave Side of the Bale.

How a Portion of this Epicycloid is squarable, fee Phil. Tranf. N. 217. by Mr. Caswell, and in Phil. Tranf. N. 218. you have a general Propo-fiction for measuring the Areas of all Cycloids and Epicycloids. How to find the Evoluta to this kind of Curve, as also to find the Areas of Cycloidal and Epicycloidal Spaces. See Hayes's

Fluxions, p. 210, &c. EPISCOPALE Onus. See Episcopalia.

EPISCOPALIA, are Synodials, Pentecostals, and other Customary Payments, from the Clergy to their Diocesan Bishop; which Dues were for-merly collected by the Rural Deans, by them transmitted to the Bishop.

These Customary Impositions were called Onu Episcopale, and were by special Privilege remitted to those free Chapels as were built on the Demesne of the King, and exempt from Episcopal

Jurildiction.

EQUATED Bodies. On Gunter's Sector there are sometimes placed two Lines, answering one another, and called, The Lines of Equated Bodies: They lie between the Lines of Solids and Superficies, and are noted with the Letters D, I,C, S, O, T, for Dodecahedron, Icosihedron, Cube, Sphere, Octahedron, and Tetrahedron.

Their Uses may be these;
The Diameter of a Sphere being given, to find the Sides of the 5 Regular Bodies, leverally, equal to that Sphere.

2. The Side of any of the Bodies being given, to find the Diameter of the Sphere, and the Sides of the other Bodies, which shall be severally to

the first Body given.

If the Sphere be first given, take its Diameter, and apply it over in the Sector in the Points S, S: If any of the other Bodies be first given, apply the Side of it over in its proper Points: So Parallels taken from between the Points of the other Bodies, shall be the Sides of those Bodies, equal feverally to the first Body given.

EQUATIONS. Captain Halley in Philosoph.

Trans. N. 190. p. 38. gives an Account of the Number of Roots in Cubick and Biquadratick Equations, together with their Signs and Limits. Vol. II.

traction of all Roots out of them without any previous Reduction.

In N. 309, there is an Analytical, Geometri-cal, Mechanical, and Universal Method for the Resolution of Cubick and Biquadratick Equations, by Mr. 3. Colson. And an Analytical Resolution of some Equations of the 3, 4, 5, 7, 9, and Superior Powers; and so on Infinitely, in Finite Terms, and in such a Method as Cardan used for

Dr. Gregory, in the Preface to his excellent Oxford Euclide, in G. L. shews, that from the 86th and 87th Proposition of Euclides Data, even Biquadratick Equations, where the 2d and 4th Terms are wanting, may be refolv'd. As all Quadratick Equations may be, by the 84th and 85th Propositions of the same Data.

EQUES Auratus, is used to fignify a Knight, which is called Auratus, because antiently none but Knights might guild or beautify their Armour, or other Habiliments of War, with Gold. However, in Law, this Term is not used; but instead of it Miles, and sometimes Chevalier.

EQUILATERAL Hyperbola. If the Transverse Diameter of any Hyperbola be equal to its Parameter, then all the other Diameters will also be equal to their Parameters: And such an Hyperbola as is this, is called an Equilateral, whose A-symptotes do always intersect each other at Right

Angles in the Center.

EQUITY, is of two Sorts, and those of contrary Effects; for the one doth abridge and take from the Letter of the Law; and the other doth

enlarge and add thereto.

*The first is thus defined; 'Tis the Correction of the Law made generally in that Part wherein it fails; which is a Correction much used in our Law: As suppose an Act made, That whosever does such a Thing, shall be a Felon, and suffer Death: Yet if a Madman, or an Infant, who hath no Discretion, do the same, he shall neither be a Felon, nor suffer Death.

The other Equity is defined, to be an Extenfion of the Words of the Law to Causes unexpress'd, yet having the same Reason; so that when one Thing is enacted, all other Things are so too, that are of the like Degree: As the Statute, which ordains, that in Action of Debt against Executors, he that doth appear by Distress shall answer, doth extend by Equity to Administrators; for such of them as shall appear first by Distress, thall answer by Equity of the said Act: Quia sunt in Equali genere. Cow. Interpret.

EQUIVOCAL Generation. There is scarce

any thing feems more to countenance Equivocal Generation, than the Production of Worms, &c. in the Bodies of Animals; and yet Mr. Ander, in his Discourse de la Generation de Vers dans le Corps de l' Homme Paris, in 8vo. 1700. shews, that they breed there by a Seed which finds Entrance some how into our Bodies; and in particular, he shews, that the Ciron, or Hand-Worm, issues perfectly from its Egg, and after that grows infen-fibly. He judges that the Eggs of small Infects enter our Bodies by the Air we breathe, and in our Food; and that they are hatch'd there, only when they find an agreeable Heat and Disposition of the Humours and Parts.

Dr. George Garden hath observ'd; See Phil. Tran. N. 237. that the Bearers, or Bearing Buds of Fruit-Trees, are full of Asperites, and not so And in N. 210, he gives a Method for the Ex- mooth in their Bark as the other Parts of the Vol. II.

Ff 2

Tree

Tree; and that if after Harvest you look on these with a common Microscope, you will find the Cavities there full of Eggs of an oblong Figure. and of a Citron Colour; especially, in such Years, and in those Trees, where the Caterpillers have been numerous. From whence he concludes, that we should not say Insects are bred out of Corruption equivocally, and not ex Ovis, only because we cannot discern the particular Manner

of their Propagation. See Insects.

Mr. Ray faith, it feems to him to be most probable, that there is no such Thing as Spontaneous or Equivocal Generation; but that all Insects are the Natural Issue of Parents of the same Species with themselves. Fr. Redi, in his Book de Gener. de g'l Insetti, bath, I think, cleared up this Point, and shew'd there is no Generation of Animals ex Materia Putrida. And Dr. Lister hath given an Account of the Insects bred in the By-Fruits and Excrescencies of Vegetables, in Phil. Tran. N. 71,

Mr. Willoughby accounts for the Ichneumon Wasps, and the Manner of their laying their Eggs in the Bodies of other Infects; as of Caterpillers, &c. Phil. Trans. N. 76.

Dr. Lister, in Phil. Trans. N. 83. harh refuted the vulgar Notion, that Horle-hairs thrown into Water will become animated Bodies; and shews, that the Appearances of that Kind are Hair-Worms actually bred in the Bodies of other Infects, as of the Common Black Beetle, &c.

ERRANT, in our Law, is the same as Itinerant, being attributed to Judges that go the Cir-

cuit; and to Bailiffs at large.

ESCAMBIO, is a Licence granted to one, for the making over a Bill of Exchange to another, at Sea, Reg. Orig. Fol. 194. For by the Statute of 3 R. 2. c. 2. no Merchant ought to exchange or return Money beyond Sea, without the King's License.

ESCAPE, fignifies, in the Civil Law, a violent or Privy Evalion out of some lawful Re-

Araint

ESNECY, Æsnecia, in the Law, is a Prerogative given to the eldest Co-partner, to chuse first, after the Inheritance is divided.

ESPICURNANTIA, is the Office of Spigur-

nel, or Sealer of the King's Writs.
ESQUIRE, in French Escuier, i. e. Scutiger, was originally such an one, as attending a Knight in Time of War, did carry his Shield. But now it signifies a Gentleman, or one that beareth Arms as a Testimony of his Nobility or Gentry; and is a meer Title of Dignity, next to and below a Knight. They who claim this Title now are, all the younger Sons of Noblemen; the Four Equires of the King's Body; the eldest Sons of all Barons, Knights of the Bath, and Knights Batchelors; those that serve the King in any worthipful Calling; fuch as created Esquires by the King with a Collar of SS's of Silver: The Chief of some Families are also Esquires by Prescription: Those that bear any superior Office in the Common-wealth, as a Justice of Peace, while in Commission, and Utter Barristers, &c.

ESSAY Hatch, is the Miners Term for a little Trench or Hole, which they dig to search for

Shoad, or Oar. See Tin.

ESSENTIAL Oils of Vegetables, are, according to the Chymists, such are drawn from the Plant in a Limbeck, by the Help of Water.

ESTERLING. The same with Sterling. ESTORERS. The same with Hase Bote, or House Bote : Which see.

ESTRANGERS, in the Law, are sometimes taken for such as are not Privies or Parties to the levying of a Fine, or making of a Deed; and sometimes for those that are born beyond the

ESTRAY, fignifies any Tame Beaft found within any Lordship, and not own'd by any Man; in which Case, being cried, according to Law, in the Market adjoining, if it be not claimed by the Owner in a Year and a Day, it

is the Lord's of the Soil.

EVENINGS, was formerly the Delivery, at Night or Even, of a certain Portion of Grais or Corn to a Customary Tenant, who performs his wonted Service of Mowing or Reaping for his Lord, and at the End of his Day's Work, did use to receive such a Quantity of Grass or Corn to carry Home with him, as a Gratuity or Encouragement for his bounden Service. Kennet's Pa-

roch. Antiq.
EVICTION, in the Civil Law, is a Recovery of the Title to any thing fold by a Stran-

EVOLUTA. See in Involute and Evolute Fi-

gures, in Vol. I.

EVOLUTION. The Equable Evolution of the Periphery of a Circle, or any other Curve, is such a gradual Approach of the Circumserence to Rectitude, as that all its Parts do meet together, and equally evolve or unbend; so that the same Line becomes successively a less Ark of a reciprocally greater Circle, till at last they turn in-to a strait Line.

In Philos. Trans. N. 260. p. 445. you have a new Quadratrix to the Circle, found by this Means, being the Curve described by the Equable

Evolution of its Periphery.
EUSTACHIAN Tube. The same with the

Aqueductus Tallopii. See Tuba Eustachiana. EXACTION Secular, was any Sort of Tax or Imposition formerly paid by servile and feudato-

ry Tenants.
EXCEPTION, in the Law, is a Stop or Stay to an Action; being used in the Civil and Common Law both alike, and in both divided into

Dilatory and Peremptory.

EXCLUSIONS. The Method of Exclusions is Way of coming at the Solution of Problems (in numerical Cases) by previously ejecting or excluding out of our Consideration, such Numbers as are of no Use in solving the Question; and whereby consequently the Process may be regularly and judiciously abbreviated.

An Account of which Method, Mr. Frenicle gives, in the Ouvrages de Mathematique, &c. in

Fol. Paris,

ol. Paris, 1693. EXHIBITION, was anciently an Allowance for Mear and Drink, such as the Religious Appropriators made to the poor depending Vicar. And this Word is still retained in the Colleges of Oxford and Cambridge, in nearly the same Sense.

EX OFFICIO. By a Branch of a Statute of I Eliz. 1. The Queen, by her Letters Patents, might authorise any Persons, &c. to administer an Oath Ex Officio; whereby the supposed Offender was forced to confeis, accuse, or clear him-self of any Criminal Matter, &c. But this Branch, relating to the said Oath, is repeal'd by Star. 17 Car. 1. c. 11.

EXPLE-

EXPLETORY Justice. See Justice. EXPONENTIAL Curves, are such as partake both of the Nature of Algebraick and Transcendent ones. They partake of the former, because they confift of a Finite Number of Terms, tho' those Terms themselves are Indeterminate: And they are in some measure Transcendental, because they cannot be Algebraically constructed.

EXPONENTIAL Equations, are such as Sir Isaac Newton calls Geometrice Irrationals; they are

sometimes also call'd Transcendental.

EXPONENTIAL Quantities, are such whose Exponents are indeterminate, variable, or flowing Quantities; and the Quantities are of several Degrees and Orders. When the Exponent is a Degrees and Orders. When the Exponent is a fimple indeterminate Quantity, 'tis called an Exponential of the first or lowest Degree.

When the Exponent it self is an Exponential of the first Degree, then the Quantity is an Expo-

nential of the second Degree, &c.

Thus zi is an Exponential of the first Degree; because the Quantity y is a simple flowing Quan-

tity. But 30 is an Exponential Quantity of the fecond Degree; because y is an Exponential of

the first Degree. So also zy is an Exponential of the Third Degree; the Expotent yx being one of the second.

See D. Bernoulli's Trastatus de principiis Calculi

Exponentialis: And Craig's Correction also of a Mistake in it; in Phil. Trans. N. 245. p. 374.

Hayes Fluxions, p. 306. Where are Rules to find the Fluxions of Logarithms and of Powers, when the Exponents are Flowing Quantities. As also how to conftruct Exponential Curves, and to determine their Tangents.

EXPROMISSOR, in the Civil Law, is one that discharges the first Debtor, and takes the

Burden upon himself.

EXTEND. To extend, in a Legal Sense, fignifies the valuing of Lands and Tenements of one bound by Statute, &c. and hath forseited his Bond to such an indifferent Rate, as that, by I are now not supposed to be such.

the yearly Rent, the Obligator may in time be

fully paid his Debt.

EXTREMITIES of the Figures in Painting, are the Head, Hands, and Feet; and these should be drawn with more Nicety and Exactness, ot more terminated than other Parts; and must help, by that Means, to render the Action more

expressive.

EYE. Dr. Hook in his Posthumous Works, p. 12. faith, That the discerning Power of the Eye, is not capable of making Distinction of Parts, when they are smaller than the small Pores of Wood; which he found by this Experiment: By a convenient Lens, he brought the Object so near the Eye, that the crossing of the Rays in the Eye was about the middle Space between the visible Side of the Object and the Bottom of his Eye; from whence it followed, that the Picture of the visible Part of the Object was as big as the Thing represented; and the Eye being then at most but capable of seeing or distinguishing those Pores; it follows, that if the Cause of that Distinction be from the Ends of the Filaments of the Optic Nerve, as Descartes ingeniously supposes, the Filaments can't be smaller than the Microscopical Pores of Wood; and that the Eye is uncapable of distinguishing the Parts of any Object that are smaller than those: So that any Object being so far remov'd from the Eye, as that its Picture on the Retina shall be less than a Microscopical Pore, will become invisible; at least if it be but of a dull Radiation; for if it be of a bright one, (as the Stars are) the whole Filament is moved by having one Part of it powerfully acted on; and so we have a Sensation of the Object the same as if it were much bigger. And this seems to be the Reason, why the Stars appear to our naked Eye many thousand Times bigger than they really are, and even as big as thro' a long Telescope, And p. 13, he saith, that if by the Help of Glasses, the Eye can be made capable of collecting a much greater Quantity of Rays from a Point, and make them meet in the Retina, 'tis not improbable, but that a much greater Number of Bodies may be discovered to be Radiant, which

F. By Statute 5 & 6 E. 6. cap. 4. 'tis enacted, That whoever shall maliciously strike any Person with a Weapon in the Church or Churchyard, or draw it there, with an Intent to ftrike, shall have one of his Ears cut off; or if he have no Ears, shall be burnt on the Cheek with an F; that he may be known for a common Fighter or Fray-maker

FABRICK Lands, are Lands given to the Rebuilding, Repair, or Maintenance of Cathedrals, and other Churches, and mentioned in the Act of Oblivion, 12 Car. 2. c. 8. Formerly every one almost gave by his Will something, more or less, to the Fabrick of the Cathedral, or his Parish Church, and these were called Fabrick Lands; and

by the Saxons, Timber Lands.

FACE prolong'd, in Fortification, is that Part of the Line of Defence Razant which lies between the Angle of the Shoulder and the Curtain; or tis the Line of Defence Razant diminished by the

Length of a Face.

FACIA's, in Architecture, as the Workmen call it, (for it should be spelt Fascia,) are nothing but broad Lifts or Fillers, and are commonly made in Architraves, and in the Corners of Pedestals. In Brick Buildings, they call the Jut-tings-out of the Bricks over the Windows in all Stories but the highest, by this Name; these are fometimes plain, and fometimes moulded; and this moulding it only a Scima Reversa, or an O ... G ... at the Bottom, and above this are two plain Courses of Bricks, then an Astragal, and last of all, a Bouleine; which the Workmen call a Bouleil.

FACK, in a Ship, is any one round of a Cable when it is quoiled up out of the Way.

FAGGOT, in Times of Popery here was a Badge worn on the Sleeve of the Upper Garment of fuch Persons as had recanted and abjured what the Powers that then were, did call Heresy; which was put on after the poor Wretches had carried a Faggot, by way of Penance, to some appointed Place of Solemnity. And sometimes they interpreted the leaving off this Badge of the Faggot to be a Sign of Apostacy.

FALDAGE, Faldagium, is a Privilege which antiently several Lords reserved to themselves of fetting up Folds for Sheep in any Fields within their Manors, the better to manure them; and this not only with their own, but their Tenants Sheep, which they called Sella Falda. This Faldage in some Places they call a Fold Courfe, or Free-fold; and in some old Charters 'tis called Foldsoca, i. e. Libertas Faldæ or Faldagii.

FALDFEY, or Faldfee, was a Composition paid some Cuttomary Tenants antiently, that they might have Liberty to fold their Sheep apon their

own Ground.

FARDEL of Land, according to some Writers, is the 4th Part of a Yard Land; but Noy, in his Complete Lawyer, p. 57. saith, two Fardels of Land make a Nook, and four Nooks a Yard Land.

FARDING, or Farthing of Gold, seems to have been a Coin uled in antient Times, containing in value the 4th Part of a Noble, viz. Twenty-pence in Silver: In Weight, the 6th

Shillings in Silver. This Word is used 9 H. 5. c. 7. and there appears to have been a Coin as well as the Noble and Half Noble.

FARDING-deal, or Farundel of Land, was the 4th Part of an Acre.

FAST-Country. A Term used by the Tin-Miners, and fignifies the same with Shelf; which

FASTING Men, Homines babentes. Term which some will have to signify Men of Repute and Substance: But 'tis more probable, that by it was meant rather Pledges, Sureties, or Bondsmen; which, according to the Saxon Custom, were fast bound to answer for one anothers peaceable Behaviour.

FAUSBRAYE. See False Braye.

FEATHER Edg'd, is a Term used by Workmen for such Boards as are thicker on one Edge

or Side than on the other.

FELLOWS, in Fortification, are six Pieces of Wood, each of which form an Arch of a Circle; and these, joined all together by Duledges, make an entire Circle; and these, with 12 Spokes, make the Wheel of a Gun Carriage. Their Thickness is usually the Diameter of the Ball of the Gun they serve for, and their Breadth something

FEODARY, Feodatorious, was formerly the Title for the Seneschal or Prime Steward, who received Aids, Reliefs, Herriots, &c. and such

Customary Fees due to any Lord.
FIBRES. There are other Divisions and Distinctions of Fibres, besides those two mentioned in Vol. I. For, according to some Authors, there are in an Animal Body, Carnous, Membranous, Cartaliginous, Tendinous, Ossens, and Nervous Fibres, according to the Matter of which they con-fift. The Carnous Fibres, of which the Flesh is composed, are vascular and hollow, being full of little Cells: They are called Fibremotices, because they are the chief Organs of Muscular Motion.

There is a Difference also among Fibres, as to their Situation and Course. For those that run lengthwise in Right Lines, are called Strait Fibres: Those that run about some Part, as those do that form Sphinter Muscles, are call'd Circular. Those Fibres which cross Strait ones at Right An. gles are called Transverse; but those which inter-

lect them at any other Angles, Oblique Fibres.

FIDE Juffor, in the Civil Law, is the same with Repromissor, Adpromissor, Sponsor, Prades, and Vades; That is, a Surety, or one that obliges himself in the same Contract with a Principal,

for the greater Security of the Creditor or Stipulator.
FIELD-Colours, are small Flags about a Foot and half Square, which are carried along with the Quarter-master-General, for marking out the Ground for the several Squadrons and Battalions of an Army.

FIELD-Pieces, are small Cannon which are usually carried along with an Army in the Field; such as 3 Pounders, Minions, Sakers, 6 Pounders, Demi-Culverins, and 12 Pounders; and these being small and light, are easily carried.

FIELD-Staff, is a Staff carried by the Gunners; 'tis about the Length of an Halbert, with a Speer Part of an Ounce of Gold, that is, of five at the End, which, on each Side, hath Ears screw'd on like the Cock of a Match-lock; and in these, the Gunners screw in Lighted Matches when they are on Command. And this is call'd Arming the Field-Staffs.

FIFE Rails, in a Ship, are those that are plac'd on Banisters on each Side of the Top of the Poop, and so along with Hances or Falls they reach down to the Quarter-Deck, and to the Stair of the Gangway.

FIGURE. The Rectangle under any Diameter and its proper Parameter, is, in the Ellipsis and Hyperbola, called the Figure of that Diame-

r. De la Hire, Lat. Con. p. 47, 48.
FINERY, is the Name of one of the Fires in Forges in an Iron-work. See Iron. At the Finery, by the Working of the Hammer, they bring the Iron into what they call Blooms and

FIRE. See Light. There is an Account of the Generation of Fire, by Mr. Malbranche, in the Fr. Memoirs for the Year 1699, which is ingenious enough; but it seems to depend entirely on the Hypothesis of Descartes. In the same Book, Mr. Amontons shews a Method of making the Force of Fire supply that of Men or Horses in

Engines, p. 112. FIRE-Master, in our Train of Artillery, is an Officer that gives the Directions and the Proportions of the Ingredients for all the Compositions of Fire-Works, whether for Service in War, or for Rejoycings and Recreations. His Orders are given to the Fire-Workers and Bombardeers, who

are obliged to execute them.

FIRE-Workers, are subordinate Officers to the Fire-Masters, but they command the Bombardeers: They receive the Orders from the Fire-Masters, and see that the Bombardeers execute them.

FIRME, the same with a Farm, or Land and Tenements hired at a certain Rate. But it antiently fignified the Reception and Entertainment of the King, or any other Lord and his Retinue; and frequently in the Doomsday Book, a Condition of Tenute was pro firma per unum diem, or pro firma per unum noctem : And fo, because in the Saxon, and part of the Norman, Times, the Rent of Lands was paid in Provisions, Firma signified the Profits and Rent of an Estate: But Henry II. for better Convenience, alter'd this Custom into an Equivalent of Money; which Pecuniary Rent

was still call'd Firma Regis,
FIRST-Fruits, Primitia, are the Profits of every Benefice for one Year, given before the Reformation to the Pope; but by 26 H. VIII. c. 3. translated to the Crown: And by that Act, he which enters on any Spiritual Living before he pays or compounds for it, on Conviction, for-feits the double Value thereof. Every Clerk therefore, before his Induction, (or soon atter,) should go himself with one Friend of the City of London, Inns of Courts, or Parts adjacent, or send two such Friends for him, to the First Fruits Office, and there enter into Bond to pay the First Fruits of his Benefice within two Years next ensuing, at sour equal Half-yearly Payments. Only one Tenth of the whole Yearly Sum mention'd in the Queen's Books to be deducted; becanse that must be paid by itself the first Year. Formerly four Bonds were given for the four feveral Payments; but by Statute 2 and 3 of Her

The Successor is chargeable with Arrears of Tenths due from his Predecessor; and consequently, by 27 H. VIII. c. 8. is impower'd to distrain his Predecessor's Goods, being upon the Benefice, and hath likewise a good Action at Law, against him, or his Executors.

FISH-Block, in a Ship, is the Block which is

hung in a Norch at the End of the David, and ferves to hawle up the Fluke of the Anchor to the

Ship's Row.

FISHES. Rondeletius distinguishes Fishes, from the Places where they are found, into Sea Fish, River Fish, and Lake or Pond Fish; and of these he makes some other Subdivisions. But Mr. Wila loughby saith rightly, That Fishes are much better divided by Aristotle into these three Kinds, Cetaceous, Cartilaginous, and Spinous.
The Cetaceous Kind (which are sometimes

therefore call'd the Bella Marina) have Lungs and Breath like Quadrupeds, they copulate also like them, conceive and bring forth their Young alive, whom they suckle with their Milk.

The Cartilaginous Sorr, are produc'd from large Eggs like Birds, which are excluded the Womb also like those of Birds.

The Spinous Kind, are also Oviparous, but their Eggs are smaller, and they have Spine up and

down in their Flesh to strengthen it.

But he thinks it would be yet more proper to divide Fishes into the Cetaceom Kind, or such as breath with Lungs, and into such as breath with And then, to subdivide those that breath with Gills, not into Cartilaginous and Spinous, but into Viviparous and Oviparous.

The Viviparous Kind, that breath with Gills, he subdivides into Long, such as the Gales, and Canes or Sharks, and Dig. Fish: And the Broad Kind; such as the Pastinaca, Raja, Squatina, &c. all whose Subdivisions he gives in his Chapter of

Cartilaginous Fishes in general.

The Oviparous Kind, that breath with Gills, are the most numerous; and these he subdivides into fuch as are what we usually call Flat Fish; and such as swim with their Backs upright, or at Right Angles to the Horizon.

The Plain or Flat Fish Kind, called usually Plani Spinosi, are either Quadrati, as the Rhombi and Pafferes; or Longinfculi, as the Sole &.

Such as swim with their Backs erect; are either Long and Smooth, and without Scales, as the Eel Kind; or Shorter and less Smooth: And these have either but one Pair of Fins at their Gills, which are call'd Orbes and Congeneres; or else another Pair of Fins also on their Bellies. And this latter Kind he divides into two others; 1. Such as have no Prickly Fins on their Backs, but Soft and Flexile ones. 2. Such as have Prickly Fins upon their Backs.

Those Fishes which have only Soft and Flexile Fins on their Backs, may be divided into such as have Three, Two, or but One single Fin there. No Fish but the Aselli have Three Fins on their Backs.

Fishes with Two Fins on their Backs, are either the Truttaceous or Trout Kind, or the Gobionite,

or Loch or Gudgeon Kind.

Fishes with but one foft Back Fin, are of three Sorts; the first Kind have one long continued Fin from Head to Tail, as the Hipparus of Rondelesius, &c. the second have this Fin, but hort, and present Majesty, but one Bond only is appointed to be given; and the Rates of all Benefices, according to the Queen's Books, are declared unaltoplaced just in the Middle of their Back; and these Carp, Tench, &c.

Such Fishes as have Prickly Fins on their Backs, are of two Kinds:

1. Such as have Two prickly Fins on their Backs; and in these the Anterior Radii of their Fins are always prickly: Or,

2. Such as have but one prickly Fin there.

Mr. Willoughby gives us this Catalogue of our English Fishes.

1. Of the Long Cartilaginous Kind; are the 1. Canis Curcharius, or Lamia, the White Shark.

2. Galeus Glaucus Rondeletii, the Blue Shark.

3. Canis Galeus Rondeletii; called a Tope in Cornwal.

4. Galeas acanthias sive Spinax, the prickled Dog or Hound Fish.

5. Galeus seu Mustela lavis, the smooth or unprickled Hound Fish.

6. Catulus major, vulg. Canicula Aristotelu, the Rough Hound; in Cornwal, the Bounce.

7. Catulus minor, the leffer Hound Fish or Morgay.

2. Of the Plain Cartilaginous Kind; are the

1. Raja levis undulata, the Skate or Flare.

Raja Clavata, the Thornback.
 Raja Aspera Nostras, the White-borse.

4. Squatinu, the Angel or Monk-Fish.

5. Rana Piscatrix, the Toad Fish or Sea-Devil.

3. Of the plane Spinous Kind; are the

1. Rhombus Maximus Aspero Squammosus, the Turbot or Brett.

2. Rhombus non acculeatus squammosus; in Cornwal call'd the Lug-alefe.

3. Paffer Bellonii, the Place.

4. Passer Asper sive Squammosus, the Dab. 5. Passer Fluviatilis sive Amphibius, the Flounder, Fluke, or Butt.

6. Hippoglossus Rondeletii, the Holy-Butt; call'd in the North the Turbot.

7. Buglossus or Solea, the Sole.

4. Of the Eel Kind; we have,

1. Lampetra major, the Lamprey, or Lamprey Eel.

2. Lampetra parva and Fluviatilis, the Lampern.

3. Anguilla, the Common Eel.

4. Conger, the Conger or Sea Eel.

5. Ammodytes Gesneri, the Sand Eel or Launce.

6. Gunnellus Cornubiensis, the Butter Fish.

7. Mustela vulgaris Rondel, the Sea Loach or Whistle-Fish.

8. Mustela Fluviatili, the Eel Pout, or Turbou.

9. Lupus Marinus, the Wolf Fish, or Sea Wolf.

10. Alauda non cristata, the Sea Lark; called in Cornwal Mulgranoc and Bulcard. 11. Alauda Christata, the Crested Sea Lark.

12. Liparis Rondeletii. 13. Gobio Fluviatilis, the Bull-head or Millersthumb.

14. Scorpana Bellonii Similis, the Dutch-Pots. Hog; the Cornish Boys call it Father-Lasher.

5. Of the Kind of Fithes wanting the Belly Pair of Fins; we have,

I. Mola Salviani, the Sun Fish.

2. Acus Aristotelis, Species major. 3. Acus Aristotelis congener, the Sea Adder.

4. Xiphias, seu Gladius piscis, the Sword Fish.

6. Of the non Spinous Kind of Fishes, with 3 unprickly foft Fins on their Backs; we have,

1. Asellus oulgaris major, the Cod-fish, or Kaling.

2. The Whiting Pollack.

3. Asellus Niger, the Colefish, or Rawling Pollack.

4. Asellus Lucus, the Bib or Blinds.

5. Asinus Antiquorum (Turn.) the Haddock.

6. Asellus mollis major, the Whiting.

7. Of the non Spinous Kind, with only 2 foft Fins on their Backs; are found with us,

1. Merlucius, the Hake.

2. Afellus longus, the Ling:

3. Thynnus, see Thunnut; the Tunny, or Spanish Mackrel.

4. Scomber, the Mackrel.

5. Thymallus, the Gragling, or Umber.

6. Albula Salmoni Similis, the Guinnard.

7. Albula Harengi formis, the Schelley.

8. Salmo, the Salmon.

9. Salmulus, the Samlett, or Branlin.

10. Salmo Grifeus, the Gray

11. Trutta Salmonata, the Salmon Trout.

12. Trutta Lacustru, the Scurf, or Bull Trout.

13. Trutta Fluviatilis duum generum, the Trout.

14. Umbia Minor Gefn, the Red Charr, or Welsh Torgoch.

15. Carpio Lacu Benaci, the Guilt or Guilt Charr.

16. Eperlanus seu Violæ, the Smelt.

17. Golius Niger, the Rock Fish or Sea Gudgeon.
18. Lumpus Anglorum, the Lump or Sea Owl.

19. Cataphractus Schonfeldis, in the West of England, a Dog.

8. Of the non Spinous Kind, with only I Fin on the Back; we have,

1. Harengus, the Herring.

2. Harengus minor, the Pilchard, called also Calchis.

3. Encrassicholus, the Anchoris.

4. Alosa seu Clupea, the Shad or Mother of Herrings.

5. Sardina, the Sprat or Sparling; which is nothing else but the Fætus of a Herring

6. Acus Vulgaris, the Garr-Fish, or Horm-Fish.

7. Sturio; the Sturgeon.

8. Lucius, the Pike or Pickrel.

9. Cyprinus, the Carp.

10. Cyprinus Latus, the Bream, or Bruma.

11. Tinca, the Tench.

12. Orfus Germanorum, the Rudd, Oerve, or Nerfling.

13. Capico, seu Cephalus, the Chub or Chevin.

14. Barbus, the Barbel.

15. Leuciscus, the Dace or Dare.

16. Rutilus, seu Rubellas, the Roach.

17. Alburnus, the Bleak or Bley.

18. Gobius Fluviatilis, the Gudgeon.

19. Bobises Fluviatilis barbatula, the Loche. 20. Varias, seu Phoxinus levis, the Pink or

The last Twelve of these are called by us (Malacostomi) Leather-mouthed Fishes; because they have no Teeth in their Jaws, but only deep down in their Mouths.

9. Of the Spinous Kind with 2 Fins on their Back, of which the Foremost is aculeate; we have,

Minnow.

1. Lupus, the Basse.
2. Mugil, the Mullet.

3. Gurcardus Piscis, the Gray Garnard.

4. Hirundo Aldrovandi, the Tub-Fish.

5. Cuculus Aldrovandi, the Red Garnard, or Rotches.

6. Lyra prior Rondel, the Piper.

7. Mullus major, the Sur-Mullet.

8. Draco, sive Araneus Plinii, the Spider.

9. Frachurus, the Scud.

10. Perca Fluviatilis, the Perch.

11. Faber Piscis, the Dorge.

10. Of

- to. Of the Aculeat Kind, with only one Fin on the Back, whose Radii are some prickly, and some soft; we have,
 - 1. Aurata, the Gilt-bead, or Gilt-poll.

2. Pagrus, the Bream

3. Turdus vulg. the Old Wife or Wrass.

4. Perca Fluviatilis minor, seu auratu, the Ruff. 5. Piscis Aculeatus vulgaris, seu pungitius A-berti, the Common Prickle-Back, or Sharp-

ling, or Banstickle. 6. Pisch aculeatus minor, the lesser Prickle-Back.

- 11. Of the Cetaceous Kind, we account only,
 - 1. Balana Britannica Antiquorum; which now feems to be gone from our Seas, and we fearce know what kind of Fish it was.

2. Balana vulg. Rondel, the Whale, which is fometimes found ftranded on our Coasts; or rambles up our Rivers.

the Dolphin, very 3. Delphinus Antiquorum,

rarely, but sometimes seen here.

4. Phocana, the Porpuss, call'd by Schonfeld, the Northern Dolphin.

FITS of easy Reflection of the Rays of Light; so Sir Isaac Newton, in his Opticks, calls the Dilposition of the Rays to be reflected at any Time; and their Disposition to be transmitted, he calls,

FITS of easy Transmission: And the Space it passes between every Return and the next Return, he calls the Interval of its Fits. Opt. Book II. See Light.

P. 3. See Ligue.
FIXED Stars. The Phoenomena's that have been ofety'd by Aftronomers about the Fix'd Stars

are thefe:

r. That they all, together also with the Planets, or Erratick Stars, and all the Celeftial Bodies, do appear every Day to rise and set; and to move with a Circular Motion from East to West; the Plains also of these Diurnal Circular Revolutions being at Right Angles to the Earth's Axis, or Parallel to the Equator.

All which is fairly and eafily accounted for, by supposing our Earth to revolve round its own Axis in 24 Hours, from West to East. But the Eye of the Spectator moving together with the Earth, that must appear to him immovable; as a Ship doth to those that are in it, till by Observation and Judgment they come to find it otherwise.

Provebimur Portu, Calique ac Astra recedunt.

2. It hath been observ'd of the Fix'd Stars, that befides the former apparent Motion round the Earth in 24 Hours, they also seem to have an. other which is quite contrary to that; for they appear to change their Longitude, or Distance from the Beginning of Aries, forward according to the Order of the Signs, or to move in Confequentia by a flow Motion of about a Degree in 70 Years. So that those Stars which in Hipparchus, nay even in Ptolemy's Time, were in Aries, are now found to be in Taurus; and so on all round the Zodiack.

As to which, we must consider that the Terminus à quo, or Point from whence this slow Motion is propagated, being the Vernal Equinoctial Point, or the Eastern Intersection of the Equinoctial and Ecliptick; till it can be determin'd whether this Point be fix'd or moveable, it cannot be Vol. II.

known whether the Stars move from that, or that Point from them: And indeed the latter is much more probable, when we compare with this what certainly happens in other Instances in the Heavens. For 'tis well known now, that the Nodes of the Orbits of the secondary Planets, or the Points of their Intersection with the Ecliptick, do shift and change, and go a little backward, or move in Antecedentia; as is very evident in the Nodes of the Lunar Orbit: Why may it not be so then with the Nodes of the Earth's Orbit? The Pracession therefore of the Terrestrial Equinoxes may serve to account for this Motion of the Fix'd Stars, fince the Quantity will be found the same in both. For from the Newtonian Principles, it appears, the Terrestrial Nodes should go backward, after the Rate of about 50 Seconds every Year; and just so much the Fix'd Stars have been observ'd to move forward

every Year.
3. It hath never been observ'd, that the Fix'd Stars have changed their Latitude, though, as be-

fore, they annually do their Longitude.

Which is a difficult Thing to account for without the New Astronomy. For allowing the for-mer Motion of the Fix'd Stars, how can they all, and always, keep the same Distance from the Ecliptick? 'Tis true, the Celestial Orbits are all found to be in immovable Plains, but those Plains are different, and do intersect each other with different Angles; nor is there any two of the Primary Planets, whose Orbits are in the same Plain. If therefore these Stars had any such Motion, as that seeming one of Longitude, 'tis very likely that their Orbits would be posited with respect to some one great and peculiar Plain, and which should be inclin'd in a peculiar Manner to the Plains of the other Orbits, so as that their Orbits would intersect the Ecliptick, and the Orbits of the Planets; but fince there is no fuch Thing observed, itis likely, that Motion of Longitude belongs not to the Stars, but to the Nodes of the Earth's Orbit, as has before been But allowing that Recession of the ihewn. Earth's Nodes, 'tis evident why the Stars should have (or appear to have) a Motion in Longitude, but none in Latitude; because that Recession of the Terrestrial Nodes happens without any Change of the Earth's Annual Motion as to the Plain of the Ecliptick; for if the Stars themselves are immovable, and the Earth's Orbit (or the Ecliptick) be always an immovable Plain, there can be no such Thing as any Change in the Latitude of the Stars.

The Diameters of the Fix'd Stars are very small, scarcely sensible even in the largest Telescopes, seen through which, they appear but like Lucid Points, and without any of those adsciti-

tions Rays which ftrike the naked Eye.

5. The Fix'd Stars have no Diurnal Parallax, but, as hath lately been discover'd by Dr. Hook and Mr. Flamstead, a small Annual one; and consequently their Distance must be immensely great. In order to guels at which, Mr. Hugens supposes the Dog. Star, Syrius, to be about the Bignels of our Sun; and then considers how remote our Sun must be placed, before his Diameter would appear as little as that of Syrim: And on the whole, he concludes, that Syrius and the nearest Fix'd Stars, cannot be less distant than 15000000000 of our Miles from the Earth, which is 27000 times as far off as our Sun is from us.

And by that Annual Parallex which hath been ound to belong to the fix'd Stars, and is about 47 Seconds, they conclude, that they are diftant from us about 9000 times the Radius of the Magnus Orbis, i. e. 9000 times as far off as the Sun; or about 500000000000 Miles.

6. The Milky Way is a circular Tract in the

Heavens, extending over a very confiderable Part of them; and is so call'd, because it looks white and brighter than any other Part of the Sky. And this, by the Telescope is discover'd to be a Congeries of very small Stars, which are singly in-

conspicuous to the naked Eye.

7. There are above 1000 Stars which are visible to the naked Eye; but the Telescope hath discover'd about 20 times as many more: And the larger and better those Glasses are, the more are still discover'd.

8. The Light of the Fix'd Stars is much more ftrong and vivid than that of the Planets, tho their apparent Diameters are much less; because the Stars, like the Sun, shine by their own Native Light, but the Planets only by Reslection

from the Sun.

The Fix'd Stars are observ'd to twinkle much more than the Planets: because their ap parent Diameters being very insensibly small, the least Atom or Particle of Matter floating in our Atmosphere will hinder (for a Moment) the Stars being entirely visible. As the gross Smoak of a Chimney will do by the Planets themselves, which in such a Case will twinkle.

That there are Changes and Alterations among the Fix'd Stars, hath appear'd by the Observa-

tions of our Modern Aftronomers.

In Phil. Trans. N. 73. there is an Account that S. Mentanari found two Stars of the 2d Magnitude wanting in the Navis, in the Year 1668, April 10. which were certainly visible before. And that he had made many such Observations of

Stars of less Note.

Cassini hath discover'd also many new Stars: One of the 4th, and two of the 5th Light, in Cassiopeia; two others in Eridanus; and four to-wards the Artick Pole, which he is sure were not visible formerly. He takes Notice also of several in Bayer's Catalogue, which do now disappear. Hevelius, in 1666, found a new Star in Pettore Cyg. ni. And Don. Anthelme, a Carthusian at Dyon another in the Head of that Constellation. And this both he and Mr. Cassini observ'd to be twice in great Splendor, and as often diminishing.

Bullialdus observ'd the new Star in the Neck of the Whale, to be very different in his Magnitudes at different Times. And Hevelius observes the same Thing of another Star in the same Con-

Rellation.

From all which Observations, and many others might be produc'd, 'tis plain, there are very great Changes and Alterations amongst even the

Fixed Stars themselves.

And if that noble Conjecture of our Modern Astronomers be true, that each Fix'd Star is a Sun to some System of Planets moving round him, as we do round the Sun, there must needs be terrible Changes in those Planetary Worlds; and those probably both Conflagrations and Deluges. Of this, see more in Whiston's Astronomy,

from their vast Distance, and their affecting out Eyes with so strong and vivid a Light; which they could not do, if they were not actually blazing Fires: And that they are so, the Disappearance of some Stars, which have formerly been visible, and the Appearance of new ones, doth much confirm.

And the incomparable Sir If. Newton, in the Latin Edition of his Opticks by Mr. Clark, hath, to p. 83. added this Note; by which we may conclude the Fixed Stars to be at an immense Di-

stance from us.

" That the Fixed Stars, by reason of their im-" mense Distance, are to be look'd upon as Points, (unless fo far as their Light is dilated by Refraction) is plain from hence: That when by the Moon's Appulles to them they are eclipsed or cover'd by her Body, their Light doth nor, like that of the Planets in the like Case, va. nish or disappear gradually, but at once and all together; and when they emerge again out of the Eclipse, they don't become visible by degrees, but, as it were, inflantaneously, or at " least in the Space of 1 or 2 Seconds.

Besides what hath been said in the former Vol. and above, Dr. Cheyne adds this further Guess at the Immensity of the Distance of the Fix'd Stars.

Tho' we on this Globe approach nearer to some of them about 24000 Diameters of the Earth, i. e. about 188304000 Miles (of 5000 Foot in a Mile) at one time of the Year than we do at another; yet their Parallax, if any at all, is scarcely then sensible, which it must be, if they were

at an estimable Distance from us.

Mr. Hurgens computes, that the Distance of the Sun, to that of the nearest Fix'd Star, is as I to 27664. That is, (allowing the Distance of the Sun to be 12000 Diameters of the Earth, and a Diameter to be 7846 Miles, according to the best Calculations) the Distance of the nearest Fix'd Star from us, is at least 2404520928000 Miles; which is so great, that if a Cannon Ball (going all the Way with the same Velocity it hath when it parts from the Mouth of the Gun) would scarce arrive there in 700000 Years.

In Philos. Trans. N. 202. there is a Method of finding the Parallax of the Fix'd Stars, which Dr. Wallis acquaints Mr. Molyneux with; but

both those Persons are since dead.

FIXITY. To the Production of this Property of Fixity, there is necessary chiefly a Supposition of the Particles attracting one another, within a certain Distance, with a very violent Force; or elle they could never keep together, when preis'd by a violent Heat; which yet we find the Particles of some fix'd Bodies will do. See Cobesion.

FLAME-beat. The same with a White-beat;

FLAT-pointed Nails, are of two Sorts, the longer are used in Shipping, and are very proper to hold where you cannot clench; the shorter are fortified with Points to drive into Oak, and are used to draw Sheathing-Boards to, &c.

FLAW, at Sea, fignifies a suddain Gust of Wind, which sometimes also the Seamen call a Squale. FLEXION and Retrogressian of Eurves. Sco

Contrary Flexion.

FLIGHT. In melting the Lead-Oar in the Works in Mendip, there is a Substance flies away Dr. Hook, Op. Possibum. p. 109. gives very pro-bable Reasons why the Fix'd Stars should be of the same Nature with the Sun; which are drawn

Works in Mendip, there is a Substance sites away
in the Smoak, which they call therefore the Flight.

They find it sweetish upon their Lips, if their Fathere is a Substance sites away
in the Smoak, which they call therefore the Flight.

They find it sweetish upon their Lips, if their Fathere is a Substance sites away
in the Smoak, which they call therefore the Flights.

They find it sweetish upon their Lips, if their Fathe same Nature with the Sun; which are drawn they avoid all they can. This falling on the Grass, kills Cattle that feed there; and being gather'd and carried Home, kills Rats and Mice in their Houses. That which falls on the Sand, they gather and melt (upon a Flag-bearth) into Shot and Sheet Lead.

FLORENS, were Gold Coins in the 18th of our Edw. III. of the Value of 6 Shillings. Cambden saith, they were so called, because made by Florentines: And Fabian saith, they were not of so fine Gold as the Nobles and balf Nobles of that

Prince.

But what is most observable, is, that Fabian calls the Floren a Penny, val. 6s. 8d. the half Floren an Halfpenny, val. 3s. 4d. the Quarter Floren a Farthing, val. 1s. 8d. And these Words you will often meet with in old Histories and Accounts, applied to several Coins, as Rials and Angels, &c. where you are to understand, by Denarius the whole, by Obolus the half, and by Quadrans the 4th Part or Farthing. Chr. Preciolum P. 22.

By Indenture of the Mint, in 18 Edw. III. every Pound Weight of old Standard Gold was to be coined into 50 Florences, to be current at 6 Shillings a-piece; all which made, in Tale, fifteen Pounds: Or into a proportionable Number of half or quarter Florences. Cowel's Interpreter.

FLUIDITY. Besides what hath been said of this Quality in the former Vol. I must add here, That the Corpuscular Philosophy, before Sir Is. Newton's wonderful Improvement of it, did not go to the Bottom of this Matter; for it gave no Account of the Cause of the chief Condition requisite to constitute a Fluid Body, viz, the various Motions and Agitations of its Particles. But this may be in a good Measure accounted for, if you suppose it to be one of the Primary Laws of Nature, that as all Particles of Matter do attract one another when they come within a certain Di-ftance, so, at all greater Distances from one another, they do fly away from, and avoid one another. For then, though their common Gravity may keep them together in a Mass, together (it may be sometimes) with the Pressure of other Bodies upon them; yet their continual Endeavour to avoid one another fingly and the adventitious Impulies of Light, Heat, or other external Causes, may make the Particles of Fluids continually move round about one another, and fo produce this Quality. It is, indeed, a Difficulty I cannot yet get over, to account for the Particles of Fluids always keeping at such a Distance from one another, as not to come within the Sphere of one another's Attraction. The Fabrick and Constitution of that fluid Body of Water is wonderful and amazing, that a Body so very rare as that is, and which has such a vast Over-proportion of Pore, or interspersed Vacuity, to solid Matter, should yet be perfectly incompressible by the greatest Force. And yet this Fluid is easily reducible into that firm, transparent, friable Body, which we call Ice; by being only exposed to a certain Degree of Cold. One would think here, that though the Particles of Water cannot come near enough to attract each other, yet the in ervening Frigorifick Matter doth, by being mingled per minima with them, strongly attract them, and is itself also strongly attracted by them, and sowedges or fixes all the Mass into a firm solid Body: Which solid Body loses its Solidity again, when by Hear the Vinculum is folv'd, and Vol. IL.

these Frigorisick Particles are disjon'd from those of the Water, and are forc'd to fly out of it. And perhaps just thus doth the Fumes of Lead six Quicksilver.

When a firm solid Body, such as a Metal, is by Heat reduc'd into a Fluid; doth nor the Fire disjoin and separate its constituent Particles, which mutual Attraction caused to cohere before, and keep them at such a Distance from each other, as that they are without the Sphere of one another's Attraction as long as that violent Motion lasts? And don't they, when that is over, and the Heat is slown out, come nearer to, attract one another, and coalesce again?

As therefore the Caule of Cohesion of the Parts of solid Bodies appears plainly to be their mutual Attraction; so the chief Cause of Fluidity seems to be a contrary Motion impressed on the Particles of Fluids, by which they avoid and fly one another as soon as they come at, and as long as they keep at such a Distance from each

Other.

'Tis observ'd also in all Fluids, that the Direction of their Pressure against the Vessels that contain them, is in Lines perpendicular to the Sides of such Vessels; which Property being the necessary Result of the Particles of any Fluids being spherical, it shews that the Parts of all Fluids are so, or of a Figure very nearly approaching thereunto. For Fluids in an Animal Body, see Glands in Vol. II.

FLUTES, in Architecture, are the Hollows made in the Body of a Column or Pillar, and which then is said to be Fluted. The Dorick, Ionick, Corinthian and Composite Columns, are usually fluted all along the Body of the Pillar, from the Base to the Capital. Each Column hath 24 Flutes, and each Flute is hallowed in exactly a quarter of a Circle. In the Dorick Column the Flutes join together without any Interspace; but in the Ionick, Corinthian and Composite Orders, there runs a List between every two Flutes,

FLUXIONS. This general Method of finding the Fluxions of all Powers and Roots, I had from the Honourable Fr. Robarres, Esquire.

If a Quantity gradually increases or decreases, its immediate Increment or Decrement is called its Fluxion.

Or the Fluxion of a Quantity is its Increase or Decrease indefinitely small.

Let a Quantity x be put into Fluxion, whereby it becomes $xx \pm x(x)$ representing an Increment or Decrement indefinitely little, being called the Fluxion of x).

Now the Fluxion of all the Powers, and of all the Roots of x, may be found by this general Rule:

As x + x contains the simple Quantity and its Fluxion; so the Square, Cube, Sc. and the Square Root, Cube Root, Sc. of x + x must contain the respective Powers or Roots of x with its Fluxion respectively.

its Fluxion respectively.

And consequently, if the Flowing Quantity be respectively substracted, the Fluxion only must remain.

 Pluxion of $x \times x$ is $x + x \times 2 \times x + x \times + x \times x$ -xxx = 3xxx + 3xxx + xxx.

But fince xx, Part of the Fluxion of xx, is infinitely (maller than 2 x x, whereby it can make no sensible Change in that Quantity, it may be laid aside as of no Value.

And for the same Reason, 3 xxx + xxx may be left out of the Fluxion of xxx; fo that their remains only

$$2xx$$
. for the Fluxion of $\begin{cases} xx \\ xxx \end{cases}$

Thus also the Fluxion of \sqrt{x} is $\sqrt{x} + x$

 $-\sqrt{x} = 2\sqrt{x}$; which will be evident, by only extracting the square Root of x + x according to the common Method, thus;

$$x + \dot{x} \left(\sqrt{x} + \frac{\dot{x}}{2\sqrt{x}} \right)$$

$$2 \sqrt{x} + \dot{x}$$

$$\frac{\dot{x}}{6} \qquad \frac{\dot{x}\dot{x}}{4x}$$

The Fluxion of
$$\begin{vmatrix}
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\dot{x}
\end{vmatrix} = \begin{cases}
\frac{\dot{x}}{3\sqrt{x}} \\
\frac{2xx}{3\sqrt{x}xx}
\end{cases}$$

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So that $\sqrt{x+x}$ is equal to $\sqrt{x+\frac{x}{2\sqrt{x}}}$ \sqrt{x} , which is equal to $\frac{x}{2\sqrt{x}}$ the Fluxion of \sqrt{x} , as above.

Indeed $\sqrt{x} + \frac{x}{2\sqrt{x}}$ is the true Root of $x + \frac{1}{x} + \frac{x}{4} = \frac{x}{x}$ as the Operation shews, and consequently somewhat bigger than the Root of $x + \dot{x}$. But $\frac{xx}{x4}$ being indefinitely less than what is annex'd to the Difference between $x + \dot{x} + \frac{x x}{4 x}$ and $x + \dot{x}$, may be confider'd as of no Value. Wherefore $\sqrt{x} + \frac{x}{2\sqrt{x}}$

may be taken for the true Root of x + x.

Authors Names who have written of Fluxions: D. Bernoulli Tractatus de Principiis Calculi Exponentialis.

Nieuwentyt's Analysis Infinitorum. Amster. 1695. Dr. Cheyne's Fluxions, with Moivre's Animadversions on them; and the Doctor's Reply.

Hays's Fluxions. Lond. 1704. Analyse des Insiniment Petits. Par l' Hospital Fr. Paris, 1696.

Le Calcule Integrale, par M. Carre. Paris, 1700. Mr. Abraham de Moiver's Use of Fluxions, in the Solution of Geometrick Problems. See Philof. Trans. N. 216.

Mr. Humphrey Ditton's Institution of Fluxions.

FLYBOAT, is a large Vessel with a broad Bow; used by Merchants in the Coasting Trade. Some of these will carry 800 Tun of Goods.

FLYERS, is the Workmens Term in Architecture for Stairs that go strait, and don't wind round; nor are the Steps tapering, but the fore and back Part of each Stair and the Ends are respectively parallel to one another. So that if one Flight don't carry you to your design'd Height, there is a broad half Space; and then you fly again with Steps every where of the same Breadth and Length, as before.

FLYING Bridges, in Fortification, are made of two small Bridges laid one upon the other, fo that the uppermost, by the means of Ropes and Pullies, is forc'd forwards 'till the End of it join to the Place design'd.

FOCUS. Dr. Hook, Op. Post hum. p. 122, very well

accounts for the Reason of the great Effect of Burning Glasses, thus: Suppose there be one, either Concave or Convex, of a Foot in Diameter; this will constipate or crowd together all the Rays of the Sun, which fell before on the Area of a Circle 12 Inches in Diameter, into the Compass of i of an Inch. The Area's then of the two Circles will be as 9216 to 1; and consequently, the Heat of the Lesser, to the Heat of the Greater, will be reciprocally as 9216 to 1: That is, the Heat in the Focus will exceed the Sun's common Heat at that time 9216 Times. And this will have an Effect, as great as the direct Rays of the Sun would have on a Body plac'd at one 96th Part of the Distance of the Earth from the Sun, or on a Planet that should move round the Sun, at but a very little more than a Diameter of the Sun's Distance from him, or that would never appear further from him than about 36 Minutes.

FODDER, or Fother of Lead, is a Weight containing eight Piggs; every Pigg three Stone and an half. In the Book of Rates, a Fodder of Lead is said to be 2000 p. Weight; at the Mines, it is 22 Hundred; and among the Plumbers,

at London, it is but 19 1 Hundred.

FOETUS. The Fæsus is almost of an Oval Figure, whilst it lies in the Womb: For its Head hangs down with its Chin on its Breaft; its Back is round; with its Arms it embraceth its Knees, which are drawn up to its Belly; and its Heels are close to its Buttocks; its Head is upwards, and its Face is towards the Mother's Belly. But about the 9th Month, in the Humane Fœtus, the Head, which was specifically lighter than any other Part, becomes specifically heavier; its Bulk bearing a much smaller Proportion to its Substance than it did before; and consequently it must now tumble and sink down in that Liquor in which it swam, as it were, besore: So its Head falls down, its Feet get up, and its Face turns towards the Mother's Back. But because 'tis then in an irksom, tho' proper, Posture for its Exit, the Motion it makes for Relief gives frequent and great Pains to the Mother; which cause a Contraction of the Womb, for the Expulsion of the Fatus. When it happens to present it self in any other Posture, it should be

carefully put back again; and, if possible, turn'd the right Way by the Midwise: But if that can't be done, it should be drawn out by the Feet.

FOLIATE. In Phil. Trans. N. 245. there is Way, communicated by Sir Rob. Southwell, of The Mixfoliating the Globe Looking-glasses. ture is of Quickfilver and Marchasite of Silver of each 3 Ounces; Tin and Lead, of each half an Ounce. These two first thrown on the Marchasite, and last of all the Quicksilver. Stir them well together over the Fire; but they must be taken off it, and be towards cooling, before the Quickfilver is put to them. When you use When you use it, the Glas should be well heated, and very dry: But it will do also when 'tis cold, but best when the Glass is heated.

This is a little odly express'd: But I suppose 'ris meant, that the Marchasite should be powder'd, the Lead and Tin melted and poured upon it, and then all well stirred and mixed together while in Fusion; and afterwards, when 'tis almost cold, the 3 Ounces of Mercury put to it to

make the Amalgam.

FOLK-Land, was the Terra vulgi; the Land of the Common People who had no Estate therein; but held the same under such Rents and Services as were accustomed or agreed, at the Will only of their Lord the Thane; and therefore their Bargain was not put in Writing, as that about the Boc-Land was, but was accounted Pradium Rufti-

cum & Ignobile.

FOLKMOTE, was the general Word for a Popular Convention of all the Inhabitants of any Place; which if it were of those of a City or Town, it was called a Burgh-more; but if of all the Free Tenants of a County, 'twas called a Schire-mote. In Towns and Burghs, this solemn Affembly was made by the Sound of a Bell call'd the Mothell. In the County Folk-mote, all Knights and Free Tenants did their Fealty to the King, and elected their annual Sheriff for-merly, (on the 1st of Ollober) before the King nominated. But after that, (about the Time of Edward II.) the City Folk-more was changed into the Common-Council, and the County Folkmote into the Sheriffs Turn and Affifes. The Word Folk-mote had also sometimes a less Extent, signifying only the Affembly of the Tenants to a Court Leet or Baron of their Lord.

FOOT-Bank, or a Banquette, in Fortification, is a small Step of Earth on which the Soldiers

stand to fire over the Parapet.

FOOT-gelde, was an antient Amerciament for not cutting out the Balls of the Feet of great Dogs in the Forest; which was done for preventing their running after the King's Deer; and was called Expediation.

FORAMEN Arteria Dura Matris, is a Hole in the Cranium, which allows a Passage for the

Artery belonging to the Dura Mater.

FORAMEN Lacerum, in the 3d Hole in the
Os Pharoides, by which the 3d Pair of Nerves

pals out of the Cranium.

FORE-Staff, is an Instrument used at Sea to take the Sun's Alritude, or the Heighth of the Moon, or any Star in the Night; and 'tis so call'd, because when 'tis used, your Face is to the Object: Whereas in the Use of the Back-staff, or David's Quadrant, the Back of the Observer is towards the Sun. The Fore-staff is the same with them by 4, the Denominator; for then a Quothe Cross-Staff: Which you will find fully detrient of the same Value will arise, (for 4) 60 s. scrib'd in this Vol. under that Word.

FORMELLA, was a Weight of Lead, which in 51 H. 3. A. D. 1267. is said to contain six Petra, except 2 lb. Each Petra contain'd 12 lb. and each Pound contain'd the Weight of 25 Shillings.

FORNICATION, is formetimes used in Architecture, to fignify Arching or Vaulting.
FORTIFICATION. Writers on this Subject.

Sir Jonas Moor's Modern Fortification. London, 1673. 8vo.

Nouvelle Maniere de Fortisier les Places, par M. Blondel. Hague, 1684.

La Grand Art d' Artillerie, par Casimir Symyenwicks. Frankfort, 1676.

Les Fortifications d' Antoine de Ville. Lyon, 1618. Fortificationi di Buono ajuto Lorini. Venet. 1597.

Corona Militari d' Artiglieria di Alessandro Capo. *Ibid*. 1602.

F. L. Vegetius & alii de Re Militari, cum Fig. Paris, 1539

Cohorn's Fortification, Engl. by Cap. Savery. Blondell's Art de Jetter des Bombes.

Anderson's Gunnery

Fortification and Military Discipline, by C. John Steed.

Norwood's Fortification.

L' Arte de Fortifier, par M. Dechales. L' Arte de Fortification, par M. Ozanam.

FORTINGLES, the same with Farthingdell;

i. e. the 5th Part of an Acre, Penny, &c. FORTITUDE, is that Virtue which enables us to persevere in doing well, notwithstanding a-ny Dangers, Obstacles or Difficulties we may meet with in the Performance of what we know to be our Duty.

FOSSA, is, according to some Anatomists, the Term for the Middle Part of the Corvix, or Hinder Part of an Humane Neck. The Upper Part being called Lophia, and the Lower Epims.

FOSSATORUM Operatio, was antiently the Service of Work and Labour done by Inhabitants and adjoining Tenants for Repair and Maintenance of the Ditches round the City or Town, for which some compounded, paying a Duty called Fossagium.

FOTMEL, in Old Times, was a Weight of Lead containing Ten Stone, or, at that time, Seventy Pounds; as appears from the Cartul. St. Albani, MS. in the Cotton Library.

FOUCADE, the same with Fougade.
FOUNDAY, is a Word used in the Iron Works, for the Space of fix Days; in which time they usually make about 8 Tun of Iron.

FOURNEAU, is the Powder Chamber, or the

Chamber of a Mine, which holds the Powder in Barrels or Sacks, (usually about 1000 lb. Weight) which by means of the Saucidge is fired, and so

the Mine is sprung.
FRACTIONS. Besides the common one, given in Vol. I. there is also another Notion of a Fraction; which is very necessary to be understood, beause it will be of use to shew the Reason of many of the vulgar Rules and Operations in Thus suppose # of 201. or of a Fractions. Pound Sterling, were the Fraction; this Fraction, instead of three quarters of one Pound, may be consider'd as a fourth Part of three Pounds: That is, by taking as many of the Integers as the Numerator expresses, (viz. 3.) and dividing (15 s.) And this shews you the Reason of that manner of Expression which is used by Geometers and Algebraifts about Fractions; who read

-, thus, a divided by b.

FRACTIONS Decimal. See Decimal. FRACTIONS Sexagesimal. See Sexagesimal. FRACTIONS in Algebra. A Fraction is a broken Number or Quantity, expressing the Parts of some Integer. It consists of two Parts, with a Line of Separation placed between them. Of which, that above the Line is called the Numerator, because it Enumerates or tells you how many of the Parts of the Integer the Fraction contains: And that below the Line is call'd the Denominator; because it Denominates or expresses the Nature of the Parts the Integer is supposed to be divided into. Thus,

Suppose a = 3 and b = 4, then will $\frac{a}{b}$ or $\frac{3}{4}$ be

a Fraction, expressing, that some Interger being divided into 4 Parts or Quarters, there is taken 3

of them, or 3 Quarters.

A Fraction is either Proper, when the Numerator is less than the Denominator, as $\frac{3}{4}$: Or Improper, when the Numerator is equal to it, or greater: As $\frac{4}{4}$ or $\frac{4}{3}$ are Improper Fractions; because one expresses the whole Integer, and the other more than the Integer; however tis often of good Use to express Quantities after this Way.

The Operations about Algebraick Fractions, or Fractions exprest by Letters, are much of the same Nature with those in common Arithmetick.

I. All Fractions ought first to be reduc'd to their lowest Terms; which is done by dividing both Numerator and Denominator, by their greatest common Devisor; that is, the greatest Quantity which can divide both. For then the Quotient will be a Fraction of the same Value as the former, but in the smallest Terms that can be. Thus

 $\frac{344}{64}$, by dividing both Parts by 34, will be brought

down to $\frac{a}{2}$ or $\frac{1}{2}a$. And $\frac{4a^2}{6a^4}$ being divided by its

greatest Common Divisor 2 44, will be reduc'd

to $\frac{2aa}{3}$

$$\begin{array}{c} 47)3677 \\ 47)4b7+16d7 \end{array} \left(-\frac{97}{b+46} \right)$$

And this may most times be done by Inspection, by casting out of both Numerator and Denominator such Letters as are multiplied into both of

them'; as in these Examples.

But such greatest Common Devisor may be found in all Cases where the Eye cannot readily discover it, by dividing the Denominator by the Numerator, and the last Devisor by the Remainder, if any be; and so on, 'till there come to remain nothing: And then that last Devisor is the greatest Common Measure. But if Unity, or 1, remain at last, then the Fraction was in its lowest Terms at sirst, and cannot be reduc'd to any smaller Terms. This Practice is the same as in Vulgar Fractions; and you have an Example of it in Species in Ward's Algebra, Chap. 4.

II. To reduce any Integer, as b or a + c, to the Form of an Improper Fraction, draw the Line of Separation, and under it write 1, then it will fland $\frac{b}{1}$ or $\frac{a+c}{1}$, which, the in the Form of Fractions, are not alter'd, because r neither Mul-

tiplies nor Divides.

If a Denominator, as d, were given: First Multiply the given Integer by such Denominator, and then write the Denominator under the Product.

$$\frac{db}{d} = b$$
, and $\frac{da + dc}{d} = a + c$.

III. To reduce Fractions of different Denominators, to others of the same Value that shall have a Common Denominator; (which Opera-tion must always precede Addition and Substraction in Fractions.) You must first bring the Fractions down as low as you can; (by Rule 1.) then Multiply a-cross the Numerator of the first into the Denominator of the second, for a new Numerator of the first Fraction; then the Numerator of the second into the Denominator of the first, for a new Numerator for the second Fraction; and lastly, Multiply the Denominators one into another, for a Common

Denominator. Thus, let $\frac{a+b}{d}$ and $\frac{bb}{f}$ be given,

and they will by this Rule be reduced to $\frac{fa+fb}{dx}$,

and $\frac{dbb}{df}$; Fractions in Value equal to the for-

The Reason of which is plain; for each Fraction is Multiplied and Divided by the same Quantity or Letter, and therefore must retain the same Value as before, tho' reduc'd to another Form:

$$\frac{4}{6}$$
 $\frac{3}{4}$ $\frac{16}{24}$ $\frac{18}{24}$

For every Fraction being Multiplied by Multiplying its Numerator, but Divided by Dividing it; and being also Multiplied by Dividing the

Denominator, and divided by Multiplying it:

It follows, That each Fraction will gain as much by the Multiplication of its Numerator, as it loses by the Multiplication of its Denominator. And, Vice versa, in case of Division, by one and the same Quantity.

If there are more than two Fractions, every Numerator must be Multiplied continually into all the Denominators but its own; and the Denominators one into another continually for a

new Denominator. E. gr. $\frac{a}{x}$, $\frac{b}{r}$, $\frac{c}{x}$, will be

reduc'd to this Form $\frac{ayz}{xyz}$, $\frac{bzx}{yzx}$, $\frac{cyx}{zyx}$, which are

Fractions of the same Value as the former (as is apparent by ejecting the Common Letters) but reduc'd to a Common Denominator.

IV. And when this is once understood, Addition and Substraction in Fractions are perform'd by only Adding or Substracting the Numerators, and Subscribing the Common Denominator before

If the Fractions $\frac{a+b}{d} \frac{bb}{f}$, were to be Added or Substracted; they will stand, when reduc'd (by Rule 3.) in this form, $\frac{fa+fb+fb}{df}$. or $\frac{f + fb - fbb}{df}$: The former of which is the Sum, the latter the Difference, of the two given Fradions.

V. Multiplication in Fractions, is persorm'd by Multiplying the Numerators into one another for a new Numerator, and the Denominators for a new Denominator, the Fractions having been first reduced to their lowest Terms.

$$\frac{a}{b} \times \frac{d}{c} = \frac{da}{bc}$$
, and $\frac{a+b}{c} \times \frac{a-b}{d} = \frac{aa-bb}{cd}$.

Hence, if any Fraction be Multiplied by the Denominator, or by some Integer the same with it, the Numerator is the Product. As 44

$$\times$$
 $b = a a$, for $\frac{a a}{b} \times \frac{b}{1} = \frac{a a b}{b}$; which,

casting off the Common Letters in both Parts,

leaves a a.

Also, if any Fraction be to be Multiplied by some Letter or Letters that are found in every Member of the Denominator, the Multiplication may be made only by ejecting such Letters out of the Denominator: As $\frac{ab}{cd}$ Multiplied

by
$$d = to \frac{ab}{c}$$
.

VI. Division in Fractions, is perform'd (after Reduction, according to Rule 3.) by Multiplying the Numerator of the Dividend by the Denominator of the Devisor, for a Numerator; and the Denominator of the Dividend by the Numerator of the Divisor, for a new Denominator: As in Vulgar Fractions. Thus,

$$\frac{a}{b}$$
) $\frac{d}{c}$ $\left(\frac{b}{a}\frac{d}{c}\right)$

 $\frac{a}{b} \qquad \frac{d}{c} \qquad \left(\frac{b d}{a c}\right)$ The Reason of which is plain, from what was said above, That a Fraction is Divided by Multiplying its Denominator. Thus,

$$\left(\frac{3}{4}\right)\frac{12}{16}\left(\frac{48}{48}=1\right)$$

For to divide 18 by 2, is to seek how often 3, the Numerator of the Devisor, is in 18 , which is done by Multiplying 16 by 3, and the Answer is $\frac{2}{4}$: But then again, because $\frac{3}{4}$ is but $\frac{3}{4}$ of 3, it will be contain'd in 18 4 times oftner than 3 is; and thesefore, in order to bring it to a Par, Divide the Value of that Praction by Multiplying its Denominator by 12, and the Product 48 will be the Numerator of the Quotient.

But if it happen that the Fractions have a Common Denominator, then cast off that, and divide one Numerator by the other.

$$\left(\frac{a}{b}\right)\frac{c}{b}\left(=\frac{c}{a}\right)$$
 and $\left(\frac{b}{a}\right)\frac{b}{a}\left(=b\right)$.

For Fractions having a Common Denominator, are as their Numerators

VII. A Mixt Quantity or Number, is that which is part Integer, and part Fraction. $a + \frac{b}{a}$: Such Quantities are reduc'd to the form of improper Fractions, by first Multiplying the Integral Part by the Denominator of the Fractional Part; then adding the Numerator to it, and subscribing the Denominator under all. Thus, the former Quantity $aa + \frac{b}{c}$ is Reduc'd

to this improper Fraction
$$\frac{c \cdot a \cdot a + b}{c}$$
.

Every improper Fraction is Reduc'd back again into its equivalent Mixt Number or Integer, by dividing the Numerator by the Denominator.

Thus,
$$\frac{c \cdot a \cdot a + b}{c}$$
 divided by c, quotes $a \cdot a + \frac{b}{c}$

FRAISING of a Batallion, is to line the Mus-ketiers all round with Pikes, in case of their be-

ing charg'd by a Body of Horse.
FRANKPLEDGE, Franciplegium visus Franciplegii, was the Antient Custom for the Freemen of England, at 14 Years of Age, to find Surety for their Truth and Fidelity to the King, and good Behaviour to their Fellow Subjects. This Surety, among the Saxons, was taken in their Friborg, Lath, or Tithing-Court; and after the Norman Conquest, it was call'd Frankpledge, and was continu'd in the Court-Leet of Royal Jurisdiction to be held annually on the Feast of St. Mi... chael by Magne Charta.

So that to have Visum Franciplegii, View of Frankpledge, was no more than to have the Privilege of holding a Court Leet; and this Power was determined by Stat. 8 of Edw. II. and 1 of Edw. III. The Place of holding such Courts was, if it were fair Weather, on some open Green; but if it was bad Weather, they adjourn'd to the Mannor House, or to that of some adjoyning Te-

nt. Kennet P. Antiq.
FREEZING. The true Cause of the Congelation of Warer into Ice, seems plainly to be the Introduction of the Frigorifick Particles into the Pores or Interftices between the Particles of the Water; and by that means, getting so near to them, as to be just within the Sphere of one another's Astracting Force, (see Attraction) and then they must cohere into one solid or firm Body. But Heat afterwards separating them, and putting them into various Motions, breaks this Union, and separates the Particles so far from one another, that they get out of the Distance of the Attracting Force, and into the Verge of the Repelling Force, and then the Water reassumes its Finid Form.

Now that Cold and Freezing do arile from some Substance of a Saline Nature floating in the Air, it seems probable from hence, That all Salis, and more eminently some particular ones, when mix'd with Snow or Ice, do prodigiously encrease the Force and Effects of Cold; We see also, that all Saline Bodies do produce a Stiffnels and Rigidity in the Parts of those Bodies into which they enter. Microscopical Observations upon Salts inform us, That the Figures of some Salts, before they shoot into Masses, are thin double-wedg'd like Particles, which have abundance of Surface in Respect to their Solidity, (which is the Reason why they swim in Water when once raised in it, specifically heavier). These small Points or the Salt getting into the Pores of the Water, whereby also they are in some measure suspended in the Winter Time (when the Heat of the Sun is not ordinarily strong enough to dissolve the Salts into a Fluid, to break their Points, and to keep them in perpetual Motion) being less disturb'd are more at Liberty to approach one another, and by shooting into Chrystals of the Form above-mentioned, do, by both their Extremities, infinitate themselves into the Pores of Water, and by that Means freeze it into a solid Form. And we see, that the Dimensions of Water see increas'd by Freezing, its Particles being kept at some Di-stance one from another by the Intervention of the Frigorific Matter.

But besides this, there are many little Volumes, or small Parcels of Air, included at several Distances, both in the Pores of the Watry Particles, and in the Interstices formed by their Spherical Figures. Now by the Infinuation of these Chrystals, the Volumes of Air are driven our of the Watry Particles, and many of them uniting, form larger Volumes, which thereby have a greater Force to expand themselves than when dispers'd, and so both enlarge the Dimensions, and lessen the specifick Gravity, of Water thus congeal'd into Ice. And hence, saith Dr. Cheyne, (from whom this last Account) we may guess at the Manner, how Water, impregnated with Salts, Sulphers, or Earths, which are not eafily dissolvable, may

form itself into Metals, Minerals, Gums, and other Fossils; the Parts of these Mixtures becoming a Cement to the Particles, of Water, or getting into their Pores, change them into these different ibstances. Phil. Prin. of Nat. Rel. p. 66. FRESCO. Painting in Fresco is thus perform'd: Substances.

The Colours are ground with Lime-Water, Milk, or Whey, and temper'd or mix'd together in Pots, as in Size Colouring. The Plaister is The Plaister is made of the Powder of old rubbish Stones mixt with burnt Flints or Lime, and Water; but the Salt of the Lime must be wash'd out, by often pouring on fresh Water; and to make the Plai-ster stick the better, they drive in Stumps of Horse-nails, about 6 Inches asunder. With this Horse-nails, about 6 Inches asunder. With this Plaister the Wall is to be laid thick, and then it must be let dry; and afterwards a new Layer of Plaister is put of the Thickness of an Half-Crown; and the Colours must be wrought with a quick free Hand whilst it is wet, for there is no altering of it after it is dry. This Way of is no altering of it after it is dry. This Way of Painting was in most antient Use among the Greeks, and from them came to the Romans, with whom it was famous. Raphael Urbin, and Julio Romano, were eminent this Way: There being three Chambers in the Vatican of their doing, yet in being

FRICTION, is a Word used often among Mechanicians, or the Writers on Mechanicks, for the Resistance which arises to the Motion of the Parts of any Engine from the Matter of the Wheels, &c. rubbing against one another, or

against any other Body.

Of the Resistance arising from Friction of the Parts of an Engine one against another, Mr. Amontons hath a large Discourse, which is printed in the Memoires de l'Academ. Royale des Sciences, for the Year 1699. where he makes several Experiments, gives Rules to find and calculate Tables of this Relistance arising from jection constitutes this Furniture; some are Great,

Friction, and of that which is the Refult of the Rigidity of Chords used in Pulleys, &c.

FRIGAT, is a Ship of War, usually of two Decks, light built, and defign'd for swift Sailing. When it hath but one Deck, and consequently

is of a smaller Size, they call her a Light Frigat.

FRIGATOON, is a Venetian Vessel, commonly used in the Adriatick: She is built with a square Stern, without any Fore-mast; having only a

Main-mast, Missen-mast, and Bow-sprit.
FRUGIVOROUS Birds, according to Mr. Willoughby, are the Parrot-Kind, which tho' they have a crooked Beak and Talons, and therefore do belong in general to the Birds of Prey, being Rapacious and Cornivorous; yet because they eat Fruit too, I suppose, he distinguishes them from the rest by this Title. See Birds.

FRUMGYLD, was the old Saxon Term for the first Payment made to the Kindred of a slain Person, in Recompence of his Murder.

FURNACE Almond. In the smelting of Silver Oar, and clearing it from the Lead, they use a Furnace which they call an Almond Furnace; in which they melt the Slaggs or Refuse of the Litharge, without pounding or stamping it, and with Charcoal only.

FURNACE of Affay, is used in the Smelting-Houses of Silver Oar; and is to try the Value of the Silver, or what Proportion it bears to the Lead: Which they know by weighing the Pieces cut off from every Bar, and then melting them anew, and after the Lead is separated, weighing the remaining Silver. See Silver, in this Vol.

FURNITURE of Dials. As on all Sorts of Dial Plains, Serait Lines may be describ'd, which by the Shadow of a Stile, or a Line parallel to the Earth's Axis, will shew the true Hour of the Day: So by the Shadow of an Apex, Nodus, or one determinate Point in that Axis or Stile, on the Plane of the Dial, may many useful and curious Astronomical Conclusions be describ'd or shewn: And all these taken together, are call'd the Furniture of Dials.

Such as.

1. The Parallels of the Sun's Diurnal Motion; shewing every Day what Degree of the Ecliptic the Sun is in; or, if less Accuracy be thought enough, what Sight of the Zodiac.

2. The Length of the Day and Night; or, The Proportion of the Sun's Diurnal to his No Burnal

Arch, throughout the Year.

3. The Time of the Year; shewing, by the Shadow of the Axis, both the Month and Day.

4. The Sun's Almaoanters, or, Parallels of Altisude; shewing the Sun's Altitude above the Horizon, and the Proportion of Shadows.
5. The Azimuths, or Vertical Circles; shewing

what Azimuth or Point of the Compais the Sun

is upon it all Times of the Day.

6. The Babylonish, Italian, Jewish (or Unequal) Hours; together with the Meridians or Horizons of any Particular and Remote Places; and many other Things, &c. I purposely omit to mention the Planetary Hours, the Circles of Position, &c. in order to Astrological Fooleries; because, I hope, at this Time of Day, they are of no Esteem with any Persons of Mathematical Skill, or in-deed of common Sense and Understanding.

as the Azimuths or Vertical Circles, the Meridians or Hour Circles, and the Circles of Longitude of the Sun or Stars; and these on all Sorts of Dial-Planes will be strait Lines: And if the Planes on which such great Circles are described, are parallel to such great Circles in the Heavens as they are designed to represent, then will those straight Lines be all parallel to one another.

But if the Dial-Plane be perpendicular to any

But if the Dial-Plane be perpendicular to any of those corresponding great Circles in the Heavens, then the ftraight Lines so projected on the Plane, will meet in the Centre at Equal Angles.

But if the Plane lie oblique to any of those great Circles in the Heavens, the projected fraight Lines will still meet in one Centre upon

the Plane, but at Unequal Angles.

All lesser Circles of the Sphere, (such as are, she Parallels of the Sun's Declination or Course, and all Almacanters, or Parallels of Altitude) being projected on a Plane, become Conick Sections, i. e. either Ellipses, Parabola's, or Hyperbola's; except when these lesser Circles are projected on such Planes as do lie parallels of Declination, when they happen to be drawn on a Plane, lying parallel to the Equinoctial, for then they will be perfect Circles, which are Sections of a Cone parallel to its Base. So also, if the Almacanters, or Parallels of Altitude, be describ'd on a Plane parallel to the Horizon, they will become persect Circles.

It may be of Use to remark also, That all Dial-Planes in any Latitude, and however posited in that Latitude, whether Direct, Declining, Inclining, or Reclining, or both Declining and Inclining, or Declining together, are, in some Part or other of the Earth, Horizontal Planes: and the Height of the Stile is equal to the Latitude of the Place wherein it is an Horizontal Plane; and the Substile of the Dial is the Meridian of that Place; and the Difference of Longitude of that Plane, shews

how much to the East or West the Place lies from that wherein it is an Horizontal Plane.

Whence it must. sollow, that if you draw, for any Declining-Reclining Plane, or any other Dial-Plane, a good Dial with Hours and Quarters; and much more if you draw it to Minutes, &c. and then, on the same Plane, with Red Ink, &c. draw an Horizontal Dial for the Latitude of that Place, which is equal to the Stile's Height in the former Declining-Reclining, &c. Plane; and letting the Substile be the Hour-Line of 12 to it, draw all the other Hours, Quarters, &c. from thence; and then on that Horizontal Dial draw also the proper Furniture: When you have done this, I say, if you can expunge the Hour-Lines of the Horizontal Dial, the Furniture of that Horizontal Dial will be the true Furniture for the Declining-Reclining, &c. be it never so irregular, supposing it have but a Centre.

As to the Description of this Furniture on all-Kinds of Dial-Planes, you will find large and sull Directions in Wells's Art of Shadows, Hollwell's and Leybourn's Dialling, &c. And the sull Demonstration of the whole Matter, Christopher Cluvius gives us in his Gnomonicks. See also Gaspar Schottus's Cursus Mathematicus, Book 14. of Ho-

rography

FURRING, in Architecture, is making good the Rafters-Feet in the Cornish: That is, when Rafters are cut with a Knee, these Furrings, or Furrs, are Pieces that go straight along with the Raster from the Top of the Knee to the Cornish. Also when Rasters are rotten, or suck hollow in the Middle, there are Pieces cut thickest in the middle, and tapering towards each End, which are nailed upon them to make them straight; and such Pieces are call'd Furrs, and the putting them on, Furring the Rasters.

FUST, is a Term in Architecture for the Shaft of a Column, from the Astragal to the Capital.

GABELL, Gabella, Gabellum, the same with Vectigal in old Writers, hath the same Signification as Gabelle in French: And for the better understanding of Antient Records, Statutes, Charters &c. you should know, that Gabel, or Gavel, Gablum, Gabellum, Gabellettum, Galbellettum, and Gavillettum, do all fignify a Rent, Custom, Duty, or Service, yielded or done to the King, or some other Lord: and Dr. Cowell seems to have judg'd right, that Gablum is to be distinguish'd from a Rent or Payment made, or a Contract or Bargain; and hath only Relation to such a Payment or Service as was imposed by the Power and will of the Lord.

GABEL-End of a House, is the Upright Triangular End, from the Cornish or Eaves, to the

Top of its Roof.

GAGE, in Joinery, is an Instrument made to strike a Line truly parallel to the straight Side of any Board or Piece of Stuff. Its chief Ule is for gaging of Tenents true to fit into Mortisses, and for gaging Stuff of an equal Thickness. It is made of an oval piece of Wood, fitted on upon a square Stick, to slide up and down stiffly thereon, and with a Tooth in the End of a Staff, to score or strike a Line upon the Stuff at any Distance, according to the Distance of the Oval from it. GAGE-Point. See Gauge-Point.

GAGER Deliverance. See Wage.

GAIN, in Architecture, is the Workmen's Term for the Bevilling Shoulder of the Joist or other Timber. 'Tis used also for the lapping off the End of the Joist, &c. upon a Trimmer or Girder; when the Thickness of the Shoulder is cut into the Trimmer also, and bevilling upwards that it may just receive the Gain; and so the Joist and Trimmer lie even and level with their Surface. This way of working is used in Floors and Hearths.

GAINAGIUM, or Wainagium, fignifies all manner of Plough-Tackle, or Infiruments used in Husbandry, without any Respect to Gain, or Profit. For as Magna Charta provides, That the Knight and Freeholder shall be americal Salva Contenemento suo, and the Merchant Salva Mercandisà sui; so the Villain Countryman, or Plowman, was to be fined or amerced for his Offences. but still Salvo Guinagio suo, i. e. Saving all bis Plow-Geers, and necessary Implements of Husbandry: For he was not to be fined to as to be ruined and undone, by taking from him the necessary Means of Life.

GALEASSE, is a large low-built heavy Vesfel, using Sails and Oars: It hath three Masts, and those not to be lowered, as they are in a Galley. They have three Tire of Guns in the Head, and usually two Tire in the Stern. In two Dutch Prints that I have of a Galeasse, there are 25 Oars of a Side; and I'm told, there is about 6 or 7 Men to an Oar.

GALEONS, were formerly the French Ships of War; but now the Word is only used amongst the Spaniards and Italians. And the Spaniards do now call only those Ships Galeons, which are sent annually to La Vera Cruse, or other Places, in the West-Indies, to fetch home Bullion.

GALL. Dr. Keil shews, An. Secret. p. 36. That the Gall or Bile, being to be mixed with the

Chyle, as it comes out of the Stomach into the Duodenum, could be no where so conveniently secerned from the Blood, as where the Liver is placed, had also all the Branches of the Celiack Arteries, carry'd all the Blood to the Liver, from which the Gall was to be separated: It is evident, considering the Nearness of the Liver to the Heart, and the Intestine Motion of the Blood. that so viscid a Secretion, as the Gall is, could never have been separated by any Gland in that Place. In this Case therefore, Nature is forced to alter her constant Method of sending the Blood to all Parts of the Body by the Arteries; and here the forms a Vein, (which is no Branch of the Cava, as all other Veins are) and by it the fends the Blood from the Branches of the Mesenterick and Celiack Arteries, (after having passed through all the Intestines, Stomach, Spleen, Caul, and Pancreas) to the Liver. By which extraordinary Contrivance, the Blood is brought a great way about, before it arrive at the Liver; and its Celerity is extremely diminish'd: So that all the Corpu. cles which are to form the Gall, may have sufficient Time to attract one another, and to unite, before they come to their secerning Vessel. And thus the Use of the Vena Porta is found out.

And moreover he computes, that fince 4 Branch of the Mesenterick Artery is to its corresponding Branch of the Porta, as 9 to 25; therefore the Blood in the Branches of the Porta moves above 177 times flower than it does in the Trunk of the Melenterick Artery; and this only on the Account of the Increase of the Diameters of

the Vessels.

Thus Nature provides for the forming of the Gall, in that Blood which passes through the Mesenterick Artery. Next he enquires what Care is taken about that which is convey'd by the Celiack Artery to the Liver. For it feems it was necessary to send a larger Quantity of Blood thither, than could be disposed of through the Intestines. Part of the Blood of the Celiack Artery is spread upon the Stomach and Caul, and its Velocity diminished, as we have seen in the Intestines: But still all the Blood which those Parts could receive, was not sufficient for the Liver; and there was no room for the Division and Expiating of the Vessels through such a large Space as the Mesentery, and the long Tract of the Guts. And therefore here Nature bath a new Contri-vance to abate the Velocity of the Blook, (to which the Intestine Motion is always proportional); which is, by empting the Blood entirely out of the Vessels, into a large spongy Bowel, the Spleen; which seems to be a Cistern produced for that very Intent and Purpole. And the Cir-cumference of the Celiack Artery being half an Inch, or .5 its Square is .25: And therefore the Square of the Splenick, which is a Branch of it, cannot be above .18. Now the Dimersions of the Spleen are fix Inches long, 3 or 4 in Breadth, and 2 in Thickness. He makes therefore this easy Supposition, That it is a Cylinder of 2 Inches Diameter. Wherefore the Square of its Circumference being 36, the Blood must move above 200 Times flower in it, than in the Beginning of the Splenick Artery; and is longer before it gets to the Liver, than that which passes through all the Intestines.

From all this Art and Contrivance, it is an evident Demonstration, that the Intent of Nature was to diminish the Velocity of the Blood; and that such a flow Motion is absolutely ne-cessary for the secerning of the Bile in the Liver.

The Particles which compose the Gall, he shews, bear a very small Proportion to the rest of the Blood; as is evident from that great Quantity of Blood which is carry'd to the Liver, and the small Quantity of Bile which is separated from it. In a large Dog, whose Dullus Choledostius was near as big as a Man's, I could never gather above two Drams in an Hour. Now there is thrown into the Aorta every Hour about 4000 Ounces of Blood; and it appears by the Proportions of the Arteries, that the Mesenzerick and Celiack are to the rest, as 1 to 8. And therefore 500 Ounces of Blood are carry'd every Hour to the Liver. And fince only two Drams of Gall are separated from it, the Blood must be to the Blood, at least as 2000 is to 1.

'Tis by Reason of this small Proportion of the Bile to the Blood, that it was so necessary to allow so much Time for the Attraction of the Particles

which form the Bile.

From this Contrivance also of the Aorta, the Bile receives another Advantage, not less considerable than the Diminution of the Velocity of the Blood: And that is, the Blood passing thro's for many different Parts before it comes to the Liver, parts with the greatest Share of its Lympha. By which means, the Particles composing the Bile approaching nearer towards one another, are by their mutual Attraction sooner united.

And the Confideration of these two Contrivances does highly (he thinks) confirm the Truth of his Theory of Animal Secretion. For the Di-minution of the Velocity of the Blood, and the Substraction of the Lympha, can agree in no other End, than the uniting the Particles of the

Bile.

GALLEHALPENS, were formerly a Genoa Coin, brought into England by the Merchants of that City; who trading hither in Galleys, lived commonly in a Lane near Tower-street, call'd from them Galley-Lane; and they landed their Goeds at a Place in Thames-street, call'd Galley-Key; and they traded with their own small Silver Coin, which our People call'd Gallehalpence. But these, together with two kinds of Coin, call'd Suskins and Dockins, were forbidden by the Statute of 3 H. V. 1. See Stow's Survey of London.

p. 137.
GALLERY of a Mine, is any Branch of it carried on towards any Place. For the Bessegers, and the Besieged, do carry each of them Galleries or Branches under Ground, in search of one another's Mines, which often meet and destroy one

another.

GALLEY, is a low-built Ship, using both Sails and Oars. Usually they have only a Mainmast and a Fore-mast, which may be struck for lowered at pleasure. 'Tis said, their Length is nsually about 130 Feet, and their middle Breadth about 18, and the Length of the Oar is about 36 Feet, and about 4 or 5 Men to an Oar. They are of Service only in the Mediterranean, and such still quiet Seas. These were like the Roman Li-burnica. See my Introduction to the Bibliotheca Navigantium & Itinerantium, about the Antient Sbipping. Vol. II.

GALLIOT, is a small Galley, or a Sort of Brigantine, built very slight, and design'd for Chase. She hath but one Mast, and can both fail and row. She usually carries two or three Pedrero's, and hath 16 or 20 Oars: Some call the Bomb-Ketches Galliots.

GAMING. For the Laws of Chance in

Games. See Play.

GARBLER of Spices, is an Officer of great Antiquity in the City of London, who may enter into any Shop, Warehouse, &c. to view and fearch Drugs, Spices, &c. and to Garble the same, that is, to make them clean from any Garbles or Dust. See 21 Jac. I. c. 19.

GARSUMME, (Gersuma, a Spelm. Gloss.) a Fine or Amerciament often used in Doomsday

Book.

GARTER. The most Noble Order of the Garter, is an Order of Knighthood first instituted by our famous King Edmard III. 1350. and inferior to none in the World; confisting of 26 Nobles, or Persons of even yet higher Degree; i. e. Sovereign Princes, Kings, and Emperors; whereof the King or Queen of England is the Sovereign; and the rest are stilled. The Companyations of the Order Sea Compiler. Associated Associated Sea. panions of the Order. See Cambden, Assemble, &c. GARTER, is also the Title of the Principal

King at Arms among our English Heralds. The Office was created by Hen. V. See Stow, p. 581.

and Stat. 14. Car. II. c. 33.
GAVELL-BREAD, Corn-Rent, or Provision of Bread, referred from the Tenant to be paid in Kind.

GAVELCESTER, Sextarius Vestigalu, was a certain Measure of Ale, to be paid by way of Rent: It appears to be the same with Tokester, which hath sometimes been corruptly written Colcester; as perhaps in Selden's Desertation, an-nexed to Fleta, c. 8.

GAVELLERTH, Gavelhere. The Duty of Work of plowing so much Earth or Ground, done by the Customary Tenant for his Lord:

GAVEL-MEDE, was the Duty of mowing Grass, or cutting Meadow Land, required by the Lord from his Customary Tenant: So,

GAVEL REP, or Bedreap, was the Duty of Reaping at the Bid or Command of the Lord. GAVELLING-Men. Tenants which paid a

reserved Rent, besides some Customary Duties to

be done by them.

GAUGE-Point of a solid Measure, is the Diameter of a Circle, whose Area is equal to the solid Content of the same Measure. Thus the Solidity of a Wine Gallon being 231 Cubick Inches, (according to Winchester Measure;) If you conceive a Circle to contain so many Inches, the Diameter of it will be 17.15; and that will be the Gauge-Point of Wine-Measure. And an Ale-Gallon containing 288 Cubick Inches; by the same Rule, the Gauge-Point of Ale Measure will be found to be 19.15.

And after the same manner may the Gauge-

Point of any Foreign Measure be discover'd.

And from hence may be deduced, by way of Consequence, that when the Diameter of a Cylinder in Inches is equal to the Gauge-Point of any Measure (given likewise in Inches;) every Inch, in Length thereof, will contain an Integer of the same Measure, V. gr. In a Cylinder whose Diameter is 17.15 Inches, every Inch in Height contains one entire Gallon in Wine Measure; Hh 2

and in another, whose Diameter is 19.15, every made Dr. Harver conclude, that the Blood had Inch in Length contains one Ale Gallon.

GAUGER, is an Officer of the King's Excife, whole Business it is to examine all Casks of Beer, Wine, Oil, Honey, Butter, &c. and to give them a Mark of Allowance, (which is a Circle burnt with an Iron) before they be fold in any Place of this Office. See 27 E. III. c. 8. 4 R. II. c. 1. 18 H. VI. 17. 23 H. VI. 10. 1 R. III. 13.

28 H. VIII. 14. and last of all, 12 Car. II. c. 4. GAUGING. On this Subject, the following

Authors may be consulted:

Stereometrical Propositions, variously applicable, but particularly intended for Gauging: By Robert Anderson. Lond. 1668. 800.

Gauging Promoted; being an Appendix to the former Book. Lond. 1669.

Smith's Practical Gauging. Jones's Guide to the young Gauger. Kepleri Stercometria Nova. Mayne's Practical Gauger. Hunt's Practical Gauging. Newton's Gauging. Everard's Gauging.

GELD, the same with Gild, or Guild.

GEMOTE, is an old Saxon Term for what we now call a Court: Tis often used in the Laws

of Edward the Confessor.

GENERAL. When an Army is preparing to march, the Drums beat a peculiar Sound, in order to acquaint the whole Army, that they should all get ready to march: And this Notice by the

Drum, they call Beating the General.
GENERALE, the Single Commons, or Ordinary Provision, of the Religious in Convents, was formerly call'd by this Term Generale, as being their General Allowance; and so distinguish'd from their Pillantia, or Pittances, which, on exrraordinary Occasions, were added as Over Commons.

GENERAL Issue. See Issue.
GENERATION. As to what the Moderns, from their Discoveries by Microscopes, have advanc'd on this Subject, you will find by comparing the Observations and Discoveries of Dr. Harvey, S. Malpighii, Dr. de Graaf, and M. Leeuwenhoek, with one another: And these Three Things seem to me very probable. 1. That Ani. mals are ex Animalculo, 2. That the Animalcules are originally in Semine Marium, & non in Famini. 3. That they can never come Forward, nor be Formed into Animals of the respective Kind, without the Ovs in Famini.

The First of these seems probable from these 3 Observations; 1. That some such Thing has been so often observed by Malpighiu in the Cicatricula of an Egg before Incubation, as the Rudiments of an Animal in the Shape of a Tadpole; as may be seen in his First, and in his repeated Observations de Formatione Pulli in Ovo. 2. The sudden Appearance and Displaying of all the Parts, after Incubation, makes it probable, that they are not then actually formed out of a Fluid, but that the Stamina of them have been formerly there Existent, and are now expanded. The first Part of the Chick which is discover'd with the Naked Eye is, you know, the Punctum Saliens, and that not till Three Days and Nights of Incubation be past: And then on the Fifth Day the Rudiments of the Head and Body do appear. This

a Being before any other Part of the Body, and that from it all the Organs of the Parus were both formed and nourished; but by Malpighius's Observations, we find that the Parts are then only so far extended, as to be made visible to the Naked Eye, and that they were actually Exi-ftent before, and discernable by Glasses. After an Incubation of 30 Hours, are to be feen the Head. the Eyes, and the Carina, with the Vertebra, distinct, and the Hears. After 40 Hours its Pulle is visible, and all the other Parts more distinct, which cannot be discern'd by the Naked Eye before the Beginning of the Fifth Day; from whence it seems very probable that even the so early Discovery of those Parts of the Fatus by the Microscope, is not the discerning of Parts newly form'd, but only more dilated and extended by receiving of Nutriment from the Colliquamentum; so that they seem all to have been actually existent before the Incubation of the Hen. And What Swammardam has discover'd in the Transmutation of Insects, gives no small Light to this, whilst he makes appear in the Explanation of the 13th Table of the General History of Insects, that in those large Eruca's which feed upon Cabbage, if they be taken about the Time they retire to be transform'd into Aurelia's, and plunged often in warm Water to make a Rupture of the Outer Skin, you will discern, through the Transparency of their Second Membrane, all the Parts of the Buttersty, the Trunk, Wings, Feelers, &c. folded up : But, that after the Eruca is changed into an Aurelia, none of these Paris can be discern'd, they are so drench'd with Moisture, though they be there actually formed.

Another Consideration is from the Analogy, which we may suppose between Plants and Animals. All Vegetables, we see, do proceed ex Plantula, the Seeds of Vegetables being nothing else but little Plants of the same kind solded up in Coats and Membranes; and from hence we may probably conjecture, that so curiously an organized Creature, as an Animal, is not the sudden Product of a Fluid, or Colliquamentum, but does much rather proceed from an Animalcule of the fame kind, and has all its little Members folded up according to their several Joints and Plicatures, which are afterwards enlarg'd and diftended, as we see in Plants. Now though this Consideration alone may seem not to bear much Weight, yet being join'd to the two former, they do mu-tually strengthen each other. And indeed all the Laws of Motion which are as yet discover'd, can give but a very lame Account of the forming of a Plant or Animal. We see how wretchedly Des Cartes came off, when he began to apply them to this Subject. They are formed by Laws yet unknown to Mankind; and it seems most probable, that the Stamina of all the Plants and Animals that have been, or ever shall be in the World, have been formed ab Origine Mundi, by the Almighty Creator within the First of each respective Kind. And he who considers the Nature of Vision, that it does not give us the true Magnitude, but the Proportion of Things, and that what seems to our Naked Eye but a Point, may truly be made up of as many Parts as seem to us be in the whole visible World, will not think this an absurd or

impossible Thing.

But the Second Thing which later Discoveries have made probable is, that these Animalcules are

originally in Semine Marium, & non in Famini: :
And this I collect from these Considerations:

I. That there are innumerable Animalcula in Semine Masculino Omnium Animalium. M. Leeuwenbock has made this so evident by so many Observations, that I do not in the least question the Truth of the Thing.

2. The Observing of the Rudiments of the Fatus in Eggs, which have been Facundated by the Male, and the seeing no such Thing in those which are not Facundated, as appears from Malpigbius his Observations, makes it very probable, that these Rudiments proceeded originally from

the Male, and not from the Female.

3. The Resemblance between the Rudiments of the Fatus in Ova, both Before and Aster Incubation, and the Animalcule, makes it very probable, that they are One and the Same. The same Shape and Figure which M. Leeuwenhoek gives us of the Animalcule, Malpighius likewise gives us of the Rudiments of the Fatus, both before and after Incubation; yea, and even the Fatus's of Animals do appear so at first to the Naket Eye; so that Dr. Harvey does acknowledge, that all Animals, even the most Perfest, are Begotten of a Worm.

4. This gives a Rational Account of Many Fatus's at One Birth, especially that of the Countess of Holland; and how, at least, a Whole Cluster of Eggs in a Hen are Facundated by One Coition

of the Male.

5. This gives a New Light, as it were, to the First Prophecy concerning the Messiah, that the Seed of the Woman shall bruise the Head of the Serpent: All the rest of Mankind being thus most

properly and truly the Seed of the Man.

6. The Analogy I have already mention'd, which we may rationally suppose between the Manner of the Propagation of Plants and Animals, does likewise make this probable. Every Herb and Tree bears its Seed after its Kind; which Seed is nothing else but a Little Plant of the same Kind, which being thrown into the Earth, as into its Uterus, spreads forth its Roots, and receives its Nourishment, but has its Form within it self; and we may rationally conjecture some such Analogy in the Propagation of Animals.

The Third Particular, which later Discoveries make propable, is, That Animals cannot be Formed of these Animalcula without the Ova in Faminis, which are necessary for supplying them with proper Nutriment; and this, these Considerations seem to evince. I. It is probable that an Animalcule cannot come forward if it do not fall into a proper Nidus. This we see in the Cicatricula in Eggs, and tho' a Million of them should fall into One Egg, none of them would come forward, but what were in the Centre of the Cicatricula; and perhaps the Nidus, necessary for their Formation, is so proportioned to their Bulk, that it can hardly contain more than One Animalcule; and this may be the Reason why there are so sew Monsters. This we see is absolutely necessary in Oviparis; and the only Difference which seems to be between them and the Vivipara in this Matter, is in this, That in the latter the Ova are properly nothing more but the Cicatricula, with its Colliquamentum, so that the Fætus must spread forth its Roots into the Uterus to receive its Nourishment; but the Eggs in Oviparis may be properly termed

an Uterus in relation to the Fatus; for they contain not only the Cicatricula with its Amnion and Colliquamentum, which is the immediate Nouristment of the Fatus, but also the Materials which are to be converted into that Colliquamentum; so that the Fatus spreads forth its Roots no farther than into the White and Yolk of the Egg, from whence it derives all its Nouristment. Now that an Animalcule cannot come forward without some such proper Nidus, M. Leeuwenhoek will not readily deny; for if there were nothing needful but their being thrown into the Uterus, I do not see why many Hundreds of them should not come forward at once, at least whilst scatter'd in so large a Field.

Now, 2. That this Cicatricula is not originally in Utero, seems evident from the frequent Conceptions which have been found extra Uterum: Such as the Child which continued 26 Years in the Woman of Tholouse's Belly; and the Little Fatus found in the Abdomen of Mad. de S. Mere, together with the Testicle .torn, and full of Clotted Blood; such also seem to be the Fatus in the Abdomen of the Woman of Copenhagen, mentioned in the Nouvelles des Lettres, for Sept. 85. all the Members of which were easily to be felt thro' the Skin of the Belly, and which she had carried in her Belly for four Years: And the seven Years Gravidation related by Dr. Cole. Now granting once the Necessity of a Proper Nidus, for the Formation of an Animalcule into the Animal of its respective Kind, these Observations make it probable, that the Testes are the Ovaria appropriated for this Use; for though the Animalcules coming thither in such Cases, may seem to be extraordinary, and that usually the Impregnation is in Utero, yet it may be collected from hence, that the Cicatricula or Ova to be Impregnated, are in Testibus Famineis; for if it were not so, the accidental coming of Animalcules thither, could not make them come forward more than in any other Part of the Body, since they cannot be Formed and Nourished without a Proper Nidus.

But, 3. It is acknowledg'd by all, that the

But, 3. It is acknowledged by all, that the Fætus in Utero, for some considerable Time after Conception, has no Connexion with the Womb; that it sits wholly loose to it, and is persectly a Little Round Egg with the Fætus in the Midst, which sends forth its Umbilical Vessels by Degrees, and at last lays hold on the Uterus. Now from hence it seems evident, that the Cicatricula, which is the Fountain of the Amimalcule's Nourishment, does not sprout from the Uterus, but has its Origine elsewhere, and falls in thither as into a sit Soil, from whence it may draw Nutriment for the Growth of the Fætus; else it cannot be easily imagined how it should not have an Immediate Connexion with the Uterus from the Time of

Conception.

If you joyn all these Three Considerations together, viz. that an Animalcule cannot come forward without a Proper Nidus, or Cicatricula;
that there have been frequent Fatus's extra Uterum; and that they have no Adhesion to the Uterus for a considerable Time after Conception; they
seem to make it evident, that Animals cannot be
Formed ex Animalculis without the Ova in Faminis. To all these I shall subjoyn the Proposal
of an Experimentum Crucis, which may seem to
determine whether the Testes Faminea be truly the
Ovaria: viz. Open the Abdomen of the Females
of some Kinds, and cut out these Testicles, and

this will determine whether they be absolutely necessary for the Formation of Animals.

It is indeed difficult to conceive, how these Eggs should be Impregnated per Semen Maris, both because there is no Connexion between the Tube and the Ovary for its Transmission; and for that Dr. Harvey could never discover any thing of it But as to the last, M. Leeuwenhoek has cleared that Difficulty, by the Discovery of innumerable Animalcula Seminis Maris in Cornutus Vteri, and those living a considerable time And as to the former, we may eiafter Coition. ther suppose that there is such an Inflation of the Tuba, or Cornua Uteri, tempore Coitionis, as makes them Embrace the Ovaria, and such an Approach of the Uterus and its Cornua, as that it may eafily transmit the Seed into the Ovary: Or else, that the Ova are Impregnated by the Animalcules after they descend into the Vierus, and not in the Ovary. The former seems probable for this Reason, that at least a whole Cluster of Eggs in a Hen will be Facundated by One Tread of the Cock; now this Facundation seems to be in the Vitellary, and not in the Uterus, as the Eggs pass along from Day to Day: For it can hardly be supposed that the Animalcules should subsist so long, being scatter'd loosely in the Uterus, as to wait there, for many Days, for the Facundation of the Eggs as they pass along. The latter Conjecture has this to strengthen it; That the Animalcules are found to live a considerable Time in the Vterus, and that if they should Impregnate the Ova in the Ovary it self, the Fatus would encrease so fast, that the Ova could not pass through the Tuba Vieri, but would either burst the Ovary, or fall down into the Abdomen from the Orifices of the Tube; and that from hence proceed those extraordinary Conceptions, in Abdomine extra Uterum.

But M. Leeuwenhoek, to weaken this Consideration about the Conception's being like unto an Ovum in the Womb, proposes a Parallel between the e Animalcules and Insects, and infinuates, that as the Latter cast their Skins, and appear of another Shape, so the Other, which at first seem like Tadpoles, may cast their Outer Skin, and then be Round; and that this may be the Occasion of the Round Figure of the Conception in the Womb. To this it may be replied, That according to M. Leeuwenhoek's own Sentiment, the Animalcules cannot come forward, if they do not find the Punaum or proper Place for their Nourishment, to which it seems they must have some Adhesion. Now the Conception in Viviparis is not fastened unto the Womb for many Days, nor does Adhere to any Point of it; so that it seems this Roundish Body is not the Animalcule thus changed after having cast an outer Skin, but is rather the Cicatricula, or little Egg, into which the Animalcle has enter'd as its Punctum, or Place of Nourishment; else I do not see why they should not be Adhering to the Womb from the First Conception; or why (as I have faid) many Hundreds of them are not Conceived and Formed together. GENITURA. See Seed.

GENTLEMAN, is derived from the French Gentil, i. e. Honestus, vel Honesto loco natus; and the Saxon Word Man: So that it fignifies a Man well born. So the Italians call such Persons Gentil Huomoni: And the Spaniards keep the Meaning, when they call a Gentleman Hidalgo, or Hijo d'algo; i.e. the Son of some Man, or of some Man of Note or Reckoning. Under this Name

with usare comprised all above Yeomen; so that Noblemen may truly be call'd Gentlemen. But by the Course and Custom of England, Nobility is either Greater or Less, Upper or Lower. The Greater contains all from Knights upwards; the Leffer all from Barons downwards: As Smith saith, Cap. 21. de Republ. Anglic.

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GEOMETRY Abstruse. See Transcendentals. GEORGE Noble, was a Piece of Gold, current in 1 Hen. VIII. at Six Shillings and Eightpence. At which Time, by Indenture with the Mint, one Pound of Gold (in Weight) was to be coined into Eighty one George Nobles.

GIRDERS, in Architecture, are the largest Pieces of Timber in a Floor: Their Ends are ulually fastened into the Summers or Brest-Summers, and the Joists are framed in at one End to the Girders. No Girder should lie less than to Inches into the Wall, and their Ends should be laid in Lome, &c

GLANDS. All Secretions in an Animal Body are made by Glands, and a Gland is nothing but the Convolution or various Folding of the small Arteries, whose last Branch must be Cylindrical. This Cylindrical Artery, in its Windings, sends out several little Ducts or Se-I Particles, of a lesser Diameter than that of the

cretory Vessels of equal Diameters, which some-times unite in one common Pore, sometimes run into a common Bason. This Structure is evident in all the larger Glands, such as the Intestines, with their Secretory Ducks, the Lasteals, the Testicles, and some of the Conglobate Glands, and may be seen in all the rest, if they happen to be Obstructed, and so swell to become visible; and therefore the same may reasonably be concluded of all Glands in general. There are small Branchings of Nerves passing all over the Coats of the Arteries, and seem to be designed principally for their Spiral Contortion, that the Blood may be the more easily propagated through them.

A Conglobate Gland is a little smooth Body wrapt up in a fine Skin, by which it is separated from all other Parts, only admitting a Nerve and Artery to pass in, and giving way to a Vein and Excretory Canal to pass out: Of this Sort, are the Glands of the Brain, the Labial Glands, and

the Testes.

A Conglomerate Gland is composed of many little Conglobate Glands all tied together, and wrapt up in one common Tunicle or Membrane. Sometimes all their Execretory Ducts unite and make up one common Pipe, thro' which the Liquor of all of them runs, as the Pancreas and the Parotides do. Sometimes the Ducks uniting, form several Pipes, which only communicate with one another by cross Channels; and such are the Breasts. Others again have several Pipes without any Communication with one another, of which Sort are the Glandula Lachrymales, and the Prostaea. And a fourth Sort is, when each little Gland hath its own Excretory Duck, thro' which it transmits its Liquor to a common Bason, as in the Kidneys.

As to the Manner how the several Fluids, after they are form'd in the Blood, are separated from it in the Glands; it depends (as Dr. Keil shews, An. Secret, p. 82.) entirely on the Figure and Structure of the Glands, which therefore must first be determined. As Truth, when plain and evident, doth of itself dispel all false Opinions; So the true Structure of the Glands being once demonstra. ted, there will be no Occasion to refute the Dostrine of Ferments, not the Hypothesis of Tubes differing as to the Figures of their Orifices; both which have several Times been demonstrated to be false.

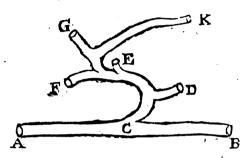
That the Glands are nothing but Convolutions of small Arteries, the greatest and most accurate Anatomists of this Age, Malpighi, Bellini, and Nuch, have discover'd. And indeed, that all the Vessels of the Body, in which the Liquors are continually moving, can have no other than a Cylindrical or Conical Form, is demonstrable from the Nature of Fluids, whose Pressure is always prependicular to the Sides of the Vessel containing them, and equal at equal Heights of the Fluid. If therefore the Sides of the Vessels are soft, and equally yielding every where, (as are all the Tubes in the Body of a Fætus) they must, by the Pressure of their contained Fluid, be equally every where diftended; and consequently the Section of such a Vessel, perpendicular to its Axis, must be a Circle; and therefore the Vessel must be either a Concave Cone or Cylinder, or at least such a Figure whole Transverse Section, normal to the Axis, must be a Circle.

The Circular Orifices therefore of the Glands can only differ in Magnitude; and all Sorts of

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Orifice of the Gland, may enter it: So that without some further Contrivance, that Fluid which contains the biggest Particles, must likewise consist of all the Particles of all the other Secretions; neither could any Fluid thicker than the Blood be separated from it, because of the great Proportion of the Aqueous Fluid, whose Particles being vastly smaller than any other, and invisible to the best Microscopes, must enter all the Glands, and be mix'd with the secenced Fluid.

Now how this Inconvenience may be prevented, and how the Particles of any Size may either be separated by themselves, or with any affigned Portion of the Aqueous Fluid, or of other lesser Particles, I shall endeavour to shew.



Suppose then AB to be a small evanescent Artery, and that the Particles of the least Size were

to be separated from the rest.

From the Side of the Artery must arise the Gland or Tube C K, whose Orifice at C is such as is capable of admitting only Particles of the least Size, together with the Aqueous Fluid: These therefore will be separated from all the other Particles of the Blood, and the Tube C K being a Cylinder, they will pass to its surther End K, which is supposed to be the Excretory Duct of the Gland.

If the Quantity of the Aqueous Fluid, separated with the least Particles, must be diminish'd, that such a Fluid as is requisite may pass through the Excretory Duck K, from the Tube C K; you must imagine, that several other smaller Canals go out, as at D, E, F, and G, whose Orifices are so small, that they admit no other Particles, besides those of the Aqueous Fluid, to pass through them; and therefore as the least Particles, together with the Aqueous Fluid, pass along the Tube C K, the Aqueous Fluid must constantly be diminished; and the Quantity of the least Particles still remaining, they can pass no where but through the Excretory Duck at K: And this Diminution of the Aqueous Fluid will always be according to the Number of the Canals, D, E, F, G, that is, in Proportion to the Length of the Tube C K. And therefore, according as the Gland is longer or shorter, so the more or less Aqueous Fluid will pass through the Orifice of the Excretory Duck at K; and consequently, the secreted Fluid, on this Account, be Thicker or Thin.

If the Particles of a middle Size, between the biggest and the least, are to be drawn off from the rest of the Blood: Let the Orifice at the Gland C be just so big as to admit those Particles, and not any other of a larger Size. These Particles therefore, with the Aqueous Fluid, and all better Particles, will pass through the Orifice C; but if the Canals D, E, F, G, are big enough to receive all the other Particles, and too little to admit those that are to be separated, it is evident, that

those Particles must arrive at the Excretory Duck K, with what Proportion of Lesser Particles is

required.

And thus we see how any Sort of Particles may be drawn off, either by themselves, or mixed with any others, in any Proportion: And this is done in the most simple manner, only by Arteries; for C K is only a smaller Artery, either Straight, Spiral, or otherwise contorted, and D, E, F, and G, are again Arteries smaller than it; and if any of these are so smaller than it; and if any of these are so smaller than it; and if any of serum, they will constitute Lymphatick Vessels. From whence it is, that we find Lymphadults arising in great Numbers from those Glands that separate thick Humours; as from the Tessicles, Liver, &c.

GLANDULÆ Miliares. See Miliares, and

Skin.

GLANDULÆ Myrtiformes, are the Contrachions of the Fibres of the broken Hymen, upon the first Coition.

GLANDULÆ Schacea, are a large Number of Glands which lie under the Skin of the Auricula of the Ear; and which, because they separate a greasy Matter, like Tallow or Schum, their sirft Discoverer Valsalva, in his Book of the Ear, calls by this Name. This Schum being carried to the Surface of the Skin, he saith, hardens there, and turns into a scaly greasy Substance, not unlike that of Bran. Perhaps they are such Glands as those that secrete the Scurf and Dandruff that arises from combing the Head.

GLASS Drops, or Bubbles, sometimes called Prince Ruperi's Drops; are small Parcels of coarse green Glass, taken out of the Pot in Fusion at the End of an Iron Pipe; and being exceeding hor, are let fall or dropt from thence into a Vessel of Cold Water, and so lie there 'till they are sensibly cold. These exhibit a very surprising Phanomenon, viz. as soon as you break off the least Bit from the Stem of it, or pecked End, the whole Bulk of the Drop slies to pieces with a brisk Noise, and some of the Pieces will be as small as Dust. Dr. Hook, in his Micrographia, hath a particular

Differtation upon this Subject.

GLOBULES, are such small Particles of Matter as are of a Globular or Spherical Figure: As the Red Particles of the Blood which swim in the transparent Serum, which are easily discoverable by the Microscope; and 'tis pleasant to see how these Blood-Globules, whenever they come within a due Distance, do astrast one another, and unite like Spheres of Quicksilver; and by this Means the Blood separates into two Parts; one of which is the Coagulation this Way of the Red Parts of it, and the other is the Serum. Now the Serum consists of a great Number of Corpuscles or small Particles (but they are not all Spherical nor Globular, like the Red Globules of the Blood) and these of various Figures and Magnitudes, and swimming in a Limpid Fluid. And these Serous Particles don't unite with, nor attract one another as the former did, 'till some Part of the Fluid in which they swim hath been evaporated by Heat; but then they do (and form a Coagulum) as the Blood Globules did. So that the Power of Attraction is greater in the Red Globules, than in the Particles of the Serum.

GLYPHICE, is a Part of Sculpture, being the

GLYPHICE, is a Part of Sculpture, being the Art of Cutting, Carving, or Casting, the Images and Resemblances of natural Things in Metals.

GOLD

GRA

GOLD Mines. In Phil. Trans. N. 58. Dr. Edw. Brown gives the following Account of the Gold Mines in Hungary. Among the 7 Mine Towns in Hungary, (which are not far from one another, viz. Chremnitz, Schemnitz, Newfol, Coningsberg, Bochantz, Libeten, and Tiln) Chremnizt is the richest in Gold. They have also at present, Gold Mines at Bochantz and Coningsberg ; and they report in that Country, that there hath been for-merly a rich Gold Mine at Glass-Histen, but loft fince that Bethlem Gabor over-ran those Parts, when the Undertakers stopped up the Mine and fled.

They have worked in the Gold Mine at Chremnitz 900 Years. This Mine is divers English Miles in Length, and about 160 Fathoms Deep. Many Veins of the Ore run to the North, and to the East. They work also towards One, Two, and Three of the Clock, as they speak; for the Miners direct themselves under Ground by a Compass, not of 32 Points (such as is used at Sea), but by one of 24; which they divide, as we do the Hours of the Day, into twice Twelve. Of the Gold Ore, some is White, and some Black, Red, or Yellow: That with Black Spots in White is efteem'd the best, as also the Ore which lieth next to the Black Veins. This Ore is not rich enough to fuffer any Proof in small Parcels, like that in other Mines, whereby to know what Proportion of Metal is contain'd in it; but they pound a very great Quantity thereof, and wash it in a little River, which runs nigh the Town. The whole River being divided, and admitted into divers Cuts, runs over the Ore continually, and so washeth away the Earthy Parts from the Metalline: And from a clear River above the Town, by its running through so many Works, and over so much pounded Ore, it becomes below the Town a Dark-yellow Stream, of the Colour of the Earth of those Hills.

There have been Pieces of pure Gold found in the Mine; some of which I have seen in the Emperor's Treasury, and in the Elector of Saxony's Repository; one Piece as broad as the Palm of my Hand, and others less, and upon a White Scone many Pieces of pure Gold; but these are

The common Yellow Earth of the Country near Chremnitz, although it be not esteem'd Ore, affords some Gold: And in one Place I saw a great Part of an Hill digg'd away, which hath been cast into the Works, washed and wrought in the same Manner as pounded Ore with considerable Profit.

Some Passages in this Mine, cut through the Rock, and long disused, have grown up again; and I observed the Sides of some, which had been formerly wide enough to carry their Ore through, to approach each other, so as we passed with disficulty. This happens in moist Places. The Pasfages unite not from the Top to the Bottom, but from one Side to another.

There is Vieriol in this Mine, White, Red, Blue, and Green; and also Vitriol Waters. There is a Substance found which sticks to the Gold Ore, of small pointed Parts like Needles, called by them Antimony of Gold. There are Christals found here, and some sincured Tellow.

The Miners will not allow any Quickfilver or Brimstone to have been found here; yet in the lately mention'd Antimony of Gold, there is evidently Sulphar, as I perceived by busning. The Mr. Johnson, in his Grammatical Commentaries:

Vol. II.

I i That

Quickfilver Mine, mentioned in the Answer to Kercher's Inquiries, Mund. Subter. is an Hungarian Mile, or 7 English Miles distant from Chremnitz, and is not wrought in at present.

There is a Vitriol Mine in these Hills near the Gold Mine; the Earth or Ore of it is Reddish, and sometimes Greenish. This Earth is insused in Water, and after 3 Days, the Water is poured off, and boiled 7 Days in a Leaden Vessel, till it comes to a thick granulated whitish Substance, which is afterwards reduced to a Calx in an Oven, and serveth in the making Aquafortis, or the Separa-

ting Water used at Schemnitz.
They have divers Ways of taking the Gold out of its Ore; by burning the Ore; by melting; by adding Silver Ore, and other Minerals, Sand, and Lead, as they find the Ore fluid or fix'd.

But without Lead they proceed thus:

They break and pound the Ore in Water, very

fine; they wash it often, and lay it in Powder upon Cloths, and by the gentle oblique descending of the Water over it, and their continual ftirring it, the earthy, clayish, and lighter Parts, are washed away, while the heavier and metalline remain in the Cloths; these Cloths are afterwards washed clean in several Tubs, and the Water, after some settling, poured off from its Sediment; which Sediment is again wash'd, and stirred up in several Vessels and Troughs, 'till at length they sprinkle Quicksilver upon it, and knead it well together for an Hour, and then washing it again in a wooden Vessel, after the separating of much of it which the Quickfilver touches not; by striking this Vessel against their Leg, they bring the Gold and Quick silver together, in an Amalgama, to one Corner of it. From this Amalgama they strain as much of the Quickfilver as they can through coarse Cloths first, and then through fine; then they put the Mais re-

that it may become purer. Concerning Cranach-Gold, I cannot learn that there is any such Gold, or Place where Gold is digg'd in Hungary; but in Germany I think there is, for Agrigola mentions such a Place as Golde-Cranacum, and another called Golde-Crona.

maining upon a perforated Plate, which they fet

over a deep Pan placed in the Earth, in the Bottom of which Pan they also put Quick-silver:

This Pan they cover, and lute the Cover well, and then making a Charcoal Fire upon it, they drive down the Quick-silver, yet remaining in the

Gold, to the rest in the Bottom of the Pan; then taking out the Gold, they cast it into the Fire,

For the exceeding Minuteness of the Constituent Particles of Gold, see Dustility.

GOTHICK Manner of Building, was unhappily brought into Ule, after the Irruption of those barbarous Nations, the Goths and Vandals, &c. from the North, and the Moors and Arabs, from the South and East, into the civiliz'd. World. These rude People demolish'd what they could of the antient Greek and Roman Architecture, and instead of those admirable and regular Orders and Manner of Building, introduced a licentious and fantastical Manner, which, tho' sometimes adorn'd with expensive Carvings, and costly, the lamentable, Imagery, is without any of that august Beauty, and just Symmetry, which the Fabricks of the Antients entertain us

That it is the Art of expressing the Relations of Things | Plane, have its Line of Gravity C P falling within Construction, with due Accent in Speaking, and Orthography in Writing, according to the Custom of those whose Language we learn.

GRAND Days, are those in every Term so-lemnly kept in the Inns of Court and Chancery; viz. In Easter Term, Ascension Day; in Trinity
Term, St. John Baptist's Day; In Michaelmas
Term, All-Saints Day (and of late, All-Souls
Day); and in Hillary Term, the Feast of the Purification of our Lady, commonly called Candle. mas Day. These are Dies non Juridici, no Court

GRAND Gusto, is a Term used by Painters, to express, that in a Picture there is something very great and extraordinary, to surprise, please, and instruct. Where this is found, they say the Painter was a Man of the Grand Gusto, or Goût: And they use the Words Sublime and Marvellous, when they speak of a Picture, in much the same

GRAPPLINGS The same with Grapnels. See

that Word in Vol. I.

GRAS-Hearth, was formerly the Customary Service for all the inferior Tenants to bring their Plows, and do one Day's Work for the Lord,

within four Days after Michaelmas.
GRAVITY. Dr. Gregory, in the Preface to his Excellent Aftronomy, thews, that the ancient Astronomers knew that the Heavenly Bodies gravitated towards one another, and were kept in their Orbits by the Force of Gravity. And that when Democrisus, Metrodorus, and Diogenes, and afterwards Anaxagoras, Archelaus, and Eurypides, maintain'd the Sun and Stars to be great Globes of Stone or Metal heated red hot; they meant by it, that they were heavy Bodies of such a Density, and heated to such a Degree, as to enable them to retain their Fire and Heat for the Purpoles they were defigned.

Anaximenes said, the Fix'd Stars were of a Fiery Nature, but had Bodies of an Earthy Nature moving round them, which we can't see as we can them. And this Opinion he had from Anaximander, and he from Thales Milesius; who was the first of the Ionick Sect of Philosophers; among whom this was a received Notion. It got also into the Italian Philosophy; for those of that Sect maintain'd each Star to be a World, and to have Earths or Planets moving round it, in the infinite Mundum Space; and in particular, that the Moon was an Earth like ours, and inhabited by some fine Sorts of living Creatures.

In the Leipsick Acts of May, 1690, there is a Discourse about the Cause of Gravity, by Mr. Leibnitz, together with a Defence of his Opinion of

the true Laws of Nature against the Cartesians.
GRAVITY, its Center, is a Point in every heavy Body, through which any Plane whatever being drawn, will divide the Body into two Parts of equal Weight.

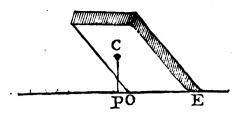
And the Plane so dividing the Body into two Parts, equal in Weight to each other, is call'd

the Plane of Gravity.

And every Line in this Plane which passes thro' the Centre of Gravity, is call'd the Diameter, or Line of Gravitation, Propension, and (by some) Inniction.

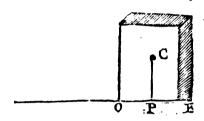
The Line of Direction of Gravity, or Line of Gravity, is perpendicular from the Center of Gravity to the Horizon.

If a Body, being placed upon an Horizontal

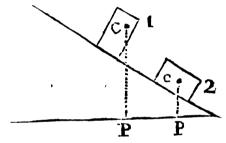


out its Base OE; then that Body must fall down, and will fall on that Side where the Perpendicular C P falls.

But if that Line CP falls any where within O E, the Base or Foot on which the Body stands,



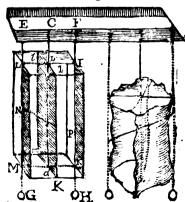
the Body will rest there without Danger of falling. And if a Body be placed on an Inclined Plane, and CP the Line of Gravity, as in N. 1. falls



without the Base, it will tumble over; when it falls within, as in N. 2. it will only Aide down.

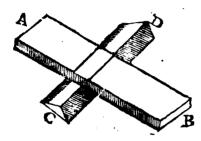
Of the Mathematical Way of finding Centers of Gravity. See Centers of Gravity, in Vol. II.

I shall here, from Sturmius, give you a good Mechanical or Practical Way for finding the Center of Gravity of Regular or Irregular Solids; by which also the Plane of Gravity, and the Diameter of Gravity, may be determined. Apply to the Solid suspended by a Rope, as C D, on both Sides of it, the Perpendiculars EG, and FH, fo that they may touch in the Lines IK, LM, which should be mark'd out with Chalk, &c. and then be joined above and below by the Transverse Perpendiculars IL, KM, so that one of the Planes of Gravity, IK, ML, may be gained: Also having turned the Solid about,



find out, after the same Manner, another such Plane of Gravity, li, km, which will cut the former above in D, and below in d; and then the Diameter of Gravity D d will be had. Then hang the Solid transversly, and the same Way find another Diameter of Gravity N P, which will cut the former in O, the Centre of Gravity fought.

And in some Cases, there may be yet used a more Compendious Way; viz. Lay the given Solid AB on the fine Edge CD, of any Hypomochlion, turning and moving it about 'till it will rest there in Equilibria; then will that Plane, in the Body or Solid which answers perpendicularly to the Edge of the Hypomochlion, be one of the Planes of Gravity: Then find out such another,



by poining the Solid another Way oblique to the former, so will their common Section be one of the Diameters of Gravity: Laftly, roll the Solid into another Polition, and then repeat the former Way of finding another Plane and Diameter of Gravity; so shall the Intersection of this Diameter of Gravity with the former be the Centre of Gravity sought.

GREAT Circle-Sailing, is conducting a Ship

(if it be possible) in the Arch of a great Circle, which passes thro the Zenith of the two Places from whence and to which she is bound. But this from Method is not practicable at Sea, tho' the nearer a Ship can keep to it, the better. See Sir Jonas Moor's Navigation.

GREE, from the French Word Gre, fignifies in our Law, Contentment or Satisfallion. Thus in 2 R. II. c. 15. to make Gree to the Parties, is to give them Contentment or Satisfaction for an Offence done to them. So in 25 E.III. c. 19. 'Tis appointed that Judgment shall be put in Dispense, 'till Gree be made to the King of his Debt. Hence

Agree, Agreement. &c.
GREGARIOUS Birds, are such as do not live solitarily, but affociate in Flights or Coveys, a great many together in Company.

GREUT, is the Miners Word for the Earthy Part of what they dig up, and which hath no Mine or Oar in it, but is peculiar to each particular Load, i. e. such a Load hath such a coloured Greut. The common Earth, which is the loose Mold above the Shelf, in which find the Shoad, they call Deads.
GROOVE, is the Shaft or Passage into the

Lead Mines, and by which they draw up their

GROSSE. Formerly a Villain in Grofs, was such a servile Person as was not appendant or annex'd to the Land or Mannor, and to go along with the Tenure as an Appurtenance of it; but was, like the other Personal Goods and Chattles of his Lord, at his Lord's free Pleasure and Dis-

posal. And thus Advouson in Gross, is distinguish'd

from Advouson Appendant.
GROTESQUE, or Grotesca Work, is the same with what is sometimes call'd Antick; being 4 confus'd Composure of Figures of different Na-tures, Sexes, &c. and usually of such Fancies as are not any where really existing in Rerum Natura

GROUND Plates, in Architecture, are the outermost Pieces of Timber lying on or near the Ground, and framed into one another with Mortesses and Tennons: In these also are Mortesses made to receive the Tennons of the Joists, the Summer, and Girders; and sometimes the Trim-mers for the Stair-Case and Chimney-Way, and

the Binding Joifts.

GROUPPE, in Painting or Sculpture, is a Knot or separate Collection of Figures, which appear to have some plain Connexion with, or Relation to one another, by the Defign of the Piece

GUARD, in the Military Art, fignifies a Duty or Service paid by the Soldiers, to secure the Army or Place from the Surprizes and Efforts of the Enemy; and of this there are several Kinds: As, t. The Main Guard; which is that from whence all other Guards are detatch'd: Those who are to mount the Guard, meet at the respective Captains Quarters, and are carried from thence to the Parade; where, after the Whole Guard is drawn up, the Small Guards are detach'd for the Posts and Magazines; and then the Subaltern Officers throw Lots for their Guards; and are commanded by the Captain of the Main Guard. 2. Advance Guard, is that Party of Horse or Foot which march before a Body, to give Notice of approaching Danger. When an Army is upon their March, the Grand Guards which should mount that Day, serve as Advance Guards to the Army. That small Body also of 12 or 16 Horse, which are posted under a Corporal or Quarter-master before the Grand Guard of a Camp, are called the Advance Guard. 3. Grand Guard, are 3 or 4 Squadrons of Horse commanded by a Field Officer, and posted before the Camp, on the Right and Lest Wing, towards the Enemy, for the Security of the Camp. 4. In a Camp also every Battalion posts a small Guard, commanded by a Subaltern Officer, about 100 Yards before its Front; and this is called the Quarter Guard. As, 5. That this is called the Quarter Guard. As, 5. small Guard of Foot which a Regiment of Horse mounts in the Front of the Regiment, under a Corporal, is call'd the Standard Guard. There is also, 6. The Picquet Guard, which is a good Number of Horse and Foot, which keep themselves always in a Readiness in a case of an Alarm: The Horse are saddled, and the Riders booted, all the while; and the Foot draw up at the Head of the Battalion at the Beating of the Taston; but afterwards return to their Tents, where they are in a readiness to march upon any sudden Alarm. This Guard is to make Resistance, in case of an Attack, 'till the Army can get

ready.

GUARDIAN of the Spiritualities, is he that collects the Spiritualities of any Bishoprick during the Vacancy of that See. The Dean and Chapter of Canterbury are Guardians of the Spiritualities for the whole Diocese and Province, during the Vacancy of that Archbishoprick.

GUERITE,

GUERITE, in Fortification, is a small Tower of Wood or Stone, plac'd usually on the Point of a Bastion, or on the Angles of the Shoulder, to hold a Centinel, who is to take care of the

Dirch. and to watch out against Surprizes.

GULE of August, is the Day of St. Peter ad Vincules, celebrated formerly and now on the first of August. See Hospinion de Origine Festo-

rum, Fol. 85.

GUN-Powder. The wonderful Explosion of this mischievous Composition (when it is kindled) seems to arise from hence: That the Sulphur and Coal-dust being Bodies very quickly set on Fire, they do very swiftly accend the Nitre; whose Spirit being thereby rarised, breaks out with a violent Explosion, like the heated Vapour of Water out of an Æolipile. The Sulphur also being of a volatile Nature, is itself also converted into Vapour, and so encreases the Explosion; and that Part of it which is of an Acid Nature, see that Spirit which they call Oil of Sulphur (as that Spirit which they call Oil of Sulphur per Campanam) upon the Accention, breaks out, and entring into the fix'd Body of the Nitre, loosens and lets out its latent Spirit also, hereby producing a yet much greater Fermentation and Heat.

And if you mingle Salt of Tartar with Gun-Powder, and let that Mixture be gradually heated 'till it come to take Fire, the Explosion will become much more quick and violent; and this can arise from no other Cause than from the Action of the Vapour of the Gun-Powder on the Salt of Tartar. By what Means the small Particles of Bodies do act upon one another with this Immense Violence, you will find under the

Word Attraction.

GUN-Room, in a Ship, is the Appartment under the Great Cabin; where the Master Gunner and his Crew rendezvous, get ready their Cartridges, &c. and do all Things belonging to their

GUNTERS Line. Designing in this Volume, the Description and Use of the common Scales, Rules and other Mathematical Instruments; I shall now give you the Constitution and Use of this Famous Line. Provide a Ruler of any Metal, Wood, &c. that is proper, of any Length, (the larger the better) and according to the defigned Length of your Line of Numbers, divide a Line of the same Length into 10000 equal Parts; and then having Recourse to a Table of Logarithms, take off from the said Scale the Artificial or Logarithmic Numbers answering to the Division of your intended Line, (omitting the Index or Characteristick) and these Distances will graduate your Line of Numbers, and divide it into its Primes, Tenths, Centesms, &c.

For the first eminent Nine unequal Parts, which have the Nine Digits annex'd, are call'd Primes; and the Subdivisions of those into Ten lesser Parts are called Tenths; each Tenth is divided, or supposed to be so, into Centesms; and those Centesms into Millains, as Mr. Wingate calls them. Numeration therefore, as they call it, on the Line will be very easy; and you may know readily how to find the Point expressing any Number of not above 4 Places on it. Suppose the Number were 4867; The Figure 4, on the Line, expresses the Place of 4000; thence accounting 8 Tenths further to the Right Hand, you will have the Place of 4800; and in the next Tenth, reckoning forward fix Subdivisions, you

will have the proper Point for 4860; and then in the next Cente/m, taking or gueffing at 7, (and Practice will make this easy) you will find the

Point (nearly) for 4867.

But if your Number had been but of 3 Places, as 486; then the Digit Figure 4 on the Line would only have represented 400. And if it had been but of two Places, or a fingle Figure, the Figure 4 on the Line would have been 40, or barely 4 Unites accordingly. 'Tis plain also, that any Decimal Fractions and Unfixt Numbers will be represented on the Line as easy as Whole Numbers, Regard being only had to the Point or Line of Separation.

PROBLEM I.

Two Numbers being given, to find a Third or Fourth Geometrical Proportion.

The Line being nothing but a Series of Logarithms or Artificial Numbers in an Arithmetical Proportion; 'tis plain, if the Compasses be ex-tended from the first Term to the second, the same Distance will reach from the 3d to the 4th, from the 4th to the 5th, and so on continually; only you must turn the Leg sorward when a greater Term is required, and backward, or towards the Less Hand, when the proportional Term required is to be less; as common Sense will direct. Thus if the Two Numbers had been 10 and 12, the Third Proportional forward would be 14.4, and backward 8.3, &c. Sothat all Questions in any Practical Art, where such kind of Proportionals are requir'd, may, you see easily, be wrought by the Gunters Line.

PROBLEM IL

To multiply or divide one Number by another.

Since in all Multiplication, As I is to the One Factor :: So is the Other, to the Product. fince in all Division, as the Devisor is to Unity :: So is the Dividend to the Quotient. Either of these Rules may be easily wrought by the Line of Numbers, fince 'tis only finding a 4th Proportional to Three Terms given. The Extent of the Compasses therefore, from 1 to the Multi-plier, will reach forward in Whole Numbers from the Multiplicand to the Product: And the Extent from the Divisor to Unity, will reach from the Dividend to the Quotient. If either or both Numbers be Decimal Fractions, the Nature of the Product or Quotient must be determined by the Rules given about managing of such Fractions; but the same Figures will be found by the Line, let the Nature or Value of the Numbers be what it will. N. B. How many Places must be in the Product or in the Quotient, may be discovered easily by the Rules of Common Arithmetick, and consequently to what Exactness you must endeavour to go in the

PROBLEM III.

Three Numbers being given, to find a Fourth in a Duplicate Ratio or Proportion.

This relates to the Proportion of Surfaces and Area's, which, when Similar Figures, are in a Duplicate

Duplicate Ratio of their Homologous Sides'. Let the Diameter of a Circle be 14 Inches, and its Area 154; What is the Area of a Circle, whose Diameter is 28?

Extend the Compasses from 14 to 28; that Extent will reach from 154 to 308, and thence to

616, the Area requir'd.

PROBLEM IV.

To three Numbers given, to find a Fourth in a Triplicate Proportion.

This relates to Solids, and their Proportion to Lines.

Let the Diameter of an Iron Bullet be 4 Inches, and its Weight 9 th. What will a Bullet weigh, whose Diameter is as much more; viz. 8 Inches?

The Extent of the Compasses from 4 to 8, applied to 9, and turn'd three Times, will at last fall on 72, the Weight sought.

PROBLEM V.

To find a Mean Proportional between any Two Numbers given: As suppose between 8 and 32.

Extend the Compasses from 8 in the Left Hand Part of the Line, to 32 in the Right, and then bisect that Distance; the half shall reach either from 8 to 16 forward, or from 32 to 16 backward.

PROBLEM VI.

To find Two or more Mean Proportionals between two Numbers given.

Divide the Distance between the two Numbers into a Number of equal Parts, which shall exceed the Means required by one; (as if 2 are required into 3, if 3 are required into 4, &c.) So shall the Feet of the Compasses, when turned from either of the Numbers towards the other, mark out the middle Proportionals required.

PROBLEM VII.

To Extract the Square Root of any Number.

Biffect the Distance between 1 on the Scale, and the Point which represents the Number; and the Half being set from 1, will give the Point representing the Root.

PROBLEM VIII.

For the Cubick Root, or that of any Higher Power.

You must Divide the Distance on the Line between 1 and the given Number, into as many equal Parts as the Index of the Power expresses; and one of those Parts set from 1, on the Line, will find the Point representing the Root requir'd. Thus if the Cubick Root of 1728 were requir'd: Divide the Distance between 1 and 1728 into three equal Parts, (3 being the Index of the Cube or Third Power) and one of those set from 1 forward, will find 12 the Root sought.

N. B. Only observe to Point the Number whose Root is to be Extracted (as in Extraction of Roots in Common Arithmetick) and then, if the last Point fall on the first Figure of the Number, the former Way of accounting on the Line will do: But if the last Point fall on the second Figure or Place in the Number (reckoning from the Left Hand towards the Right;) then account the whole Length of the first Line of Numbers in, and carry the Account on in the Second: As suppose the Root of 36 were requir'd; begin to take the 36 from the first 1 on the Lest Hand in the Line, and account the 36 on in the second Line; and then half that Distance being sent from the first 1, will reach to 6, the Root in either the first or second Line. So also if the Square Root of 1440 had been fought: Account the whole first Line for your first 1000; and then the 440 on in the Tenths between the second 1 and 2: So will half the Distance between the first 1 and that Point, reach from 1 to near 38 in either Line.

PROBLÉM IX.

For the Use of the Line in Trigonometry; See that Word.

The Use in Superficial Measure.

PROBLEM X.

Having the Diameter of a Circle, to find the Circumference.

Extend the Compasses from 1 to the Number expressing the Diameter; and then the same Extent will reach from 3.142 to the Circumference.

PROBLEM XI.

Having the Diameter, to find the Superficial Content.

The Extent, as before, from 1 to the Diameter being found, fet it twice from the Point of .7854 on the Line, and then it will reach to the Number expressing the Area.

PROBLEM XII.

The Breadth of a Relangle being given in Inch-Measure, and the Length in Foot-Measure, to find the Area in Feet.

Exrend the Compasses from 12 on the Line to the Breadth in Inches; and that will reach from the Length in Feet, to the Area in Square Feet.

PROBLEM XIII.

The Length and Breadth being given in Foot-Meafure, to find the Area in Tards.

The Extent from 9 to the Breadth, will reach from the Length to the Area in Yards.

PRO.

PROBLEM XIV.

To find the Area in single Perches.

The Extent from 16.5, to the Breadth, will reach from the Length to the Content in Perches : And the Extent from 160 to the Breadth, will reach from the Length to the Content in Acres, &c.

The Use in Solid Measure.

PROBLEM XV.

The Depth and Breadth of a Right-angled Parallelo piped being given in Inch-Measure, and the Length in Foot-Measure, to find the Content in Fees.

The Extent from 12 to the Breadth and Depth in Inches, being twice repeated from the Length in Feet, will reach to the Content in Feet. If the Parallelopiped be Oblique-angled, you must find a Mean Proportional between the Breadth and Depth: And then the Extent from 12 to the Mean Proportional being twice repeated from the Length in Feet, will reach to the Consens in Feet.

PROBLEM XVI.

To find the Solidity of a Cylinder, whose Base and Length is given.

The Extent from 1 to the Base, will reach from the Length to the Solid Consent.

PROBLEM XVII.

Having the Diameter of a Sphere, to find its Surface and Solidity.

The Extent from 1 to the Diameter, repeat twice from the Point of 3.142, and that will reach to the Number expressing the Surface: And if you repeat the Extent from 1 to the Diameter, three times from .5238 on the Line, that will reach to the Solid Content requir'd.

Its Use in Interest and Annuities.

PROBLEM XVIII.

To find what any Sum will encrease at 6 per Cent. Interest upon Interest, if forborn a certain Time. Suppose 273 l. for 5 Years.

Extend the Compasses from 100 to 106, and then repeat that Distance five times from 273, so will the Point at last fall on 402.1, or 402 1. 2 s. which is the Principal and Interest requir'd.

PROBLEM XIX.

A Sum of Money being due for a Time to come, to know what 'tis worth in ready Money.

This is the Reverse of the Last.

PROBLEM XX.

A Yearly Rent or Annuity being forborn for a Term of Years, to find what she Arrears will amouns to, at the Rate proposed.

As suppose a Rent or Annuity of 12 l. per Ann. were forborn sixteen Years; What will the Arrears amount to at the Rate of 8 l. per Cent. Intereft?

First find the Principal answering to 12 1. by saying, If 8 l. hath 100 l. for its Principal, what will 12 l. have? Answer, 150 l. Then I find (by Probl. 18.) that 150 l. being forborn fixteen Years, amounts, at 8 l. per Cent. to 513.9, or 513 l. 18 s. Out of which deducting 150 l. the Principal answering to the Annuity given, there remains 363 l. 18 s. the Sum of all the Arrears required.

PROBLEM XXL

To apow what Annual Rent or Annuity is worth in Ready Money.

Find (by the Precedent) the Value of the Arrears at the End of the Term proposed; and then (by Probl. 19.) what those Arrears are worth in Ready Money; and that will be the requir'd Price or Value of the proposed Rent or Annuity; v. gr. I find the Arrears of 12 l. per Ann. at fix-teen Years end, and at 8 l. per Cent. amount to 363 l. 18 s. And I find (by the 19th Probl.) than the faid Sum is worth in Ready Money 106 l. 4 s. and consequently I conclude, that the Lease or Annuity proposed is worth in ready Money (af-

ter 8 l. per Cent.) 106 l. 4 s.

If the Term of the Annuity don't commence presently, but suppose at five Years hence or to come, then you must find what the Arrears for all that Time are worth in ready Money; that is, what they are worth, when forborn in this Instance for twenty one Years. The Answer is, 72 l. 6 s.
GUTS: See Intestines.

GUY Rope: See Guy, in Vol. I.
GWAIF, the same with Waif; i.e. such
Goods as Felons when pursued, cast down and leave in the High-Way; which become a For-feiture to the King or Lord of the Mannor, unless the Right Owner legally claim them within a Year and a Day.

HABEN-

ABENTES Homines, Fasting-Men; as they are call'd in a Charter of Cenulph King of the Mercians, Anno 821. Du Fresne will have these to be no more than Divites, Rich Men: But no doubt the Word implies a ftricter Sence; and fignified either the King's Guard or Retinue, which were at the King's Pleasure to be Feasting-Men, or plentisully entertained at the Houses of his Tenants: On rather, thole Old Servants which were commended to the Religious by the King; and so fastned on them for Corrodies, or Maintenance for Life. Some think that they were only Pledges and Sureties, or Friburghs; which under their Chief or Principal Tything Man, were to keep the King's Peace, and to be accountable for the Breach of it.

HABITATION, in the Civil Law, is the Term for one of the Perfonal Services, by which a Man hath a Right to live in the House of another without Prejudice to the Propriety.

HADBOTE, was a Recompence made for the Violation of Holy Orders, or Violence offer'd to Persons in them.

HAIL. Dr. Wallis in a Letter from Oxon to the Secretary of the Royal Society, and printed in the Transactions, observes that Hail is very often an Attendant on Thunder and Lightning; (of which, see Thunder in this Volume.) And tis well known, that in our artificial Congelations, a mixture of Snow and Nitre, or even common Salt, will caule a very sudden Congelation of Water. Now the same in the Clouds may cause Hail-Stones; and the rather, because not only in fome prodigiously great, but also in common Hail-Stones there seems somewhat like Snow rather than Ice, in the midst of them. And as to those very large Hail-Stones, weighing \(\frac{1}{2}\) or \(\frac{1}{4}\) of a Pound; by the violence of their Fall tis manifest they must have descended from a great Height: And tho' perhaps in their first Concretion, or Congelation, their Bulk might be but of the moderate Size of common Hail, yet in their long Descent, if the Medium, through which they sell were alike inclined to Congelation, they might receive a great Accession to their Bulk, by, perhaps, many of them coalescing and incorporating into one; as in that strange Shower of Hail in December 1672. whereof their hung on the Trees a great deal in the form of Icicles, of a Foot or more in length.

HAILWORKFOLK; i. e. Holy Work-folk, or People who hold Lands for the Service of Repairing or Defending some Church or Sepulchre: For which pious Labours they were excused formerly from Feudal and Military Services.

HALF-Bloom, is the Term for a round Mass of Metal, which comes out of the Finery in all Iron-Work: See Iron. HALF-Tangent-Lines: See Scale.

HALF-Tongue, or Party-Jury, is a Jury empanell'd in a Cause where a Stranger is a Party; whereof the one Part consists of Denizens, the other Half of Strangers: And the same is used in Pleas, where one Party is a Denizen, the other a Stranger. This way of Tryal was first Enacted by a Statute of Edward III.

HALLAGE, is a Fee due for Cloths brought for fale to Blackwell-Hall in London; and also the Toll that is due to the Lord of a Fair or Market, for such goods as are vended in the Common Hall of the Place.

HALO. Mr. Huygens (vid. Philosoph. Trans. N. 60.) endeavours to account for the Appearance of Halo's, or Circles round the Sun, thus: That they are formed by small round Grains of a kind of Hail made up of two parts; one of which is opake and inclosed in the other, which is transparent; and the same way he accounts for the Parhelia; only there he imagines that the Icy Grains are of an oblong Figure, and rounding at the Ends like Cylinders with round convex Tops. Where some of these Cylinders are in an erect Position, the Circle they form will be white, and is caused by the Reflexion of the Rays of the Sun on the Surface of these Cylinders. He proceeds afterwards to account for the colour'd Halo's and Parhelia from the same Hypothesis, and produces an Experiment of a Glass Cylinder of a Foot long, and having within an Opake Kernel (which was a Cylinder of Wood) and the ambient Space was filled with Water: Which Cylinder being exposed to the Sun, and the Eye disposed in proper places, the several successive Reslexions and Refractions necessary to produce such Effects did

plainly appear.

HALY-MOTE (alias Healge-mote) a Word
retain'd in Herefordshire to this Day for a Court-Warren. It may fignifie a Convention of Citizens in their Court Hall; or, a Holy or Ecclesi-

aftical Court. Cewel's Interpr.

HAMBLING, or Hamelling of Dogs, is the same, in the Laws of the Forest, as Expeditating: And Manwood saith, Canutus, in Can. 1. calls the Lawing of Dogs, Genuscissio, Ham-string-

HAMMER. Besides the Sledges, or large Hammers used by Smiths, there is, 1. The Hand-Hannmer, which is us'd by the Smith at the Forge with one Hand. Its edge is call'd the Pen; and the other part of the Head the Face; and the Hole for the Handle is call'd the Eye. 2. The Riverting-Hammer, chiefly us'd for rivetting or fetting straight cold Iron; or for crooking of small Work; but 'tis seldom us'd at the Forge. For the Smith's larger Hammers, see Sledge.

HAMPER: See Hanaper.

HAMSOKEN, Haimsuken, Homesoken, is the Term in Scotland for the Crime of him that violently Affaulteth a Man in his own House: And our antient Records call Burglary Hamsocne.

HANAPER: See Clerk of the Hanaper. HANCES (in a Ship) are Falls or Descents

of the Fife-Rails, which are placed on Banisters on the Poop, Quarter-Deck, &c. down to the

HANCES in Architecture are the Ends of Elliptical Arches; and these are the Arks of smaller Circles than the Scheme or middle Part of the Arch.

HANDBOROW, is a Surety, a Manual Pledge; i. e. an Inferior Undertaker; as Headborow is a Superior or Chief Instrument. Spelman. HAND-

HANDGRITH, was antiently the Word for Peace or Protection given by the King with his own Hand.

HAND-HABEND, is a Thief taken with the Goods in his Hand, or upon him, as we say.

HANGWITE, according to Rastal, was a Liberty granted to a Man whereby he was quit of a Felon or Thief, hang'd without Judgment, or

escap'd out of Custody

HANSE, is an old Goebick Word, fignifying a Society of Merchants combin'd together for the good Usage and safe Passage of Merchandize from Kingdom to Kingdom. This Society was, and in part is yet, endow'd with many large Privileges of Princes respectively within their Territories. It had four principal Seats or States, where the Almain or German Merchants, being the Erectors of this Society, had an especial House; One of which was here in London; and call'd Gild-Hald a Teutonicorum, or among us vulgarly the Steel-Yard, or Still-Yard.

HAPPE, from the French Happer, to Snatch or Catch, is a Term used in our Law. As to Happe the Possession of a Deed Pole. Littleton, As to Fol. 8. To Happe the Rents; as if Partition be made between two Parcenors, and more Land be allow'd to one than to the other: And she that hath most of the Land charges it to the other, and the Happeth a Rent, the shall remain an Affize without Specialty. Comel.

fize without Specialty. Cowel.

HARMONY. Dr. Holder in his Discourse on this Subject, saith, That when the Sonorous Body is constituted of Parts solid or tense, regular and fit to receive and express the Tremulous Motion of Sound, equally and swiftly, it will then render a certain even Harmonical Tone or Tune.

The Tune of any Note is constituted by the Measure and Proportion of the Vibrations of the Sonorous Body; i. e. of the Velocity of those Vibrations in their Recourses.

For the more frequent the Vibrations are, the acuter will be the Tune; and the flower or fewer they are in the same Time, the graver is the Tune.

So that any given Note of a Tune n made by one certain Measure of Velocity of Vibration; viz. Such a certain Number of Courses and Recourses (i. e. forward or backward Vibrations) of any Chord or String in such a certain Space of Time, doth constitute such a determinate Tune: And all such Sounds as are Unisons, let them come from Voice, Bell, Pipe, or String, are made with

Vibrations all equal to one another.

The Continuance also of the Sound in the same Tune, to the End, (as in Strings of Wire, which being once struck will hold their Sound long in the same Note) depends upon the Equality of Time of the Vibrations from the greatest Range till they come to cease: As is the known Property of Pendulums: And a Mufical String struck, is like a Double Pendulum, moving upon two Centres, the Nut and the Bridge, and vibrating with its greatest Range in the middle of its Length, and the Vibrations equal, even to the last; which must make it keep the same Tune as long as it sounds. And because it doth plainly keep the same Tune to the last, the Vibrations are equal.

The Measures of Swiftness of Vibrations of the String or Chord, as hath been said above, constitutes and determines the Tune, as to the Acutemess and Graveness of the Note which it sounds:

and the lengthning or shortning of the String under the same Tension, determines the Measure of the Vibrations which it makes. And thus Harmony comes under Mathematical Calculations of Proportions; as to the Length of the Chords, the Measure of the Time in Vibrations, and of the Interval of tuned Sounds. As the Length of one String is to another (if of the same Matter, Thickness and Tension) so is the Measure of the Time of their Vibrations. As the Time of the Vibration of one String to another, so is the Interval or Space of Acutenels or Gravenels of the Tune of that one, to the Tune of the other: And consequently, as the Length is, so is the determinate Time, caterin paribu. These Vibrations impress a Motion of Undulation or Trembling in the Air, as far as the Motion extends, of the same Measure with the Vibrations.

And if the Motions made by different Chords are so commensurate that they mix and unite, and bear the same Course altogether, alternately or frequently: Then the Sounds of these different Chords, thus mixing, will calmly pass the Medium, and arrive at the Ear as one Sound, or nearly the same; and so do evenly, smoothly, and with pleasure strike the Ear; which produces what they call a Consonancy; and from the Want of such an agreeable Mixture, Dissonances do a-

And as the more frequent Mixture or Coincidence of Vibrations render the Concords generally so much the more persect; so the less there is of Mixture, the greater and more harsh will the

Discord be

From all which 'tis easie to see the Reason why Concords are agreeable and pleasing to the Ear which is because they unite in their Morions often; at least in every fixth Course of Vibration; as is apparent from the Musical Ratio's by which they are constituted, which are all contain'd within that Number of 6.

Thus the Agreement between two or more Unisons or Chords of the same Length, &c. is because the Vibrations of such Sounds are equal to Time and Measure, and do joyn and unite in

every Course and Recourse.

If the String A be double in length to B (I proceed according to the usual Division of the Monochord) i. e. as to 2 to 1. Then the Vibrations of B will be duple to those of A, or twice as swift: And consequently if these Strings are struck together, their Vibrations will unite alternately; viz. at every Course crossing at the Recourse, and give the Sound of the Oldave to one another.

If the Length of A to that of B, be as 3 to 2: Then reciprocally their Vibrations will be as 2 to 3; and their Sounds will concord in a Fifth; their Motions uniting after every second Recourse; i. e. at every other, or third Course.

If A be to B, as 4 to 3, they found a Fourth together, and their Vibrations unite after every

third Recourse, or at every fourth Course. If the Length of A be to that of B, as 5 to 4, they found a Ditone or Third Major; and their Motions unite after every fourth Recourfe, or at every fifth Course.

If A be to B, as 6 to 5, then they found a Tribemitone or Third Minor; uniting their Vibrations after every fifth Recourse, and at every fixth Course, Gc.

And

And thus by the frequency of their being mix'd and united, the Harmony of joyn'd Concords in Musick is found so very sweet and pleasing; the Remoter being also combined by their Relation to other Concords besides the Unison. The sixth to other Concords besides the Unison. Major, which is 5 to 3, is within the compass of Ratio's between 1 and 6: But the leffer Sixth (8 to 5) is beyond it; but is the Complement of 6 to 5, to an Octave; and makes a better Concord by its Combinations with the Octave and Fourth from the Unifon; having the Relation of a Third Minor to one, and of a Third Major to the other, and their Vibrations uniting accordingly. The Sixth Major bath the same Ad-

HARO, Harron, is an Outery, or a Hue-2nd-Cry after Felons and Malefactors: See the Original of this Custom; de Haro among the Normans in La Coustume de Normandie par Mr. H. Basnage, Vol. 1. p. 104. Perhaps, hence our English Word to be Har'd, i. e. Frighted; and Harasi'd, Tired,

ಆಂ.

HATCH, a Term in Mining: See Essay-Hatch. Hatch is also us'd for a Cross-Board that lies a-thwart the Pass, sto hinder the Ore from tumbling all at once into the Coffer of a

Stamping-Mill.

HATCHING, is a Term us'd in the Art of Drawing or Defigning in Black and White; and by it is understood a manner of Shadowing by a continual Series, or Succession of many Lines shorter, or longer; closer or more separate; oblique, or direct, according as the Work requires, to render it more or less enlighten'd.

HAW, is a small Quantity of Land, and usually such as lies near a House: As a Hemp-Haw or Plat, a Bean-Haw: And some old Manuscripts say that Haw is the same with Mansio, a Dwel-

ling-House, as in Doomsday-Book, &c. HEADS, is a Term us'd by Builders for those kind of Tiles which they use to lay at the Eaves of a House; being the full breadth of a Common Tile, and but half a Tile in length.

HEAD-BOROW, fignifies him that is Chief of the Frank-Pledge, and him that had the principal Government of them within his own Pledge. And as he was call'd Head-Borow, so he was also call'd Burrow-Head, Bursholder (now Bosholder.)
Third-Borow, Tything-Man, Chief-Pledge, and
Borow-Elder, according to the diversity of Speech
in divers places. This Officer is now usually call'd a Constable.

HEAD-PENCE, or Head-Silver, was former. ly an Exaction of 40 l. or more, collected by the Sheriff of Northumberland of the Inhabitants of that County every Third and Fourth Years; without any Account made to the King. But by 23 H. VI. c. 7. this was clearly abolish'd for

HEART. Authors which have treated about this Muscle are chiefly Lower de Corde, Bellini de Motu Cordis, and Borelli de Motu inimalium; who accounts that the Force of the Compression of the Heart to squeeze out the Blood into the Arteries, is equal to that of 3000 Pound weight; and that 350 Pound weight of Blood passes thro' the Heart every Hour: See Dr. Keil's Animal Secretion, p. 88. where you have a good Attempt to estimate the Quantity of the Blood in an Human Body, its Velocity, &c.
Vol. II.

HEAT. Great Bodies are capable of preserving Heat for a long while; their Parts mutually increasing one another's Heat. And it may be. that a very great dense and fix'd Body, when heated beyond such a degree, may emit Light so copiously, that by such Emission, and by the Reaction of its Light, and by the Researchion of the Rays within its hidden Measus, it may come to grow still hotter and hotter, as deriving more Degrees of Heat by those ways, than it can of Cold by any other: And by this means it may come to attain-a Heat, like that of the For the Sun and the fix'd Stars feem only vast Globes of Earth vehemently heated; and whose Heat is preserved by their great Magnitude, and by the mutual Action and Re-action that there is between them and the Light which they emit.

And their Paris are preserved from evaporating in Flame and Fume, not only by the great Fixity of their Nature; but also by the mighty Weight and Density of the Atmosphere which environ them, which press them every way with a great Nisus, and condense their Vapours and Exhalations, whenever they are emitted.

For we see that Water, but moderately heated. will boil with violence when the Pressure of our Atmosphere is taken off in the Exhausted Recei-

And a Mixture of Tin and Lead, being plac'd on a red-hot Iron in vacuo, will emit copious Fumes, and even some Flame, which yet in our Air will scarce visibly smoke. Vid. Qu. 11. New-

ton. Opt. p. 296. Edit. Lat.

Hear conduces very much to the Fluidity of Bodies, by lessening the Tenacity of their Parts; for it renders many Bodies fluid, which other wise are not so; and increases the Fluidity of Tenacious Liquors, as of Oyl, Balsam, Honey, &c. and by the same reasons lessens their Resisting Force of Water; which it must do, it that Base arise shields from the Austrian and if that Force arise chiefly from the Attrition or Tenacity of its Parts; and consequently it doth not arise from thence, but from the Vis Inertia Materiæ

HEBBER-THEF, was formerly the Privilege of having the Goods of a Thief, and the Tryal

of him within such a Liberty.

HEBDOMADIUS, was formerly that Canon or Prebendary in a Cathedral Church, which had the peculiar Care of the Choir, and the Of-

ficers of it, for his own Week.

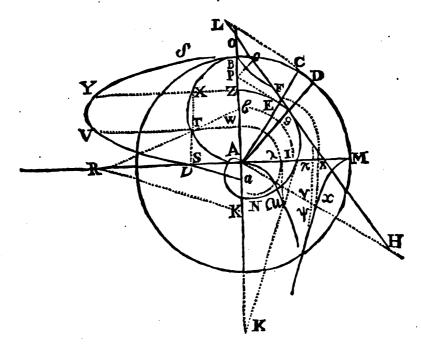
HEDAGIUM, from Heda, a Hythe, Port or Wharf; was formerly the Term for the Toll or Custom paid at the Hythe or Wharf, &c. for Landing Merchandize, Goods, &c. From which Toll or Customary Duties, Exemptions were fometimes granted by the Sovereign to some particular Persons and Societies.

HEIGHT, or Alitude of the Eye in Perspective, is its Height or Elevation above the Horizontal Plane; and it is measured by a Perpendicular let fall from the Eye to that Plane.

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HELICOLD Parabola, or the Parabolick Spi-ral, is a Curve which arises from the Supposition of the Axis of the common Apollonian Parabola's, being bent round into the Periphery of a Cir-

verge towards the Centre of the said Circle. The Tangent, Area, Length, and Flexure of this Spiral Curve is investigated by Mr. 3. Bernoulli, according to the Method of the Differential Cal. cle, and is a Line then passing through the Ex-tremities of the Ordinates, which do now con-Lips. for Jan. 1691. Thus,



Suppose the Axis of the common Parabola to be Let also CL, AH, be drawn perpendicular to bent into the Periphery of the Circle BDM (in AC; and let CD be an infinitely small Arch Fig. above;) Then the Curve BFGNA, which passes through the Extremities of the Ordinates CF, DG (which converge towards the Centre of the Circle A) is what is called the Helicoid, or Spiral Parabola, or the Parabolick Spiral. And in order to the Investigation of its Tangent, Area, Length, and Flexure; He supposes AB = r, BDMB = c. The Arch BC = x, CF = y.

on part of the Circumference, similar to, and concentrick with, the little Arch G. E.

The Nature of the Curve is l = y (where l flands for the Parameter of the Parabola.)

Whence, in this Calculus, dx being the Fluxion of x, and dy the Fluxion of t, &c. (See the Marquis l Hospital Analyt. des Instimment petits.) l dx = 2 y dy; and dy : dx :: l : 2 y.

AD: AG:: DC: GE

 $r: r-y:: dx: \frac{r dx - y dx}{r};$ First then for the Tangent. It will be FE: EG FA AH

FE: EG FA AH FC CL And $dy: \frac{r dx - \gamma dx}{r} :: r - y: \frac{dx \times r - y^2}{r dy} :: y: \frac{ry dx - yy dx}{r dy}$

To make a particular Application of the General Expression to the Curve proposed; instead of dy and dx, substitute their Proportional and 21;

Then will $AH = \frac{2j^2 - ryj + 2rrj}{lr} = (fub$ flituting lx for yy) $\frac{2xy}{x} + \frac{2ry}{t} - 4x$; and $CL = \frac{2r\gamma\gamma - 2\gamma^2}{lr} = 2x \frac{-2x\gamma}{r}$. The greatest AH (CL) will be found, if its Differentials $\frac{6\gamma\gamma d\gamma - 8r\gamma d\gamma + 2rr d\gamma}{lr}$ (or $\frac{4r\gamma d\gamma - 6\gamma\gamma d\gamma}{lr}$ the Differentials of CL) be put = 0: Whence arises $y = \frac{1}{8} r (\frac{2}{8} r;)$ and COROLLARY.

If the Parameter $\frac{l=rr}{c}$, viz. that the Applicate answering to the whole Circumserence be the Radius it self (as in the present Fig.) then the greatest A H or C L will = $\frac{8}{27}$ c.

The greatest Angle made by the Ordinate and Tangent, viz. A F H, or C F L, is found, by putting the Ratio $\frac{CL}{CF}$, or $\frac{2ry-2yy}{lr}$ equal a

Maximum; that is, its Differential 2rdy-yydy be put = 0: Whence arries $r = \frac{1}{2}$. Whence we have $r = \frac{8 r r}{2 r} = 0$. Whence we have $r = \frac{1}{2}$ consequently the greatest ΔH (CL) = $\frac{8 r r}{2 r} = 0$. But more particularly in the the Hypothesis of $l = \frac{rr}{c}$, we have $x = \frac{yy}{l} = \begin{vmatrix} :AS (=\sqrt{ry-yy}) ::AK (=\sqrt{ry-yy}) \\ :AR = \frac{ry-yy}{l} \end{vmatrix}$. $(\frac{c}{r}) = \frac{1}{4}c$, and $\frac{CL}{CF} = \frac{c}{2r}$

COROLLARY.

If IK touches the Curve in the Point I (where it intersects the Radius AM) and cuts the Diameter BAK produced in K; then shall AK = the Periphery.

Next,

2. For the Area: 'Tis DC + GE X & DG $= CDGE: Or \frac{2rdx - ydx}{r} \times \frac{1}{2} , =$ $\frac{2rydx-yydx}{2r}=\text{(fubflituting }\frac{2ydy}{4}\text{ in-}$ flead of dx) $\frac{2yydy}{l} = \frac{y^3dy}{lr}$. The Integral of which is $2 \frac{y^2}{3l} - \frac{y^4}{4l3}$, or $\frac{1}{4}xy - \frac{lxx}{4r}$; which is equal to the Curvilineal Space BFGDCB. Wherefore putting j = r, we shall find the whole Space B A N G F B C D M B = $\frac{5 r^3}{12 l}$; that is,

in the Case of $l = \frac{rr}{r}$, 'tis = $\frac{r}{12} rc$. And fince the whole Circle B D M B is $=\frac{1}{2}rc = \frac{6}{15}rc$; the aforesaid Space shall be to the Circle as 5: 6: And therefore the remaining Space B A N G B A will $= \frac{1}{6}$ of the Circle.

Again, Thirdly, For the Length of the Curve. $FG^{q} = FE^{q} + EG^{q} = dy^{q} + dx^{q}$ $\times \frac{rr \leftarrow 2rq - yy}{rr} = (\text{fubflituting } \frac{2y dy}{l},$

inflead of dx) $\frac{rrll+4rryy-8ry^3+4y^4}{rrll}dy^7$.

Hence $FG = dy \times \sqrt{\frac{rrll + 4rryy - 8ry^2 + 4y^4}{rrll}};$

The Integral of which, could it be exhibited, would give the Length of the Curve BFG: Which Rectification may yet be thus express'd. On the Diameter AB describe the Semi-circle ATXB, and let Aa be cut off = l; then drawing any indefinite Perpendiculars WV, ZT, equidiffant from A and B, and cutting the Periphery of the Semi-circle in TandX, let the Right Line AS, and let KR be parallel to Sa, and the Right Line $R\beta$ be drawn to the Centre of the Semicircle; equal to which cut off the Right Lines WV, ZT; Then shall the Points V, T, be at the Curve γVTJ ; which is of such a Nature, that the Abscissa BZ = DG, and the Space BZTJB divided by $AB = \frac{1}{2}AB$ gives a Right Line the Curve BEG

$$AR = AS = WT = ZX = \sqrt{BZ \times ZA} = \sqrt{y \times r - y} = \sqrt{ry - y}; \text{ and } Aa (=1)$$

$$: AS (= \sqrt{r_1 - \gamma_2}) :: AK (= \sqrt{r_2 - \gamma_2})$$
$$: AR = \frac{r_2 - \gamma_2}{\sqrt{r_2 - \gamma_2}}.$$

Wherefore, $ZY (=WV = R\beta = \sqrt{A\beta^{q} + AR^{q}})$ $= \sqrt{\frac{1}{4}rr + rryy - 2ry^3 + y^4}$: Whence

a Portion of the Space 2y + B, of the Breadth $dy = dy \sqrt{\frac{rrll + 4rryy - 8ry^2 + 4y^4}{l}}$;

And this divided by $A \beta = \frac{\pi}{2} r$, gives $d\gamma$ $\sqrt{\frac{rrll+4rr\eta\eta-8r\gamma^{3}+4\gamma^{4}}{rrll}}=FG.$

And consequently the whole Space Z TAB divided by $\frac{\pi}{2}$ r is equal the Portion of the Curve-Line B F G. Q. E. D.

COROLLART.

Taking BZ, AW, equal to one another; if on the Centre A, and with the Radii AZ, $A\beta$, AW, we describe Arches cutting the Curve in the Points G, I, N, (Note bere, The middle Inter-fection I, in the Case of the present Figure, falls in the Radius A M) the Portions of the Curve B G and AN, GI and NI, as also BGI and ANI, are equal to one another. Whence it plain, that even those Curves that don't admit of a Rectification, yet some times have Dissimilar. Parts equal to one another.

When I had fignified this to my Brother, he presently observ'd, That the Nature of almost any Spiral being express'd by an Algebraical Equation, another Geometrical Curve may be affign'd equal to it. For on the Centre A, with the Radia AF and AG; describing the Arches $F\rho$, $G\pi$, if the Curve $M\psi$ be imagin d such, that $r\psi$, the Difference of the Ordinates ρx , $\pi \downarrow$, be equal to the Arch EG: Then, because of $\nu x = \pi \rho = EF$, and $\nu \downarrow = EG$, and the Angles $\downarrow \nu x$, FEG, Right ones; also ψx shall be equal FG; and compounding, the whole Portion of the Curve $M \psi$ the whole Portion of the Spiral B G. Now to find the Nature of the Curve M 4, we need on-

ly substitute (in the Quantity $\frac{r dx - y dx}{x}$, which always expresses EG or $\Rightarrow \downarrow$) the Value of dx, which in our Curve is $\frac{2y}{l}$; which produces

 $\frac{2 \ j \ d \ j}{l} - \frac{2 \ j \ j \ d \ j}{r \ l}$, the Integral of which $\frac{y \ y}{l}$

of the Semi-Circle in 1 and 3, act also A/S, and the Semi-Circle in 1 and 3, and the Right Line R/S be drawn, and joining S/a, take A/K = A/S, and let K/R be parallel to S/a, and the Right Line R/S be drawn to the Centre of the Semi-circle; equal to which cut off the Right Lines W/V, χT ; Then shall the Points V, T, be at the Curve γ V/T/S; which is of such a Nature, that the Abscissa B/Z = D/G, and the Space B/Z T/S/B divided by A/B (=\frac{1}{2}A/B) gives a Right Line = the Curve B/FG.

Demonstration.

Demonstration. $AK = AS = WT = \chi X = \sqrt{B\chi \times \chi A} = \sqrt{B\chi \times \chi A} = \sqrt{\chi \times \chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{\chi \times \chi} = \sqrt{$

described at the Centre A, and upon the Axis AK; whose Parameter is a Fourth Proportional to the Periphery, Diameter, and Radius of the Circle B D'M, then shall both the Curve Lines, and the Spaces comprehended under them, be equal, viz. Taking any Point A in the Right Line AM; if to this be applied the Right Line A µ, cutting the Parabola in μ , and the Arch λ N concentrical to the Periphery of the Circle BM, be drawn cutting the Spiral in N; then the Portion of the Spiral Line AN shall ever be equal the Portion of the Parabolick Line $A\mu$; and the Space AN comprehended between the Right Line AN and the Spiral, shall equal the Parabolick Space A & u A. Which wonderful Agreement of the Spiral and Parabola we afterwards found Dr. Willis had observed before ; who relates, that Roberval and Hobbs contended about the first Discovery of it; as if two Persons, at a distance both in point of Place and Time, might not be led by their own Genius's to one and the same Invention.

4. For the Flexure of the Curve. That the Curve must have a Point of contrary Flexion, is evident; for because the Periphery B C differs but insensibly from a Right Line, for some space beyond the Vertex B, it follows from the Nature of the Parabola, that the Curve must be concave towards the Circumference in the Parts next the Vertex, and concave towards the Centre in the rest. If G, e. gr. be the Point of contrary Flexion, then AO, the Segment of the Radius, intercepted between the Centre and the Tangent, sintercepted between the Centre and the Tangent, sintercepted between the Centre and the Tangent, so the Secant of the Arch BD = 1, and the Tangent = t: Then we have the following Proportions; Viz. r: r-y (= AG):: t

\[\frac{t r-y}{r} \left(= GP \right) \cdots \frac{t r-y}{r} \left(= AP \right) \]

Again, GE: EF:: PG:P2

\[\frac{r dx-y dx}{r} \cdots \frac{t r-ty}{r} \cdots \frac{t dy}{dx} \]

Lastly; AF:P2::AO:PO (= AO - AP)

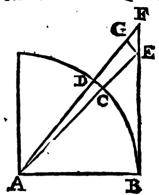
\[\frac{t dy}{dx} :: M:M - \frac{t r-y}{r} \cdots \frac{t dy}{r} \]

Whence we shall find

$$M = \frac{rrsdx - 2rsydx + ssydx}{rrdx - rydx - redy}; \text{ and}$$
Subfituting $\frac{ldx}{2y}$ for dy , and dividing by dx , we have $M = \frac{2rrsy - 4rsyy + 2sy^2}{2rry - 2ryy - rls}$. And therefore the Differential of this is to be equal to nothing; but the Differential of a Fraction is $= 0$, when its Terms, multiplied into the Alternate Differentials, are equal: For the Differential of the Fraction $\frac{y}{x}$ is $\frac{1}{x^2} \frac{dy + y dx}{x^2}$; and conquently if it be $= 0$; then also shall $\frac{1}{x^2} \frac{dy + y dx}{x^2}$ and which Rule we shall come to an Equation of fixteen Members $\frac{1}{x^2}$ and condens on an Equation of fix-

teen Members; in order to the Reduction of which, let it be observed, viz. That the Differential of an Arch is in a given Ratio to the Dif-

ferential of the Tangent and Secant; for It is to the Differential of the Tangent, As the Square of the Radius To the Square of the Secant: And It is to the Differential of the Secant, As the Square of the Radius to the Rectangle under the Tangent and Secant. For in the Quadrant ABD,



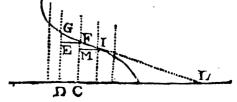
dx: dt:: DC: EF:: DC: GE+GF; $GE+GF: EF:: AD (=AB): AG+AB; AG+AB: AF:: AB^{q} (=rr): AF^{q}$ (=ss.) Wherefore, $dt=\frac{ssdx}{rr}=$ (in the prefent Case) $\frac{2ssydy}{lrr}$.

Again, dx:ds::DC:GF::DC:GE+EF; GE+GF:GF::AD(=AB):AG+AB; AG+AB:BF::AB! (=rr): $AF\times FB$ (=rs) Wherefore $ds=\frac{st\,dx}{rr}$

= $\frac{2 s t y dy}{l r r}$: And substituting these Values in the Equation instead of ds and dt, as also ss - rr instead of tt, there will come forth another Equation, which may be divided by st dy; so that the Symbols s, t, d, y, will be quite out, and only the Powers of the unknown y remain. The Equation then will be $y^6 - 3 r y^5 + 3 r r y^4 - r^3 y^3 + \frac{3}{4} r r l l y y - r^3 l l y + \frac{1}{4} r^4 l l = 0$; which may be still further divided by r - y, and so the Equation be reduced to this, $y^5 - 2 r y^4 + r r y^5 + \frac{1}{4} r r l l y - \frac{1}{4} r^3 l l = 0$: The Root of which will shew the Point of Contrary Flexure;

which in the Case of $l = \frac{rr}{c}$, is very nearly obtain'd by drawing the Ray AC, so that the Applicate CF be $\frac{1}{6}r$, or the Arch $BC = \frac{1}{26}c = 10$ Gr.

This Method for finding the Points of Contrary Flexure in Curves, seeming very tedious, and not so natural, in that it makes use of Symbols that are superfluous, and do afterwards vanish out of the Equation; gave us occasion to find a shorter and easier Way for doing the same, and that thus: I conceive the Point of Contrary Flexion as falling in that Point of the Curve, where two contiguous infinitely small Particles are imagin'd to lie in directum with one another: As, ex. gr. FG, FI, the



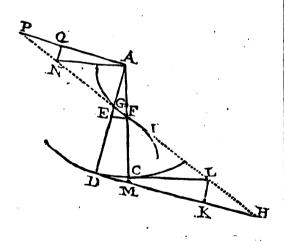
rest being bent upwards on one hand, and downwards on the other. It follows from bence.

1. That in Curves whose Axes are perpendicular, and whose Ordinates are parallel to one another, the Acute Angles EGF, MFI, or DGL, CFL, are equal, and either the greatest or the least of all those that the Ordinates make with the Curve on the one fide and the other, according as the Portion of the Curve (that is) at the Parts of these Angles, falls either with or with-

out them. From whence the Ratio $\frac{DG}{DL} (= \frac{y}{t})$ is either a Maximum or Mininum; and consequently (by what was shewn above) j: d = t dj. But since every where t dy = y dx (as is evident in all Curves) therefore shall dt = dx, viz. The Differential of the Part of the Axis between the Ordinate and the Tangent, equal to the Dif-ferential of the Abscissa: Which is also thus ma-nises: Because GF, FI, lie in directum, the Tangents GL, FL, shall cut the Axis in the same Point L; and, consequently, the Differential of the Abscissa DC, will also be the Difference of DL and CL.

The Celebrated Author of the Differ. Calculus, has given another Theorem for this (in the Acta,) Viz. Since the Triangles EGF, MFI, (becaule of the equal Angles EGF, MFI,) are fimilar; it follows. That if EF, MI, that is the dx, are equal, also EG, MF, or the dy, shall be equal too; and, consequently, ddy = 0.

2. In the Curves whose Applicates tend to some common Point or Centre A. The Angle EGF



=GAF+GFA=DAC+CFL: Whence, fince CL is the Tangent of the Angle CFL to the Radius CF, and DH the Tangent of the Angle gle DGH to the Radius DG, the Difference of the Right Lines, CL, DH, shall be equal to the Difference of the Tangents of the two Angles, that differ by the Angle DAC; one of which is to the Radius CF, and the other to the Radius DG. For tho' the Difference of the Radii EG vanishes in comparison of the whole Radius or Tangent; yet 'tis not to be neglected, if compared with their Differences.

Let AC = r; DC = dx; CF = r; CL = r;

 $=\frac{y\,dx}{2}$ an Arch, that is the Measure of the Angle DAC, with the Radius CF. This Arch (by Seft. 4.) Is to the Difference of the Tangents, in the Duplicate Ratio of the Radius to the Secant. Wherefore $FC^q (= yy): FL^q (= yy + zz)$:: The Arch found $\frac{y\,dx}{r}$: $\frac{yy\,dx + tt\,dx}{r}$ the Difference of two Tangents, each to the Radius C F. To which if we add $E F = \frac{rd x - y dx}{r}$ (which Is to EG, As DH To DG, or CL to C F, or Tangent to Radius) the Aggregate will be $\frac{ry dx + r r d^x}{ry}$, or $dx + \frac{r r dx}{ry}$, the Difference of two Tangents, the one of which agrees to the Radius DG, that is the Difference of the Right Lines CL, DH (= r;) and therefore $dt = dx + \frac{t \cdot t \, dx}{r \, y}.$

The same is more clearly shewn thus. On the Centre C, with the Radius CL, describe the Arch LK: For then the Angle ACL + LCK= AMH = ADM + DAC = ACL + DAC, and fo LCK = DAC. (Note, ThatCM is neglected here, and the Points C and M esteem'd as co incident; since CM is infinitely less than the Differentials DC, LK, EG, which are infinitely small themselves.) Whence, AC (=r) $: CD(=dx) :: CL(=t) : \frac{t dx}{r} = L K$ Again, GD(=r) : DH(=t) :: LK(=t) $\frac{t d x}{r} : \frac{t t d x}{r y} = K, H.$ Wherefore dt (= D H + C L = D H + C L = D C + K H =) $dx + \frac{t \cdot t \cdot dx}{r \cdot r}$

COROLLART.

If r be Infinite; that is, If C A, D A, be parallel, then $\frac{t \cdot t \cdot dx}{x}$ will vanish, and dt = dx, as above.

My Brother, instead of the Ratio $\frac{GD}{DH}$ or $\frac{GA}{AP}$, affumes $\frac{GE}{EF}$, putting AF = j, AP = i, EF $= d\chi$; and so finds $dt = \frac{d\chi c}{dy q}$. Which Theorems well deserve notice, upon the account of

their Universality. For a particular Application of this to the Parabolick Spiral: Because C L (= t, Fig. preced.) was

found before $=\frac{2rry-2y^2}{lr}$, then shall ds=

 $\frac{4ry\,dy-6y\,dy}{lr}; \text{ and fince } dx=\frac{2x\,dy}{l};$ substituting the Values of et, dt, e, dx, and

dividing by dy; and reducing the Equation, we shall find $y^2 - 2ry^4 + rry^3 + \frac{1}{4}rrlly - \frac{1}{4}rrlly$ $\frac{1}{4}r^2 // = 0$, as before.

and consequently, $FL = \sqrt{yy + t}$. Also, 5. The highest Point of the Curve above the Radi-Let it be AC (=r): DC (= dx): CF (=y): us BA, is found by making AO (sound before) In-

finite; viz. $\frac{2rrsy-4rsyy+2sys}{2rry-2ry-r/t} = In-$

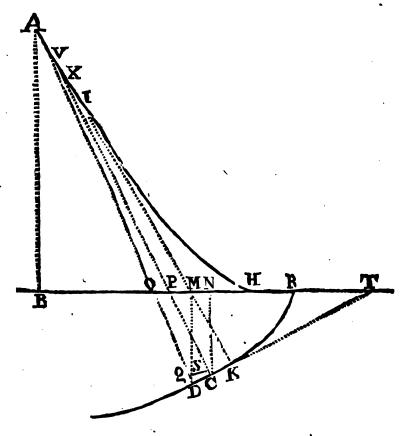
finite, or 2rry - 2ryy - r/t = 0; or inflead of y subflictuting $\sqrt{/x}$, we have $2r \sqrt{/x} - 2/x - lt = 0$: Or in the Case of l = 1

$$\frac{rr}{c}$$
, $2\sqrt{cx-2x} = i$. Which Equation

cannot be Geometrically resolv'd, upon the account of the inexplicable Ratio of the Arch to the Tangent. But the Point sought may be found Mechanically near the Truth, thus, by counting 70°.
12'. from B towards M. I Note here, by the By, That it may be demonstrated from hence, that an Indefinite Quadrature of the Circle, and in general the Redification of any Geometrical Recurrent Curve, is impossible: For if this were posfible, there wou'd be given the Relation between the Curve and the Ordinate or Abscissa: And fince the Relation of these to one another, as alleriphery of a Circle, then all the Normals, DA, so to the Tangent, is supposed to be given; also CA, KA, &c. will meet in one common Point

the Relation of the Curve to the Tangent would be given too. Wherefore, if the Equation that expresses this Relation, be duly compared with the other $2\sqrt{cx-2x}=t$, according to the Laws of Algebra, in order to fling out one of the Indeterminates, x or t: There wou'd then come forth another Equation of a certain and definite Degree; the Roots of which (which can never be more than the Equation has Dimensions) wou'd determine all the highest Points of our Curve. But this is impossible; for this Spiral, if it be continued, will wind about the Radius AB with an infinite Number of Gyres and Turnings, in each of which there is some one highest Point; and therefore the Number of those Points is Infinite.

6. Of the Evolution of Curves. If DC be the



A (the Centre) and will each of them be equal to a constant Right Line (the Radius.) But if DC be any other Curve, the said Perpendiculars will be indeterminate, and will interfect one another into many different Points, A, V, X, I; which all joyn'd make a new Curve; the Nature of which is now to be Investigated.

Let the Curve proposed be RCD, its Axis RB, Abscissa's RN, RM, Ordinates NC, MD, Tangent DCT. Let RN = m; CN = p; Ni = q. Whence, TN: NC:: NC: NP

$$q: p:: p: \frac{pp}{q} = MO;$$
Also, NC: NP (= MO):: \$D: \$2
$$p: \frac{pp}{q} :: dp: \frac{pdp}{q} : Far-$$

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Whence, $TN : NC :: NC : NP$
 $q : p :: p : \frac{pp}{q} = MO$;

Also, $NC : NP (= MO) :: SD : SD$
 $p : \frac{pp}{q} :: dp : \frac{pdp}{q}$; Far.

 $p : \frac{pp}{q} :: dp : \frac{pdp}{q}$; Far.

 $p : \frac{pp}{q} :: dp : \frac{pdp}{q}$; Far.

 $p : \frac{pp}{q} :: dp : \frac{pdp}{q}$; Far.

: C. A.
:
$$pdq + qdm \times \sqrt{pp + qq}$$
.
 $pdq - pdp$

7. Application to the Parabola. If RCD be a Parabola, whose Parameter = l, so that lm =p p, then l dm = 2 p dp, and $dm = \frac{2 p dp}{l}$, and q=2m. Substituting these in the Value of CA, we shall find $CA = \frac{11+4pp\sqrt{11+4pp}}{2}$; that is, fince $PN = \frac{1}{2}l$, and $PC = \sqrt{\frac{1}{4}ll + pp}$, $C \land will = \frac{P C_3}{P N^2}$, that is a Fourth Proportional to PN and PC.

8. To find the Nature of the Curve AVX (form'd by the Interfections of the Perpendiculars DA, CA,) with respect to the Axis RB. Cut off $RH = \frac{\pi}{4}I$ = PN, and put HB = y, and BA = z, and then AB + NC : AC ::

$$\chi + p: \frac{ll + 4pp \sqrt{ll + 4pp}}{2ll} ::$$

$$NC: CP;$$

$$p: \sqrt{\frac{1}{4}ll + pp}; \text{ and } \frac{VZ}{4} \text{ will } = 2p^{3}.$$

$$Again, NC: AB :: PN: PB;$$

$$p: \chi :: \frac{1}{2}l: \frac{l\chi}{2p}; \text{ but } y = 1$$

$$HB = PB + PH = PB + NR = \frac{l\chi}{2p} + \frac{pp}{l}, \text{ or } 2p^{3} (= \frac{ll\chi}{2}) = 2ply - ll\chi; \text{ that is,}$$

$$\frac{3l\chi}{4y} = p, \text{ and } 4p^{3} (= ll\chi) \frac{27l^{3}\chi^{3}}{16y^{3}}; \text{ that is,}$$

$$\frac{3l\chi}{4y} = 27l\chi\chi.$$

Farther, because A D, A C, are perpendicular to the Curve DC, and the Particle DC is infinitely small; therefore shall AD = AC = AV+ VC; but (because of the same Reason) VC= VX+XK, and XK=XI+, &c. And therefore AD=AV+VX+XI, &c. = Curve AIH+HR. And fince the Curve AIH arises from the Intersections of the Indistant Perpendiculars D A, C V, K X, it follows, that they are Tangents to it in the same Points, and, consequently, that the Curve RKD is that Curve which is described by the Evolution of the Curve HIA. From whence are manifest, at first view, all that Hugenius and others have publish'd about Booluta's, as also the excellent Discoveries of Tschirnhausius and Leibnitz, about the Curves formed by the Reflex'd Rays.

HELISPHERICAL Line, is the Rhumb Line in Navigation; and is so call'd because on the Globe it winds round the Pole spirally, and still comes nearer and nearer to it, but can't terminate

. HEM. The Ovens wherein the Lapis Cala. minaris, or Calamine, is baked, have a Hearth made on one side of the Oven, divided from the Oven it self by a Partition open at the Top, by which the Flame passes over, and so heats and

bakes the Calamine. This Partition is called the

HEMITONE, in Musick, was what we now call an Half Note.

HERALD, with us fignifies an Officer at Arms, whose Business it is to denounce War, to Proclaim Peace, or otherwise to be employ'd by the Sovereign in Martial Messages and other Businesses. The French call him Herault; quasi Herus aleus. But Verstegan will derive the Word from two Dutch words, viz. Here, exercitus, and Healt, Pugil magnanimus; as if he should be so called, as being Champion of the Army. The Romans called Men of this Office in the Plural Feciales. With us they are the Judges and Examiners of Gentlemen's Arms: They Marshal all the Solemnities at the Coronation of Princes; formerly manag'd Combats, &c.

The Three Chief Heralds with Us are called Kings at Arms: The Principal of which is Garter, created by Henry V. His Office is to attend Knights of the Garter at their Instalments, or other Solemnities; To Marshal the Funerals of all the greater Nobility, as Princes, Dukes, Marsmisse Facility Viscourses and Record

quisses, Earls, Viscounts, and Barons.

The next Herald is Clarencieux, Ordain'd by Edw. IV. for his gaining the Dukedom of Clarence: His Office is to Marshal and Dispose the Funerals of all the leffer Nobility; as of all Knights and Esquires on this Side Trent.

The Third is called Norroy, or North Roy; whose Office is the same on the North Side of Trent as that of Clarencieux is on the South

Side.

Besides these there are Six others, which are properly called Heralds, according to their Originals, as they were Created to attend Dukes, &c. in their Martial Expeditions; as York, Lan-caster, Somerset, Richmond, Chester and Windsor.

There also are four others call'd Marshals, or Pursuivants at Arms, reckon'd after a manner in the Number of Heralds, and do commonly fucceed in the Place of Herald when they die, &c. and these are call'd Blue-Mantle, Rouge Cross, Rouge Dragon, and Port-Cullis.

HERBENGER, or Harbinger, is an Officer in the King or Queen's House, who allotteth the Noblemen and those of the Houshold their

Lodgings.

HERETICO Comburendo : See Haretico, &c. HERIOT, was originally a Proportion of Horse and Armour according to the Quality of the Deceas'd: This was settled by the Laws of K. Canutus, cap. 69. and is still (usually) the best Riding Horse of which a Tenant dies posses'd. HERIOT Custom, was when a Tenant for

Life was by Custom oblig'd to such a Payment at his Death; which Payment to be made not only by the next Heir in Blood, but by any the next Successor. In Abbeys of Royal Patronage, at the Death or Cession of the Abbot, his Cup and Horse were paid as an Heriot to the King. Those also who held in Bondage and Villenage paid Heriots. The Religious Appropriators referv'd the Live Heriots (i. e. such as were paid in Cattle) to themselves, and allow'd the inanimate ones of small value to the Vicar: And some Appropriators had a Heriot from the Vicar when he died. Kennet's Gloffary.

HERIOT

HERIOT Service, was a Reserve by Charter or other Conveyance, and made one Condition of the Tenure of Estates in Fee Simple; which

is now for the most part extinguish'd.

HERMITAGE, strictly signified a Convent of Hermits or Friars Minors, who, under the Institution and Discipline of Sr. Paul, inhabited Deferts and solitary Places. But this name at last came to be attributed to any one Religious Cell, built and endow'd in some private and recluse Place, and then annex'd to some larger Abbey,

of which the Prelate or Governour was called Hermita. Dr. Kennet's Glossary.

HERMITAN, is the Name of a dry North and North-Easterly Wind, usually, which blows on the Coast of Guinea in Africk; but sometimes is blows also from other Doines.

it blows also from other Points.

HERMITORIUN, is the Oratory or Chappel

belonging to an Hermitage.

HETERODROMUS, in Staticks, is the Term for the common Vellis or Leaver, which hath the Hypomochlion placed below the Power and the Weight: And where the Weight is elevated by the descent of the Power, & vise versa. (Sce the Fig. in Homodromus.)

The Dung fork and Prong are Leavers of this kind, whole Hypomochlion is usually the Knee of the Workman: And all Pincers, Sheers, Sciffars, Cutting-Knives fasten'd to Blocks are double.

HETERODROMOUS Leavers. The Wheel, Windlass, Capstand, Crane, &c. are perpetual Heserodromous Leavers: As are also the outermost Wheels of all Wind and Water-Mills, and all Cog-Wheels, &c.

HETERODROMUS Vellis, in Mechanicks, when the Weight to be rais'd by a Leaver is placed beyond the Hypomochlion or Fulcrum, and so moves a contrary way to the Power, viz. is rais'd when that descends, and descends when that rifes.

HEYBOTE, or Haybote, was antiently the Saxon Term for the Liberty granted to a Tenant for cutting so much Under-wood, Bushes, &c. as was necessary for Mending and Maintaining the Hedges or Fences belonging to his Land.

HIDAGE, was a Royal Aid or Tribute rais'd in such a Proportion on every Hide of Land: William the Conqueror imposed Six Shillings on every Hide; and William Rufus Four Shillings; and K. Henry I. Three Shillings. When the Lord paid Hidage to the King, the Tenants paid a Proportion to the Lord of the Mannor.

King Ethelred, when the Danes landed at Sandwich, rais'd this Hidage so, that every 310 Hides of Land found an arm'd Ship; and every 8

Hides found a Jack and a Saddle.

HIDE of Land, or Plough-Land, was as much as one Plow could Cultivate in a Year; for the Quantity was never expressly determin'd: Some call it 60, some 80, and some 100 Acres. One Hide of Land at Chesterton in the 15th of Hen. II. contain'd 64 Acres: And in the 35th of Hen. III. the yearly Value of a Hide of Land at Blechefdon in Oxfordshire was Forty Shillings. Kennet's Paroch. Antiq.

Bede calls it Familiam, implying by it, that it, was as much as wou'd maintain a Family.

The Distribution of England by Hides of Land is very antient: Mention being made of it in the Laws of King Ina, eap. 14. And Henry I. to which there was a fet Form Marry his Daughter, had Three Shillings from icrib'd by the Feudatory Laws.

This Tax was call'd His every Hide of Land.

dage: See Hidage.
HIP-Roof, in Architecture, is such a Roof as hath neither Gable-Heads, Shread-Heads, nor Ferkin-Heads: (By which is meant such Heads as are both Gable and Hip at the same End; that is, Gable as far as the Cott or Beam, and then their over short Hips, which shut up with their Tops to the Tops of a pair of Rasters, call'd Singlers by the Country Workmen.) For a Hip-Roof hath Rafters as long, and with the Angles at the Foot, Sc. at the Ends of Buildings, as it hath on the Sides: And the Feet of the Rafters on the Ends of such Buildings as have Hip-Roofs, stand on the same Plane, viz. parallel to the Horizon, and at the same Height from the Foundation with the Rafters at the Sides of the Roofs. These Hip-Roofs some call Italian Roofs.

HIPS, in Architecture, are those Pieces of Timber which are at the Corners of a Roof: They are a good deal longer than the Rafters, because of their oblique Position; for they are The Country Workmen level at every Angle. call them Corners; and by some they are call'd Principal Rassers, by others Sleepers. As Rasters have four plain Sides, these have usually five.

HOBELERS, were formerly a fort of Light-Horse-Men, which rode on small nimble Horses, and with only light Armour on; so that they were fit, (like our Dragoons) for any expeditious Service: At length they became ty'd by their Tenure, to maintain a little light Nag, for giving expeditious Notice of any Invafion or Danger: See 18 Edw. III. c. 7. 25 Edw. III. c. 5, 8. and Cambd. Britan.

HOBITS, are a fort of small Mortars from 6 to 8 Inches Diameter: Their Carriages are like those of Guns, only much shorter. They are very good for Annoying the Enemy at a distance with small Bombs, which they will throw two or three Miles: Or in keeping of a Pass, being

loaded with Cartouches.

HODOMETRICAL Method of finding the Longitude at Sea, is that of the Computation of the Measure of the Way of a Ship between place and place; i. e. of observing the several Rhumbs or Lines in which the Ship saileth; and what Way the hath made, or how many Leagues and parts

of a League she hath run.
HOGENHINE, was formerly the Term for one that coming Guest-wife to an Inn or House, lay there the third Night: After which he was accounted one of the Family; and the Hoft was answerable for his Breach of the King's Peace. In the Laws of K Edward, set forth by Lambert, he is call'd Agenbine; and often in other places

Third-Night Awnchine.

HOKE-Day, was the Tuesday Fortnight after Easter-Day; and was antiently celebrated with Sports and Rejoycings, in Memory of many of the Danes being kill'd on that Day, and the rest expell'd the Kingdom. This was done A. D. 1002. in the Reign of K. Ethelred.

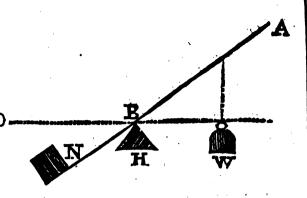
HOKE-Tuesday-Money, was a Duty paid by the Tenants to their Landlord, to have leave to

celebrate the Hoke-Day.

HOMAGIUM Reddere, was renouncing Homage, when a Vassal made a solemn Declaration of disowning and desying his Lord; for which there was a fet Form and Method pre-

HOMO-

HOMODROMUS, is a Term in Staticks for a Leaver, as AB; one of whose Ends, B



is fixed on the Obex or Hypomoclion H: And the other End A, is applied to the Moving of the Weight W, which hangs or lies somewhere in the middle, between the Hypomoclion H, and the Power in A. Here the Weight moves the same way with the Power: Whence this kind of Vettis takes its Name of Homodromus. Whereas, in the other Leaver, the Weight N is raised up by means of the Obex or Hypomoclion H; while the Power at A, the other End of the Leaver, descends; and therefore this is called Hererodromus. Of this Homodromus kind of Leavers, are the Rudders and Oars of Ships and Boats; as also their Masts.

HONOR, is used for the nobler fort of Seigniories, whereon other Inferior Lordships and Mannors do depend, by performance of Customs and Services to those that are Lords over them: And it seems as if none were Honors originally, but such as belong'd to the King, tho' given af-serwards in Fee to Noblemen. The Manner of Creating these Honors may in part be collected from the Statutes 34 H. VIII. o. 5. where Hampton-Court is made an Honor: And 33 H VIII. e. 37, 38. where Grafton and Ampthill are made Honors. There are many other Honors in England; see 37 H. VIII. e. 18, &c.!

HONOR-Courts, as are held

within the abovemention'd Honors.

HONORARY Services, are such as are incident to Grand Sergeantry, and annexed usually to Some Honor

HOOK-Pins, are taper Iron Pins, with an hook Head; and are used to pin the Frame of a Floor or Roof together, by being put in through the Pin-holes in the Mortesses and Tennons, whilst it is framing or fitting into its due Position: As foon as which is done, these Hook-Pins are ftruck out, and 'tis pinn'd up fast with Wooden

HORIZONTAL-Line in Dialling, is a Line drawn on any Plane parallel to the Horizon. It is drawn on an Eject or Reclining Plane by a

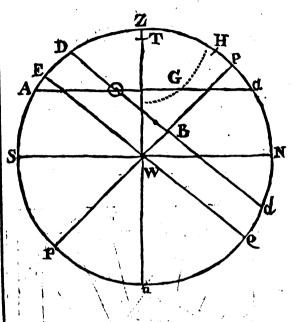
Level; or by applying a Quadrant to the Edge of a Ruler 10, as that the String and Phunmet shall cut oo. or 90 Degrees in the Limb.

HOSPITALLERS, were the Krights of a Religious Order; so call'd, because they builded an Hospital at Jerufalem, wherein Pilgrims were received. To these, when the Templers were suppress'd by the Council of Vienne in France, P. Clement transferr'd that Order. Their chief P. Clement transferr'd that Order. Their chief Abode is now at Make, and they are call'd Knights Vol. II.

of Malta. All the Lands and Goods of such as were here in England were given to the Crown:

See 32 H. VIII. c. 34.

HOUR of the Day: To find this readily by Projection of part of the Analemma, proceed thus: With 60 of the Chords draw the Circle Z S n N for the Meridian of your Place: Then



having given you, as you must have, the Latitude of your Place, and the Sun's Declination and Altitude, set the first of these three from N to P; so is P, the Pole of the World, draw P W; for the Axis. Set next the Latit. also from Z to E, and draw E W Z for the Equinoctial. Then fet the Sun's Declination from E to B, and from 2 to d, when is North, as here; but on the lower Side of BZ when its South; and draw the Parallel of Declination Dd: Then fet the Sun's Altitude from S to A, and from N to a, draw Aa for the Almacanter or Parallel of the Sun's Altitude at the Time. The common Intersection of these two Parallels in O, will give you the Sun's Place in the Heavens at that Time. And, consequently, setting the Sector to the Radius D B, B will be the Sine of the Hour from 6, either in the Morning or Afternoon. If a Sector be not at Hand, you may find the Hour by your Chords, thus; Set the Extent B D from W to T; on which Point T, as a Centre, with the Extent B . (the parallel Sine of the Hour from 6) Arike the Arch G; for then a Ruler laid from W just to touch the Convexity of the Arch G, will cut the Limb in H. Then HN measured on the Chords, will give the Degrees of the Hour from 6, which must be turned into Time.

HOUR-Scale: On one of the Edges of Colin a Quadrant there is usually an Hour-Scale (as on the other Edge is a Line of Latitudes) which is no other than a Double Tangent, or two Lines of Tangents, each of 45 Degrees, fet together in the middle; and so might, if there were need, be continued in Infinitum.

"And on the other Face of this Quadrant there is allo an Hour-Scale of another kind; being 62 Degrees of a Line of Sines, whose Radius is made equal to half the Secant of the Latitude (being fitted for London) to the Common Radius L 1 of

of the Sines. Against it, and running by it, is a prick'd Line of Declinations: To the Sun's greateft Declination is also a Portion of the Line of Sines, whose Radius is equal to the Sine of the Latitude of London, taken out of the other part of the Scale.

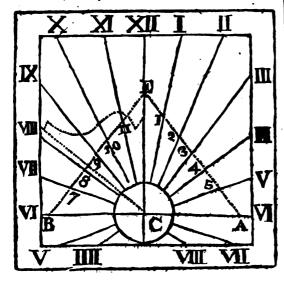
These Hour-Scales (especially the former) may be put on any Ruler, Sector, &c. and will serve

for these Ules.

The first Hour Scale, or Double Tangent, is a Scale of Six Hours; and by help of the Line of Laritudes (which should always be placed by it) will serve very readily and universally to prick down all Dyals that have Centres; after this manner.

I. To draw on Horizoneal, or a Direct Erect South Dyal.

Draw first the Right-Line CE for the Hour-Line of 12, and cross it in C (which will be the Cen-



tre of the Dyal) with the Perpendicular B A: Then from the Scale of Latitudes take off the Latitude of the Place for an Horizontal (or the conce will be co-Latitude, for a Direct South and Vertical) nearly 3 M Dyal, and fet it with your Compasses each way from C to A and B: Then take with your faid Scale

Competer the whole Hour-Scale, and festing the End of it at A and B, and its Beginning at E, transfer it, and all its Divitions (or such as you shall have occasion for at least) on each Side from A to E, and from B to E, making the Isosceles Triangle BEA: Then Numbring the Divisions with the proper Hours, as you see in the Figure, Right Lines drawn from C, through those Hours, Halves, or Quarters in the prick'd Lines AE and BE, shall be the true Hour-Lines of the Dyal: And to the Dyal you may give what Form or Figure you please.

II. To draw an upright Declining Dyal.

Suppose for the Latitude of London 51°. 30°. and declining Eastwards 25°. You must first, either by Calculation, or by Collin's Dialling-Scales, &c. find the Requisites of your Decli-

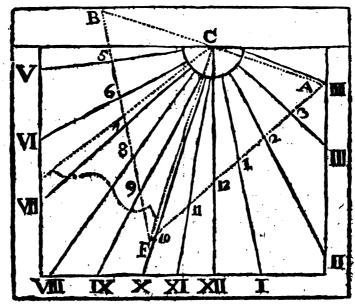
ning Dyal; which will be thefe:
The Substiles Distance from the 2 18. 34. Meridian will be

The Angle of the Hour-Lines of 12 and 6 will be
The Angle of the Inclination of

Meridians will be

And the Styles Height will be an

Angle of
Being thus prepared, you may then draw the
Line VIII, II, as the true Horizontal Line of gles, the Line XII C for the Meridian. Next make the Angle FC XII equal to 18°. 34'. the Substile's Distance from the Meridian; and by the Chords prick off FC for the Substile. To which in C, the Centre of the Dyal, draw the Perpendiquiar BA: Then make CA and CB equal to the Style's Height 34°. 19'. (taking it in your Compasses from the Line of Latitudes;) And then apply the whole Scale of Hours (as before in the Horizontal Dyal) on each fide C F, from A to F, and from B to F. Next get the Difference between 30°. 47'. the proper Inclination of Meridians, and the next Hours Distance from the Meridian that is less than that Angle; which in this Case is 10, or 30° from 12. This Differonce will be found here to be 47'. or, in Time, nearly 3 Minutes. The fitting the Scale of Hours, was before taught from A to B; count upon the



Heir

Hour.	Min.	_		
0	3	> From F to <	10	7
1	3		11	-1
2	3		12	ļ
3	3		I	
4	3		2	1
5	3.		3	3

And make Points at the Terminations with a Pin or Pen: And draw Lines from those Points to the Centre C; they shall be the true Hour-Lines on this Side the Substile.

Again, Fitting in the Scale of Hours from B to F, count from the End at B, the former Arks of Time.

Hour. Min. 3

And make Points at the Terminations, as before; through which draw Lines to the Centre, and they shall be the Hour-Lines on the other Side the Substile.

The like must be done for the Halves, Quarters, &c. getting the Difference between the Half-hour next less (in this Example 22° 30'.) under the Ark called the Inclination of Meridians, the Difference is 1°. 17'. (in Time nearly 33'.) to be continually augmented an Hour at a time, and so prick'd off as before was done for the Whole Hours.

If the Scale of Hours reach above the Plane, as in this Case at B; so that BC cannot be prick'd down: Then may an Angle be laid down on the upper Side of the Substile, equal to FC A on the under Side, and thereby the Scale of Hours laid in its true Situation, baving first found the Point F on the under Side.

The Stile may be easily laid down by the Chords, or a Protractor. And if your Scales are large and carefully made, as this is one of the easiest, so 'tis as exact a Way of Drawing Dials as any whatfoever.

HOUSEBOTE, the same with Estovers, or an Allowance of necessary Timber out of the Lord's Wood, for the Repair and Support of a

House or Tenement.

HOWKER, or Houce, is a Vessel much used by the Dutch; built something like a Pink,

They carry from 50 to 200 Tun: And with a small number of Hands will go to the East-Indies. They Tack foon and short; will Sail well, and lie near the Wind; and will live almost in any Sea.

HULKS, are large Vessels, having their Gun-Decks from 113 to 150 Foot long, and from 31 to 40 Foot broad. They will carry from 400 to 1001 Tons. But their chiefest Use is for set-tine in Mass into Ships, and the like. Though ting in Masts into Ships, and the like. antiently the Word Hulka seems to signific a small

HUNDRED, is a Part of a Shire or County, properly so called, because it contained Ten Decenna or Tythings: And either because at first there were an Hundred Families in each Hundred; or else that the Hundred found a hundred Men for the King's Wars. These Hundreds were first Ordain'd by King Alfred, the 29th King of the West Saxons; and he took the way of doing it from Germany; where Centa, or Centeua, is a Jurisdiction over an hundred Towns. Hence you see the Original of Hundreds,

which still keep the name, and remain, in some fort, the same, as to their Service in several respects: But their Jurisdiction is transferr'd to the County Court; some sew excepted, which have been by Privilege annex'd to the Crown, or granted to some Great Subject, and so remain still in the nature of a Franchise: And this hath been ever fince the Statute of 14 Edw. III. 1. c. 9. whereby these Hundred-Courts, formerly Farm'd out by the Sheriffs to other Men, were reduc'd all, or most of them, to the County-Court; and so remain at present. Where-ever therefore we meet with the Word Hundred-Court now, it fignifies some Franchise, where the Sheriff does not intermeddle by his ordinary Authority, unless when they of the Hundred refuse to do their

HUNDRED-Courts, were held antiently by the Hundredarius, or Chief Constable, of every Hundred, for better support of his Office. These, Courts were held in some Places once in three Weeks, and in others once a Month. And by Stat. 14 Ed. III. these Hundred-Courss were reduc'd to the County-Courts; tho' in some sew Hun-

dreds the Old Franchises are still remaining, HUNDREDERS, are Men Empanelled, or fit to be Empanelled, on a Jury, upon a Contro-versie; and who dwell in the Hundred where the Land in question lies. Bur

HUNDREDARIUS, the Hundreder, is he that hath the Jurisdiction of a Hundred, and who holdeth the Hundred-Court. And sometimes tis used for the Baily of the Hundred.

HUNDREDI Seda, was the Payment of personal Attendance, ordering Suit and Service at the Hundred-Court

HUNDREDUS Affirmatus, was the Profits of an Hundred-Court, Firmed or Farmed out for a

flanding Rent.

HURRICAN, is a most surious and dreadful

which the Caribbe-Islands and Storm of Wind, which the Caribbe-Islands and some other Parts of the Indies are subject to: Its Extent and Continuance is but small, but its Violence prodigious.

HUSE-BOTE, was formerly the Liberty a Tenant had to cut as much Wood on the Premisses as was necessary for the Support and Repair of the Farm-House and adjoyning Buildings. This is now call'd Estovers, Estoverium. HYDE-LAND: See Hide-Land.

HYDRO. LI2

HYDROSTATICKS. Weights which force out of the same Tube equal Quantities of the same Fluid, are to one another as the Squares of the Times in which the Fluid is forc'd out: But if the Times are equal in which the same Quantity of the Fluid is forc'd out thro' unequal Tubes; then the Powers are reciprocally as the Orifices of the Tubes: And therefore Powers which thrust out the same Quantity of a Fluid through unequal Tubes, are to one another in a reciprocal Proportion, compounded of the Squares of the Times, and of the Orifices of the Tubes.

HYDROSTATICAL-BALLANCE. A Description of an Hydrostatical-Ballance, for finding the Specifick Gravities of Liquids and Solids with ease and accuracy. By F. Hawks-bee, in Vine-Office-Court in Fleet-Street.

For LIQUIDS.

a a, a a, is the Foot to which the upright Piece or prop'd bb, bb is to be (crew'd: (See Fig. 1.) To the upper End of this upright Piece is fastned a double Cheek of Steel, c c, c c, on which the Beam d d, d d is suspended. To one End of this Beam put on the General Scale, express d by ee, ee, ee. At the other End of it, hang on the other Scale, which is a very thin and light one, and is only express'd on the Ballance by the Characters of ff.
To the Loop at Bottom of it, is to be suspended by its Hair, and the Bottle gg, gg. Thus pre-pared, the Bottle being plung'd into the Glass of Water, bb, bh, the Beam will form an Horizon. tal Polition: But if it happen something too light, or too ponderous (for all Waters have not the same Specifick Gravity, nor at all times) it must be adjusted by putting Weights on the lightest End, till brought to an Equilibrium. These Weights, in the Experiment, are to be taken no notice at all of. And by an Experiment, by and by to be mention'd, I found two Grains to be the greatest Variation, between the Weight of a Bulk of Water, equal to 574 Grains, at the greatest Degree of Heat in this Climate to the Freezing Point. And thus you may find the Specifick Gravities of all manner of Liquids, in comparison to their like Bulk of Common Water: For the Bottle will fink down in lighter, and be buoy'd up in beavier Fluids; and the Grains or Part of Grains, which must be put into one of the Scales, to reduce the Beam to an Horizontal Position, will shew the Difference of the Specifick Gravity.

For SOLIDS.

The General Scale e e remains in its Place: But instead of the Scale ff must be suspended the Brais Piece, represented by the Figure ii, ii. (See Fig. 2.) To the Loop, at the Bottom of which, must the Glass Bucket kk, kk be suspended by its Hair, which then becomes a Ballance to the other End. Into this Bucket must be put the Solid (what ever it be) whose Specifick Gravity you would find, or whose Weight you have a mind to compare with that of the like Bulk of Water: And having ballanc'd it by Weights at the other End, take it out of the Bucket, and plunge the Bucket empty into the

Slit on the Brass piece ii, a Notch being cut in't to receive it; the Bucket then in the Water will be in aquilibrio with the General Scale ee; the Dish 11 being the Weight of a Bulk of Water equal to the Solidity of the Bucket: But if it chances to vary a little, you must reduce it as before. Then putting the Solid Body into the Bucket (having first well wetted it all over in Water; and it be irregular, take care that no Air lodges in any part of it) then you will foon find what it has loft of its Weight, in comparison to what it weigh'd in the Air: And by the Difference of which Weights, divide the Weight first found, which exactly gives you its Proportion to the like Bulk of Water: See Specifick Gravity in Vol. I. Where the Reason of this Practice is shewn: What is here design'd being only the Use of a commodious Ballance for such kind of Hydrostatical Experiments.

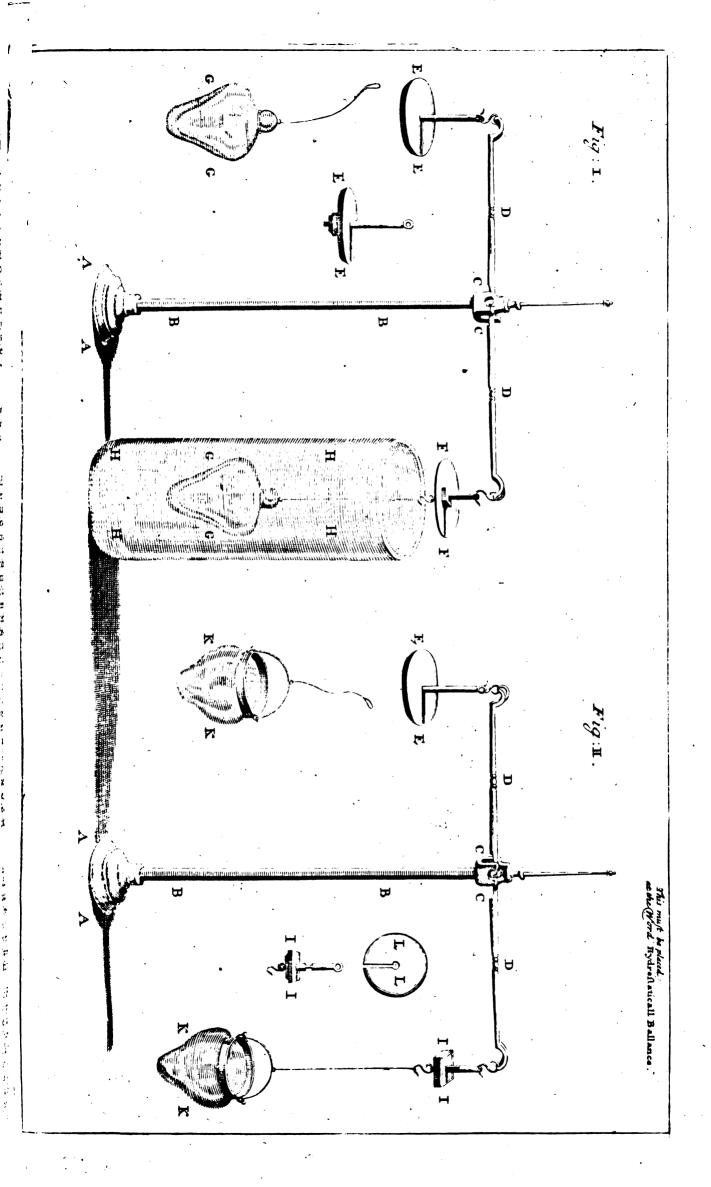
An Experiment, touching the different Densities of common Water, from the greatest Degree of Heat in this Climate to the Freezing Point; observed by a Thermometer. By Mr. Hawksbee.

I took about a Quart of Common Water, and gave it a pretty considerable degree of Heat over the Fire: Then putting it into a convenient Glass together with my Thermometer, where the Spirit foon arose into the small Ball a-top, and continued to remain there till the Water began to a. bate of its Heat; by which Time the Spirit in the Thermometer became of an equal degree of Temerature with the Water in which it was plac'd. When the Spirit has descended to 130 Degrees above the Freezing Point, (which is the greatest Height it has been observed in this Climate) I began my Observations, and found that the Bulk of Water, equal to that of the Bottle I weigh'd in't, in that State, was equal to 574 Grains, at 80 Degrees above the Freezing Point, the Bulk of Water, equal to the Bottle, then weigh'd & of a Grain more than before: At 32 Degrees above the pre-mention'd Point, the like Bulk of Water equal to the Bottel, was again increased 4 of a Grain; at the Freezing Point it weigh'd about 5 of a Grain more: in all about 2 Grains, from 130 Degrees above the Freezing Point, to the same Point: Which to me seems very considerable, and ought to be observed by those, who at different Seasons, have occasion to find the Specifick Gravities of Liquids and Solids.

HYPERBOLA. In Philof. Transact. N. 34. you have a Quadrature of the Hyperbola by the Ld. Viscount Brouncker, by a Series founded on what Dr. Wallis hath demonstrated in his Arith. of Infinites, Prop. 87, 88, 89, &c. And in Philos. Transact. N. 306. by a New Quadratrix, invented by the Ingenious Mr. J. Perks, of Great Swinford in Worcestershire; together with the Constru-

HYPERBOLICAL Cylindroid, is a Solid Figure, whole Generation is given by Sir Christoph. Wren, in Philosoph. Transact. N. 48. There are two opposite Hyperbola, join'd by the Axis Trans-versus; and thro' the Center there is a Right Line drawn at Right-Angles to that Axis Transversus; and about that, as an Axis, the Hyperbolæ are supposed to revolve: By which Revolution a Bo-Water. Then putting the Brass Dish 11, by its dy will be generated, which he calls an Hyperbo-

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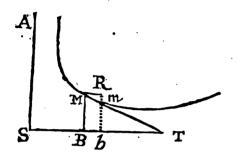


lick Cylindroid; and whole Bales, and all Sections parallel to them will be Circles. And in N. 53. of the Transactions, he applies it to the Grinding of Hyperbolical Glasses, and saith, they must be either form'd this way, or not at all.

HYPERBOLI-FORM Figures, are such Curves as approach in their Properties to the Nature of the Hyperbola; and are call'd also Hyperboloids.

The Method of drawing Tangents to Hyperboliform Figures.

Let AS, ST, represent the Assymptotes of the Equilateral Hyperbola Mm; then will S be the Centre of the opposite Sections. Draw the Or-



dinate MB, and another infinitely near, as mb. Let p be the Parameter of the Figure, let SB=x, and MB = y : Rm = y, and Bb = x. And let it be required to draw MT, a true Tangent to the Curve in the Point M, suppose all done, as in the Figure: Then will the Triangles MBT, and MRm be fimilar; and therefore $\hat{j}: x:: y: \frac{xy}{x} (= BT.)$ Now the proper Equation for the Curve is |pp=xy|; wherefore their Fluxions will be

And dividing by x, it will be $\frac{xy}{x} = \frac{y}{x}$. But from the Ordinate's continual decrease as the Ab-

scissa increases, the (=BT,) must be , you have B T =

CAROL. I.

When the Value of the Sub-tangent BT comes out negative; then the Point T will fall, as here, on the contrary Side of the Ordinate, with regard to S, the beginning of x. But when it comes out positive, the Point T will be on the contrary Side; as in the Parabola.

COROL. II.

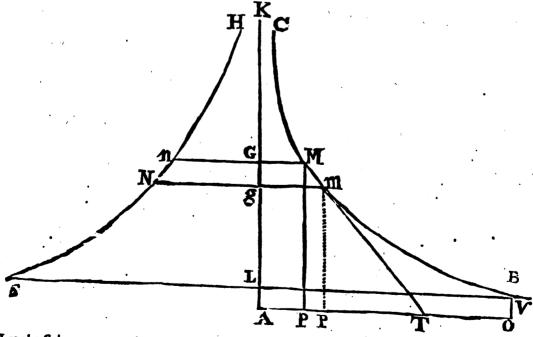
If you suppose the Parameter $= r_i$ and m to be a Negative Number; then $j^m = x$ is an Expression for all Hyperboli-form Figures; and universally the Length of the Sub-tangent BT.

$$\left(=\frac{xy}{y}\right) = \text{(because } y = x \text{ and consequent-}$$

$$\text{ly } m \ y^{m-1} \ y = x \text{) I say,} = \text{to } m \ y^m = \text{(bec. } y^m = x \text{) to } m \ x; \text{ that is, } To \text{ the Exponent of the Power of the Ordinate multiplied into the Abscissa.}$$

To Investigate the Area's of all forts of Hyperboli-form Figures.

In the following Figure, let the Curve CM m B equal, viz, o = xy + yx; or xy = -yx; be an Hyperboloid; AK and AO the Asymptotes:



Let the Sub-tangent P T be called t, and the Ordinate P M = y. The General Equation for such Curves being $r^m = x$; and the Expression for the Sub-tangent P T being m x, as above. Let G n,

Then will t j = y x. And the Rectangles NIGn=17, will always be equal to the Re-Sub-tangent P T being m x, as above. Let G n, changle P R m p = y x: And if this be always in the Figure, be always taken equal to P T: done, the Figure $K \land O B C$ infinite towards K C. ty = (because t = mx) all the mxy. But supposing the Figure KAOBC - b; and the inscribed Rectangle LBOA = d) then will the Figure K LBC = b - d =all the x y (because IR = x, and RM = y.) Whence all the Re-Changles mxy =all the yx = b, are to all the x = b - d, as m is to 1. And by Division m: m-1::b:n; That is, the Figure KAOBC: Is to the inscribed Rectangle: As the Exponent of the Power of the Ordinate m: Is to the same Exponent less 1.

COROLLART.

terminate towards K, may be measured: But within of 6 Columns.

will be equal to Figure K L S H, equal to all the if m = 1, then the second Term in the Analogy ij = (because t = mx) all the mxj. But supposing the Figure K AOBC - b; and the inscribed Rectangle LBOA = d) then will the Figure K AOBC is infinite towards K; and infinitely great in respect of the Rectangle LO. But if be less than I, that Space KAOBC will be more than infinite.

Thus in the common Apollonian Hyperbola,

whose Equation is y = x; or (supposing a the Parameter = 1) aa = xy; it appears that m-1 = 0; and consequently, it appears that the Proportion between the Rectangle L O, and the said infinite Space is infinitely great: See more of this in Hayes's Fluxions, p. 61, Sc.

HYPETHRE, in the Antient Architecture, was two Ranks of Pillars all about, and ten at If m be greater than 1; then the Space, inde- each Face, of any Temple, &c. with a Peristile

TACK

ACK, in a Ship, is that Plag which is hoisted up at the Sprit-Sail-Top-Mast-Head.

J JACTIVUS, Jatious, a Latin Word, fignifying in the Law, him that lofeth by Default: Placitum Juam neglexerit, & Jactivus exinde remansit. Formul. Solenn.

JAM, or Jamb, is in the Language of our Lead Miners in Mendip, a thick Bed of Stone, which hinders their Work when they are pursuing the

Veins of Oar.

ICH DIEN, the Motto under the Arms of the Prince of Wales; which Sir H. Spelman judges to be in Saxon Ic Thien; the Saxon D with a traverse Stroke being the same with Tb; and fignified I Serve, or am a Servant. As the Saxon King's Ministerial Lords were called Thiens.

IDEA'S. Our Observation employ'd, either about External Objects, or about the Internal Operation of our Minds, perceived and reflected only by our selves; is that which supplies our Understanding (saith Mr. Locks) with all the Materials of Thinking. These Two are the Great Fountains of Knowledge from whence all the Idea's, Notions, Phantasms, Species, &c. which we have,

or can naturally have, do spring and arise.

1. Our Senses, being conversant about particular Sensible Objects, do convey into the Mind several distinct Perceptions of things: And this way we gain the Idea's of Tallow, White, Heat, Cold, Soft, Hard, Bister, Sweet, and all those which we properly call Sensible Qualities; and this Great Source of most of the Idea's we have, depending wholly on our Senses, and derived by them to the Understanding, is called Sensation.

The other Fountain from which Experience furnishes the Understanding with Idea's, is the Perception of the Operation of our own Minds within us, as it is employed about the Idea's it hath before gotten by Sensation: Which Operations, when we come to Reflect and Confider on, our Understanding thereby becomes furnish'd with another Set of Idea's, which could not be had from things without; and such is Percopsion, Thinking Doubeing, Believing, Reasoning, Knowing, Willing, So. and all the different Actions of our Minds; Which we being conscious of, and obferving in our selves, do from these receive into our Understandings, as distinct Idea's, as we do from Bodies affecting our Senses. This is a kind of Insernal Senfation; is called very properly, by Mr. Lock Reflection: And thefe two, Senfation and Reflection, he takes to be the only Originals from whence all out Idea's take their Beginnings.

And so far the Mind or Understanding is meetly passive; and cannot choose whether it will have
these Beginnings or Materials of Knowledge or
nor. The Objects of Sense will obtunde their I.
dea's upon our Minds; and the Operations of our
Minds will not let us be without some (at least obscure) Notions of them. No one can be wholly
ignorant of what he doth when he Thinks: And
as the Mind is forced to receive Impressions from
without, so it cannot avoid the Perception of those
Idea's that are annex'd to them.

Of Idea's, some (as we should carefully observe) are Simple, and others Complex. All those Idea's that come into our Minds by Sensation, are of the former kind: And tho' the Qualities in Bodies that affect our Senses are in the Things themselves, so united and blended, that there is no Separation nor Distance between them; yet the Idea's they produce in the Mind enter by the Senses simple and unmix'd. Some Idea's come into our Minds only by one Sance, which is peculiarly adapted to receive them: As the Idea's of all Colours are received only by the Eye; all Sounds and Tones by the Ear, &c. Heas, Cold, and Solidity, by the Touch.

Other Idea's we gain by more than one Sence; as of Space, Extension, Figure, Rest, and Motion: For these make forcible Impressions both on the

Eyes and Touch.

There are other Simple Idea's, which convey themselves into the Mind by all the ways of Sen-sasion and Restection; as Pleasure, Pain, Power, Existence, Unity, and Succession; and these are all, or, at least, the most considerable of those Simple Idea's which the Mind hath; and out of which is made all its other Knowledge.

To understand the Nature of these Simple Idea's the better, and to discourse of them intelligibly, it will be convenient to diftinguish them as they are Idea's or Perceptions in our Minds, and as they are Modifications in the Bodies that cause such Perceptions in us; that so we may not think (as perhaps is usually done) that they are exactly the Images and Resemblances of something inherent in the Subject: For most of those of tion are in the Mind no more the Likeness of something existing without us, than the Names that stand for them, are the Likeness of our Idea's. But here the Qualities in Bodies, which produce these Idea's in our Minds, must be distinguished into Primary and Secondary. Primary Qualities are such as are utterly inseparable from the Body, in what State soever it be; such as the Sence constantly finds in every Particle of Matter; which are Solidity, Extension, Figure, Motion, Rest, and Num Secondary Qualities are such as are in reality Nothing in the Objects themselves, but only Powers to produce various Sensations in us by their Primary Qualities; i.e. by the Bulk, Figure, Texture, and Motion of their Insensible Parts, as Colours, Sounds, Tasts, &c. Now the Idea's of Primary Qualities are, in some sence, Resemblances of them, and their Patterns do really exist in the Bodies themselves; but the Idea's produced in us by these Secondary Qualities have no Resemblance of them at all. There is nothing like our Idea's existing in the Bodies themselves: They are in the Bodies, we denominate from them only a Power to produce those Sensations in us: And what is Sweet, Blue, or Warm in Idea, is but the certain Bulk, Figure, and Motion of the infensible Parts in the Bodies themselves, which we call so.

There are several Faculties which the Mind bath of managing these Simple Idea's, which are very well worth our Observation; as that of Discerning duly, and rightly Distinguishing one from another: In this confists the Accuracy of Judg-

ment, and the avoiding all Confusions and Mi-

- 2. That of Comparing them one with another, in respect of Extent, Degree, Time, Place, or any other Circumstances of Relation or Dependance one on another.
- 3. The Faculty of Compounding or putting together the Simple Idea's received by Sensation or Reflexion, in order to make Complex ones.
- 4. When Children, by repeated Sensations, have got some Idea's fix'd in their Memories, they, by degrees, begin to learn the Use of Signs; and when they can speak articulately, they make use of Words to signific their Idea's to others: And the Use of Words being to stand as outward Marks of our Internal Idea's; and those Idea's being taken from particular things, if every particular Idea that we take in should have a particular Name, Names must grow endless. To prevent this, the Mind, by,
- 5. Another Faculty, can make the Particular Idea's received from such Objects, to become General: Which is done by considering them as they are in the Mind such Appearances, separate from all other Existences, and the Circumstances of real Existence; such as Time, Place, or any other concomitant Idea's; and this is called Abstraction; whereby Idea's taken from particular Things, become general Representatives of all of that kind; and their Names, general Names applicable to whatever exists conformable to such Abstract Idea's. Thus the same Colour being observed to Day in Chalk or Snow, which the Mind Yesterday received from Milk or Cerusse; it considers that Appearance alone; makes it a Representative of all of that kind; and having given it the name of Whiteness, it by that sound signifies the same Quality wheresoever to be met with or imagined. And thus Universals, whether Idea's or Terms, are made.

From the Power which the Mind hath of combining thus, comparing, and separating or abstracting its Simple Idea's, which come into it by Sensation and Restation, all Complex Idea's are form'd; and, as before in the Perception of Idea's, the Understanding was passive, so here 'tis active; exerting the Power it hath in the several Acts and Faculties above-mention'd, in order to stame Compounded Idea's.

All Complex Idea's, tho' their Number be infinite, and Variety endless, may be, as it seems, all reduc'd to these three Heads, viz. Modes, Substances and Relations.

Modes are such Complex Idea's, which however compounded, are not supposed to exist by themselves, but are considered as Dependancies on, or Affections of Substances: Such are the Idea's fignified by the Words Triangle, Gratisude, Mursher, Gc. and these Modes, as Mr. Locke calls them, are of two sorts:

t. Such as are only Variations, or different Combinations, of the same Simple Idea, without the Mixture of any other; as a Dozen, a Score, Sc. and these may be called Simple Modes.

2. There are others compounded of Simple Idea's of several kinds put together to make one Complex one; as Beauty, Thest, &c.

Substances have their Idea's such Combinations of Simple Idea's, as are taken to represent distinct particular things subsisting by themselves; in which the supposed, or confused Idea of Substance, such as it is, is always the First and Chief.

Relations, are a fort of Complex Idea's arising from the Consideration and Comparison of one Idea with another. Of these, some depend only on the Equality or Excess of the same Simple Idea in several Subjects; and these Mr. Locke thinks may be called Proportional Relations; fuch 28 equal, more, bigger, sweeter, &c. Another Occasion of comparing things together, is the Circumstances of their Origin or Beginning; and this being not afterwards to be altered, make the Relations depending thereon as lasting as the Subjects to which they belong: These are Natural Relations, such as Father, Brother, Uncle, Cousims, &c. There are also Relations by Institution, as Prince and People, General and Army, &c. Mo_ ral Relations, are the Conformity or Disagree. ment of Men's free Actions to Laws and Rules, whether Divine of Human.

It may be considered also surther about our Idea's, that some are clear and distinct; others obscure and consused. Our Simple Idea's are clear, when they continue such as the Objects represent them to us, when our Organs of Sensation are in a good Tone and Order; when our Memories resain them, and can produce and present them to the Mind when ever it hath occasion to consider them: And if along with this the Mind sees that these Simple Idea's are severally different one from another, and each single one from all the rest; then they are distinct also as well as clear: And the contrary to this will occasion Obscurisy and Consusion.

IDENTITY: The Idea's of Identity and Diversity come into our Minds by the Power it hath of comparing the very Beings of Things; whereby confidering any thing, as existing in any determined Time and Place, we compare it with it self existing at another time; and accordingly pronounce it to be the same or diverse. When we fee any thing to be in any Place in any Instant of Time, we are sure (be the thing what it will) that it is that very thing, and not another: For what ever is another thing, must at that same time exist in another place, how like so ever it may be in all other respects. And in this confifts Identity; when the Idea's it is attributed to, vary not at all from what they were that moment, wherein we confider'd their former Existence, and to which we compare the present: for never finding nor conceiving it possible, that two things of the same kind should exist in the same place at the same time, we rightly conclude, that whatever exists any where at any time, excludes all of the same kind, and is there it self alone. When therefore we demand, Whether any thing be the fame or not? Italways refers to some thing that existed at such a time in such a place, which, 'twas certain, at that infant, was the same with it self and no other. From whence it f ollows, that one thing can't have two Beginnings

of Existence, nor two things one; it being imposfible for two things of the same kind, to be or exist in the same instant, in the very same place; or one and the same thing in divers places. Whatever therefore had one Beginning is the same thing; and that which had a different Beginning in Time and Place from that, is not the same with that, but different from it.

We seem to have Idea's but of three sorts of Substances, GOD, Finite Intelligences or Spirits, and Bodies. Of GOD, 'tis demonstrable that He is without Beginning, Eternal, Unalterable, and Omnipresent; wherefore of His Identity there

can be no doubt.

Finite Spirits having had each its determinate Time and Place of Beginning to exist; the Relation to that Time and Place, will always determine to each of them its Identity, as long

as it exists.

And the same will hold of Bodies: And in every Particle of Matter, to which no Addition or Substraction of Matter being made, it is the same. And though these three sorts of Substances do not exclude one another out of the same Place; yet we cannot conceive but that they must necessarily each of them exclude any other of the same kind, out of the same Place; or else the Notions and Names of Identity and Diversity would be in vain; and there could be no such Distinction of Substances, or any thing else from one another. Thus, v. gr. if two Bodies or Particles of Matter could be in the same place at the same time; then take them, great or little, they must be one and the same; nay, thus all Bodies must be one and the

'Tis plain then that the so much disputed Principium Individuations is Existence it self; which determines a Being of any fort to a particular Time and Place, incommunicable to two Beings

of the same kind.

And here it will do well to distinguish between dead and unactive Lumps of Matter, and such Bodies as those endow'd with Vegetable or Animal Life. If you consider one of the former kinds of Bodies; if it confift only of one, or a determinate Number of many Atoms, any way combined together; while that one continues without mixture with others; or while the many exist, united together in the same Mass, it will still be the same Body; but if one Atom be taken away, or any new one added, it is no longer the same Mass, or the same Body. But in the State of Living Creatures, their I. dentity depends not on a Mass of the same Particles, but on something else; for in them the Variation of great Parcels of Matter alters not the Identity. An Oak growing from a Plant to a great Tree; and a Child growing to an Adult Person, are still the same; tho' in both Cases there be a manisest Change of Parts: For here 'tis such a peculiar Disposition and Organization of Parts in one coherent Body, and partaking of one common Life, that constitutes their Identity; and as long as that continues, it will be the same Oak or Man. And so it is in a Watch; as long as the Mechanism of it continues the same, and it goes and answers the End of its Organization, its the same Watch, tho many Particles of Matter continually rub off and wear away. 'Tis clear therefore wherein confifts the *Identity* of any Animal or Vegetable. Vol. II.

But there is another fort of Identity, which hath not been improperly called Personal; which I think Mr. Lock truly determines to consist in the Sameness of a Rational Being: Since by Person we understand an Intelligent Being, having Reason and Reflection: And fince there is a Consciousness which always accompanies Thinking; it is that which makes every one to be that, which he calls bimfelf, thereby diftinguishing him from all other Beings that think, and give him his Personal Iden-See Essay of Human Understanding, Book 2. Ch. 2

JEWISH Hours, are the 24 Hours of the Day, accounted from Sun-fetting to Sun-fetting again, much after the manner as the Italians do now.

IKEMILDESTREET, one of the four old Roman Ways in England: See Watting street in Vol. II. It was called Stratum Icenorum, because it took its Beginning from the Iceni, which were those that inhabited Suffolk, Norfolk, and Cam-

bridgesbire.
1LLEVIABLE, is what cannot or may not be levied: And therefore Nibil is a Word set upon a

Debt that is Illeviable.

IMPARSONEE, in the Law, or a Parson Imparsonee, is one that is Inducted into the Possession of a Benefice. And Dyer saith, a Dean and Chapter are Parsons Imparsonees of a Benefice ap-

propriate to them.

IMPEACHMENT of Waste, Impetitio vasti from French Empeschment, Impedimentum, signi-sies in Law a Restraint from committing Waste on Lands and Tenements. And thus he that hath a Lease without Impeachment of Waste, hath by it a Property or Interest given him in the House and Trees, and may make Waste in them, without being Impeached for it; that is, without being question'd or demanded any Recompence for the Waste done.

IMPLEAD, in our Law, fignifies to Sue, Ar-

rest or Prosecute by Course of Law.
IMPOST, is the Tax which the Crown receives for Merchandize brought into any Haven within its Dominions, or from Foreign Parts. 31 Eliz. 5. and thus it may be distinguished from Custom; which is rather the Profit which the Queen makes of Wares exported: But they are

frequently used promiscuously.

IMPOSTS in Architecture, are what are some times called Chaptrels, being the Parts on which the Feet of Arches stand: Or the Capitals of Pilasters that support Arches. These Imposts conform to their proper Orders: The Tuscan hath a Plinth only: The Dorick two Faces and a Round: The Ioniek a Plancere or Cavity between the two Faces; with, some times, carved Mouldings; as the Corinthian and Composite have their Freises. But the Sallies of the Imposts must not exceed the Body of the Pilaster. Sometimes the Entablature of the Order serves for the Impost of the Arch; and this looks very great and stately.

IMPROPRIATION, is the Word for the Profirs of an Ecclesiastical Benefice, being in the Hands of a Lay-Man: As Appropriation is the Term, when 'tis in the Hands of a Bishop, College, or Religious House. Tho' these two Words are now often used promiscuously. It is said there are 3849 Impropriations in England.

Cowel's Interpreter.

IN

IN Alto & Imo; the same with Alto & Baffo; which see.

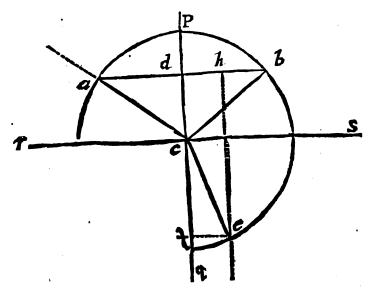
INCIDENCE. Sir Isaac Newton, in his Of eicks, Printed fince the first Edition of this Book, faith, That the Sine of Incidence is either accurately, or very nearly, in a given Ratio to the Sine of Refraction: (And the Angles of Incidence, Reflexion, and Refraction, are all in one and the same Plane.) Wherefore if that Proportion be known in any one Inclination of the Incident Ray, 'tis known in all; and thereby the Refraction in all Cases of Incidence on the same Refracting Body may be determin'd. Thus, if the Refraction be made out of Air into Water, the Sine of Incidence of the Red Light Is to the Sine of the Refraction, As 4 To 3. If out of Air into Glass, the Sines are As 17 To 11. In Light of other Colours the Sines have indeed other Proportions; but the Difference is so little, that it need seldom be confider'd.

To illustrate all this, Sir If. Newton, Opt. p. 5. gives this Example:

Let r s be the Surface of the Still Water, c the

the Air from a in the Line ac, is reflected or refracted: I would know whither this Ray shall go after such Reflexion or Refraction.

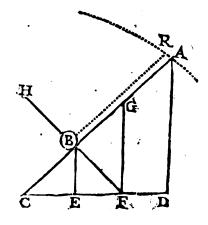
On the Surface of the Water rs, and in the Point c, I erect the Perpendicular c p, and produce it downwards to q. Knowing therefore that the Ray after Reflexion or Refraction will be found somewhere in the Plane of the Angle of Incidence a c p produced: I let fall the Sine of that Angle (viz. a d) on the Perpendicular p c; and then if the Reflected Ray be fought, I produce a d to b, fo that d b := a d, and draw c b, which shall be the Reslected Ray, because the Angle of Reflexion and its Sine, are equal to the Angle and Sine of Incidence, as they ought to be. But if the Refracted Ray had been fought, I produce a d to b; so that db may be to a d, As the Sine of Refraction To that of Incidence; i. e. As 3 To 4. Then with the Radius a c, describing the Circle abe, and in the Plane acp, I draw the Line be parallel to pq, and curing the Circumference in e: Then drawing e e, that shall be the Refracted Ray. For if e f be let fall perpendicularly on the Point of Incidence, in which any Ray coming in Line pq, it shall be the Sine of the Angle of Re-



fraction of the Ray ce; and this Sine is equal dh, and consequently in proportion to the Sine of the Angle of Incidence ad, As 3 To 4.

INCIDENT, in the Law, fignifies a thing necessarily depending upon another, as more principal. Thus a Court Baron is so Incident to a Mannor, and a Court of Pie-Powdre, that they cannot be severed in a Grant of a Mannor or Fair,

but must go along with it.
INCLINED Plane. If a Body, as B, be partly supported by the Inclined Plane A C, and partly



by the Power R acting on a Direction parallel to the Plane AC. Then that Power R: Is to the Body or Weight B:: As the Sine of the Angle of the Plane's Inclination ACB: Is to the Radius CA. CD, AD, GF, ED, and HF, being drawn as in the Figure. The Body B will be sustain'd as it were by three Forces or Powers, all acting according to different Directions, and in Æquilibrio to one another. The First of which is the Force of Gravity; expressed by BE perpendicular to the Horizon CD. The Second, the Power R, according to the Direction B R parallel to the Plane A C. And the Third is supply'd by the Resistance or Contranitence of the Plane A C; and is express'd by BH perpendicular thereunto. For Action and Re-action being equal, and one acting directly contrary to the other; the Plane which is pressed by the Body or Weight B, according to the Direction of the Perpendicular H B. must act on that Body by a contrary Direction. viz. that of FB or BH. And fince these three Powers are all mutually in Aquilibrio, and that the Body B is sustained by them, 'tis plain (when G F is drawn perpendicular to C D, or parallel to B E) that the Force of Gravity will be expressed

by GF; and that the Power R: To the Power of Gravity :: Will be as GB: To GF: But in the Right-angled Triangle CFG (FB being a Perpendicular to the Base CG) BG: GF::GF: GC; and as FG: GC::AD:AC: (by Similar Triangles;) wherefore the Power R: Is to the Force of Gravity:: As AD: To AC; or as the Sine of the Angle of Inclination to the Radius. 2. E. D.

COROLLARY I.

Wherefore the Force by which any heavy Body wou'd descend on any Inclined Plane to the Force of the Descent in the Perpendicular, is as the Sine of the Angle of the Plane's Inclination to the Radius.

COROLLARY II.

Frome hence also it follows, that the Inclination of the Plane may be so little, that the greatest Weight may be sustain'd on it by the least

For Practice therefore, Let the Weight of any Body be W, and P the Power wanted to sustain it on an Inclined Plane.

I say, by this Theorem, R: W:: S Incl.: P. That is, As Radius is to the Weight:: So is the Sine of the Angle of the Plane's Inclination to the Horizon: To the Power fought. The three first of which are given: Wherefore the Fourth is known. Trigon. Calculation. E. G. Let a Body weigh 9999 Pound; What Power will sustain it from descending on a Plane inclined to the Horizon with an Angle of 34 Degrees? Answer, 5590 Pound weight.

See the Work.

R = 10.

Weight 9999. 3.999957 $S, L Incl. = 34^{\circ}. 9.747562$

Z - R = 3.747419 = 5590 Ferd.

INCOMBUSTIBLE Cloth, is a fort of very odd Linen, made from a Stone in the form of a Talk; and call'd Lapis Ammanthus and Asbesto's, Alumen Plumosum, Polia, Corsbides, Sparta Polia, &c. 'Tis sound in many Places in China, Isaly, and Wales; and I have had a very clean fort, which would part into pretty long Threads, which was found in Scotland. The Incombustible Cloth made from this Mineral, is called Linum Vivum, Linum Fossile, Linum Indicum, Creticum, Cypricum, Se. from the Places where 'tis found. This was of such efteem among the Ancients, as to be rank'd (as Dr. Plos tells us) with the most precious Pearls: And in China a piece of it but 23# Inches long was valued at 80 Tale, i. e. 36 l. 13 s. 4 d. Pliny tells us exprelly, and of his own Knowledge, That Napkins of this Cloth being taken foul from the Table at a great Feast, where he was a Guest, were cast into the Fire, and by that means came out fairer and cleaner than if they had been wash'd in Water. Marco Antonio Castagna, Superintendent of some Mines in Italy, saith (in Phil. Trans. N. 72.) that causing a kind of Paper to be made of some of the Amianthus which he found there;

consumed than Plates of the hardest and most solid Metal; which would have scaled off in Flakes Mr. Edward Lloyd also, with a much less Heat. in Numb. 166. gives an Account of some that he found in Wales, which remain'd in the Fire above a Quarter of an Hour without any Signs of being confumed.

But in two Trials which were made before the Royal Society of a Piece of this Cloth of a Foot long, and half a Foot broad, and weighing about an Ounce and half; it was found to lose in a strong Fire, where it continued for several Minutes, above a Dram of its Weight at a time.

Of this Cloth, as Pliny informs us, Shrouds were anciently made, and used at Royal Obsequies, to wrap up the Corps in, that the Ashes of their Bodies might be preserved distinct from those of the Wood, which constituted the Funeral Pile. And we are assured, that the Princes of Tartary ule it for the same purpose to this Day. And some of the antient Indian Brachmans are said to have made themselves Cloaths of it. They tell us also, that the Wicks for the Antients Perpetual Lamps (if there were any such thing) were made of the Threads of this Alumen Plumosum, or Asbeston.

Marcus Paulus Venetus acquaints us, That one Curficar a Turk, a Superintendent of the Mines in the Tartarian Province of Chinchinthalas, affured him that they first dried this Mineral (sound there in a certain Mountain) in the Sun; then pounded it in a Brass Mortar, to separate the Earthy part from it; and that asterwards it was also washed from all remaining Filth; and then was spun into Threads like Wool, and afterwards woven into Cloth; which, said he, when spotted or foul they cleanse by throwing it into the Fire for an Hour's time, whence it comes out unhurt, and as white as Snow

INCOMPOSITE Numbers, are the same with those Euclid calls Prime Numbers. In Dr. Pell's Edition of Brancker's Algebra, there is a Table, as it's there called, of Incomposite Numbers, less than 100000; tho' it contains far more Composite than Incomposite Numbers: For it doth not only give an orderly Enumeration of all Odd Numbers which are not Composite; but it shews also that none of the rest are so. This Table being of very great use, I have here placed. It hath 21 Columns throughout; whereof the first contains 40 Odd Numbers in their natural Order. The following Columns are diftinguished on their Tops, by their Numbers, in their natural Order; as o, 1, 2, 3, &c. and so on to 99999. These Top Numbers are Hundreds; and the 40 Marginal Numbers are Unites adhering to those Hundreds. A Line running from any of the Marginal, as be calls them (or Numbers in the first Column) across the Page, shews in any intermediate Column, the Place of the Number made up of the Top Number and that Marginal. In every such place of Concourse, you shall either find the Letter p, or some Prime Number less than 317. If p be there, it shews the Number to be a Prime or Incomposite. The whole Table consists of 50 Pages, or so many several Tables, number'd: In some one of which, if any Number be less than 100000. and do end either in 1, 3, 7, or 9, you may find its Place; and then see whether it be a Prime or not. If it be not a Prime, but Composite, you will show find in 1, 2 Division. Then for inflances will there find its least Divisor. Thus for instance, it would abide longer in the Fire without being in Table I. where the Lin'd mark'd with the Marginal Marginal 67, crosses the Column which hath 16 at the Top, there you find the Letter p, which shews you that 1667 is a Prime or Incomposite Number. But where that Line crosses the next Column, you find 3, which shews you that 1767 is not a Prime but Composite Number; and that 3 is its least Divisor. So also in Table XXV. you see that 49031, 49033, and 49037 are all Prime or Incomposite Numbers: But 49039 is a Composite, and 19 is its least Divisor.

It will oftentimes be of very great use to have, as you may have here, a compleat orderly Enumeration of all Prime or Incomposite Numbers between 0, and 100.000, without any mixture of Composites; as the p's in these Tables will give you, leaving out 9, 21, &c. and all other Composites. 'Tis true that 2 and 3 are Incomposite Numbers, as well as 1 and 3; but they are not put into the Tables, because no other Incomposite Numbers can terminate in them: For if any Number end in 12, it may be halved; if in 5, it may be divided by 5.

If to each of these Primes you set the Briggi-

If to each of these Primes you set the Briggian Logarithm, you may find the Logarithm for all the rest of the Numbers in the first Hundred Chiliads, by addition of the Logarithms of their Incomposite Factors.

In perplex'd Questions in Algebra it is oftentimes necessary to be able to determine how many aliquot Parts and Divisors any proposed Quantity or Number may have, for which Purpose these Tables are of excellent use.

Every Aliquot Part of a Number is one of its just Divisors; but the greatest Divisor being equal to the whole Dividend, cannot be called a Part.

to the whole Dividend, cannot be called a Part.

If you have the least Divisor of any Number in these Tables of Incomposites, you may find all its other Incomposites Co-efficients.

For if the Divisor end in 1 or 9, and have a such an one you have at the Bolack Stroke under it, in the Dividend's place in Tables of Incomposite Numbers.

the Tables; or if the Divisor end in 3 or 7, and have such a Stroke over it in the Dividend's place; then the Dividend is the Square of an Incomposite, and consequently the Quotient is given, being equal to the Divisor.

If the least Divisor hath no such Stroke by it, let it divide the Number proposed; so shall the Quotient be the greatest Aliquot Pare of that Dividend. Then seek that Quotient it self also in the Tables; if you find it there marked with p, it is a Prime or Incomposite, and you can proceed no surther; your Enquiry is at an end.

Thus the Number 53191 is found in Table XXVII. with its smallest Divisor 43; and being divided by that 43, the Quotient is 1237. And in Table I. finding 1237 to be a Prime Number, I proceed no further.

But had the Number been 93611, you will find in Table XLVII. that 7 is its least Divisor; and that the Quotient will be 13373. This stands in Table VII. with 43 for its least Divisor, and the Quotient will be 311; which in Table I. I find to be an Incomposite: I conclude therefore, that the prime Co-efficients of 93611 ate 7, 43, and 311.

If you divide any Odd Number by all the Primes in order, beginning with 3: Then the first Divisor that finds a Quotient without Fraction, is the least Divisor that Dividend can have. If no such Divisor sind an Integer Quotient, before the Quotient becomes less than the Divisor, you may pronounce your Dividend to be Incomposite; and that that last Divisor is greater than the Square Root also of the Dividend.

Frequent occasion of dividing by Incomposites requires a Tariffa of as many Primes as shall be needful; but for resolving of Numbers less than 100000, it sufficeth if it be extended to 313. And such an one you have at the Beginning of these Tables of Incomposite Numbers.

INCOM-

TABLE

O'F

Incomposit Numbers,

Less than 100000.

N a

The Tariffa or Table of all INCOMPOSITS, less than 10000, Multiplied by 2, 3, 4, 5, 6, 7, 8, 9.

1 2 3 5 7 11 13 17 19 23 29 31 37 41 43 47 53 59 61 2 4 6 10 14 22 26 34 38 46 58 62 74 82 86 94 106 118 122 3 6 9 15 21 33 39 51 57 69 87 93 111 123 129 141 159 177 183	134 142 146
4 8 12 20 28 44 52 68 76 92 116 224 148 164 172 188 212 236 244 5 10 15 25 35 55 65 85 95 115 145 155 185 205 215 235 265 295 305 6 12 18 30 42 66 78 102 114 138 174 186 222 246 258 282 3 18 354 366	335 355 365
7 14 21 35 49 77 91 119 133 161 203 217 259 287 301 329 371 413 427 8 16 24 40 56 88 104 136 152 184 232 248 296 328 344 376 424 472 488 9 18 27 45 63 99 117 153 171 207 261 279 333 369 387 423 477 531 549	536 568 584
1 79 83 89 97 101 103 107 109 113 127 131 137 139 14 2 158 166 178 194 202 206 214 218 226 254 262 274 278 29 3 237 249 267 291 303 309 321 327 339 381 393 411 417 44	8 302 314
4 3 16 332 256 388 404 412 428 436 452 508 524 548 556 59 5 395 415 445 485 503 515 535 545 565 635 655 685 695 74 6 474 498 534 582 606 618 641 654 678 762 786 822 834 89	5 755 785
7 553 581 623 679 707 721 749 763 791 889 917 959 973 104 8 632 664 712 776 808 824 856 872 904 1016 1048 1096 1112 119 9 711 747 801 873 909 927 963 981 1017 1143 1179 1233 1251 134	2 1208 1256
1 163 167 173 179 181 191 193 197 199 211 223 227 2 326 334 346 358 362 382 386 394 398 422 446 454 3 489 501 519 537 543 573 579 591 597 633 669 681	687 699
4 652 668 692 716 724 764 772 788 796 844 892 908 5 815 835 865 895 905 955 965 985 995 1055 1115 1135 6 978 1002 1038 1074 1086 1146 1158 1182 1194 1266 1338 1362	1145 1165
7 1141 1169 1211 1253 1267 1337 1351 1379 1393 1477 1561 1589 1304 1336 1384 1432 1448 1528 1544 1576 1592 1688 1784 1816 1816 1503 1557 1611 1629 1719 1737 1773 1791 1899 2007 2043	5 1832 1864 1061 2097
1 239 241 251 257 263 269 271 277 281 283 293 30 2 478 482 502 544 526 538 542 554 562 566 586 61 3 717 723 753 771 789 807 813 831 843 849 879 92	4 622 626 1 933 939
4 956 964 1004 1028 1052 1076 1084 1108 1124 1132 1172 122 5 1195 1205 1255 1285 1315 1345 1355 1385 1405 1415 1465 153 6 1434 1446 1506 1542 1578 1614 1626 1662 1686 1698 1758 184 7 1673 1687 1757 1799 1841 1883 1897 1939 1967 1981 2051 214	5 5555 1565 2 1866 1878
8 1912 1928 2008 2056 2104 2152 2108 2216 2248 2264 2344 245 9 2151 2169 2259 2313 2367 2421 2439 2493 2529 2547 2637 276	6 2488 2504

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INCOMPOSITS. TAB. I.

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11 13 17 19	P	3 F		3 1	P P P	3 7 3 P	7 3 11 3	13 P P	3 23 3 P	P 3 19 3	7		3 P 3 P	3 p 3	7 P P 23	3 13 3 P	3 13	° p 17 37 7) P	17	23		3 P 3 9
21 23 27 29) P				3 7 3 7	P 3 7 3	P P 17 23	3 7 3 17	7 3 P 3		13	,	P 3 3	19 P 7 P	3 P 3 P	P 3 P 3	P	P 3			1	3 4	7 3 1 3
31 33 37 39		1	7 P	P 3 P 3	P 3 P 3	P P 19 P	3 13 3 7	p 3 7 3	11	7	7	3	P P 17 P	3 11 3 17	9 3 P	31	7 3	29	3 2	3 1) 3 I	P 3 1	P P 13
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5 5 5 5	3 7 9	3 P 3 P	P 3 P 3	P P 7	3 P 3 P	3 P 3	19 7 P 13	3 P 3		P	3 P P	3 P 3	P 3 7 3	13 13		3 7 3 2 P	3 3	p	3 I P 3 P	3 I 3 P 3	7	3 7 3 1	P 3 19
6666		P 3 P 3	7 P P	3 P 3 P	19 3 P 3	P P P	3 P 3 P	2	3	7	3 <u>3</u> P 3	3 P 3	p p 11	3	2	3 3 7 3	P 9 P 37 1	3 7 3	7 '1 3 P 3	P P	3 4I 3 29	P 3 P 3	37 13 7
77	77	P P 7 P	3 P 3 P	P 3 P 3	7 P 13 P	3 11 3 P		I		3 P 7	3 P 3	P 7 P	3 29 3 13		P 3 3 1	1 9 P	3 P 3 7	P 3 7 3	P 11 19 P	3 7 3	7 3 P 3	P P P	3 P 3 P
	81 83 87 89	3 P 3 P	p 3 11 3	P P 7	3 P 3	13 ·3 P	I	7 1 9 1	3 1 P 3	3 P	P P P	3 P 3 23	2 3 3 F	2	P 7 P 9	3 P 3 P	P 3 19 3	P P P	3 P	41 3 7 3	P P	3 7 3 P	7 3 P 3
	91 93 97	7 3 P 3	P P P	3 P 3 I3	17 3 P	17	7 1	3 P 3	P 3 7 3	7 13 P	3 19 3 29	р 3 р	<u></u>	7 1	3 P 3	P 3 P	13 7 11 P	3 P 3 P	37 3 P	Î9 P P	3 11 3	3 I 3 7 3	ri P
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INCOMPOSITS. TAB. II.

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11 13 17 19	P 30 P 30	P P 29 13	3 P 3 7	P 3 7 3	P 19 P 41	3 7 3 11	7 3 P 3	P II P	3 29 3 P	P	P 23 7 P	3 11 3 P	13 3 P 3	7 P 31 P	3 P 3 13	р 3 р 3	23 P P 7	3 47 3 P	37 3 11 3	р 7 Р
2I 23 27 29	43 7 P	3	p 3 17 3	11 23 13 17	3 P 3	P 3 7 3	P 43 37 11	3 7 3 P	3 11		3 P 3 13	p 3 53 3	p 11 7 P	3 P 3 P	3 23 3	7 13 P P	3 p 3	61 3 P 3	P P 43 7	3 P 3 P
31 33 37 39	3 19 3 P	P 3 P 3		3 P 3 P	3 P	43	3 P 3	P 3 7 3	19 P P 17	7	7 3 P 3	31 13 p 43	3 53 3 41	P 3 47 3	47 P 7	3 P 3 P	P 3 P 3	7 P 37 P	3 P 3 11	p 3 31 3
41 43 47 49	13 3 23 3	. p p 19	P	P 3 P 3	p 7 p 31	3 P 3 P	19 P	p 13 41 p	P 3	3 7	P 17 11	3 7 3 47	7 3 17 3	13 P P 17	3 11 9	3	11 P 7 41	3 19 3 23	23 3 P 3	7 P P 11
51 53 57 59	. 7 P 11 29		3 37	P	3 11 3 p	P	11 7 P P	7 p 3 3 1	P · 3 P 3	13 P P		23 · 3 · 7 3	P P P	3 7 3 P	7 3 P 3	53 11 p	3 3 9	11 3 13 3	P 7 17	3 59 3 37
61 63 67 69	3 P 3 P	P 3 11	P	3 17 3 23	23 3 P 3	13 11 17 7	. 3 P 3	3 P	P 7 47 19	P 3	P 3 P 3	29 P P	3 13 3 7	P 3 7	P P P	3 7 3 43	7 3 19 3	53 P P	p 3	17 3 P 3
71 73 77 79	19 3 31 3	13 41 7 P	3	P 3 P 3	7 P P 37	3 31 3 P	р 3 р 3	17 47 P	3 13 3 P	P 3 13	37 7 17 P	3 19 3 11	P 3 29	p 11	3 23 3 7	P 3 7 3	13 P	3 7 3 P	7 3 P 3	11 29 41 23
81 83 87 89	P P P	37 37 11	P 3 P 3	P P 7 P	3 13 3	29 3 13	P	3 11 3 P	P	19 29	3 P 3 P	P 3 P 3	17 7 19	3 17 ·3 P	59 3 11 3	P P 17 37	3 29 3 7	19 3 7 3	13 P	3
91 93 97 99	3 7 3 p	7 3 13 3	29 P P	3 P 3 P	47 3 11. 3	P P 7 23	3 P 3 P	P 3 P 3	7 11 P 13	41 3 P	11 3 19 3	23 7	37 37 3 p	p 3 43 3	p 7 13 p	3 P 3 59	3		3	3 7 3 M-
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INCOMPOSITS. TAB. III.

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11 13 17 19	3 P 3	p 3 23 3	р 11 р р	19 3 7	3 • 7 3	13 P P P	3 7 3 3 I	7 3 53 3	17 P P 61	3 17 3 P	p 3 29 3	19 P 7 P	3 13 3 17	47 3 13 3	7 P P P	3 37 3 P	31 3 41 3	P 29 P . 7	3 P 3 11	23 3 61 3
2I 23 27 29		7 P		P	P P 19 43	3 P 3 7	P 3 7 3	P P 29 P	3 7 3 11	7 3 13 3		3 47 3 23		17 P 7	3 11 3 61	P 3 P 3	7 P 17 13	3 59 3 17	9 9 9	31 P P 7
31 33 37 39	37 11	. E	19	7 P	XI	23 3 13 3	11 41 P P		P 3 7 3	P P II	7	7 3 11 3	l p	. 3 p 3 19	P 3 P 3	P 11 7 29	3 43 3 P	3 P 3	7 19 13 P	3 17 3 P
41 43 47 49	3	11	31	43	3 P	7 P	3 P 3 P	3 47) p	2	37	7	3 P	P 13	3 23 3 31	P	P P 7 P	P 3,	
51 53 57 59) i				61 P	3	3		23	F	31	3	3 7	p 53 11 23	7 3	7 3 P 3	P	3	.p	11 p 7 59
61 62 67	1 17	7 2.27 7 1	3 I	7 II		P 3 P 3	59 F 13	11	3	1	61		p 19 23	3 31 3	1 3	67 P 19	3	7 3 73 3	II	3 67 3 47
71777	3 I	4:	3 3 9 3 1	P 1	3 17 P :	7 7 1 7 1 2 3 3 1 9	F	3 17	3 I	7 1	3 11	3 3	7 F	41	p 13	3 F	53	29 23 53	. 7	7 3 43
8888	1 3 7 6	7 3 3 4 1 5 3 5	7	3 I P 3 4	3 1 3 1 3 6	P F 7 13	3 4	3 1	p 19	3 I 9 3 P	7 1 3 1 P	P 3 7 P	3 I 1 :	7 1 3 1	7 1	3 37) I 3 I 3 I		3 F 3 7	3 3 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5 3 5
9	3 7 1	P 7 P I	3 7 3 3	7 P 2 3 P 3	P 3 P 3		P 3 3	P 3 7	3 6 P 3 5 p	7 3 9	7 P I 9	3 2 I 3	9 1: 3 6: P	7 1 P	3 I'	7 1 3 2 3 1				
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INCOMPOSITS. TAB. IV.

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01 03 07 09	17 3 P 3	P 17 31 41	3 P 3 7	P 3 7 3	37 19 43 13	3 7 3 23	7 3 P 3	P P 19 P	3 p 3	67 3 P 3	P 47 7 43	3 P 3 P	19 3 P 3	7 69 P P	3 11 3 31	13 3 P 3	11 P P	3 P 3 13	29 3 37 3	P 7 P 11
11 13 17 19	P 7 11 13	3 P 3 29	P 3 P 3	P 59 P 71	3 11 3 7	17 3 7 3	11 17 13 P	3 7 3 P	7 3 17 3	91 91 11	3 P 3 P	13 3 11 3	P P 7 P	3 71 3 13	P 3 P. 3	7 11 P 73	3 23 3 19	3 P 3	73 13 P 7	3 41 3 P
21 23 27 29	3 19 3 P	9 11 3	P 7 13 P	3 P 3 P	P 3 P 3	b 11 b	37 37 3	3 7 3	P P	3 7 3 13	P	. P 17 P	3 I 3		41 13 7 17	3		P	3 P 3 P	89 P 3
31 33 37 39	37 3 P 3	P P 17	3 23 3 17	13 3 P 3	59 7 .41 47	47 3	19 3 p 3	P	P 3	29 3 7 3	13 31	3	3 P	P	P 3	3 P	17 7	3	17	7 P P 17
41 43 47 49	7 P P '23	3 P 3	79 73 P 3		3 17 3 P	3 P	29 7 17 61	3	3 41	53 P	P 3	3	P	7	3 11	19	F 3			3
51 53 57 59	3	P 3 47 3	P	P 3	P 3 11	79	3 P 3 P	29	7 P	17 3	3 P	23 17	P 3	7	19 19 19	3	13	P	P 3	3 73
61 63 67 69	11 3 b	61 P 7 31	3 P 3 P	P 3 P 3	7 23 29 P	P	p 3 59 3	P P 67	3 p 3		2-3 7 37 P	13	53 3 13	37 53	3 17 3 7	P 3 7 3	47 79 11	3	7 3 P 3	13 P
71 73 77 79	1	3 P 3 37	P 3 P 3	23 P 7 P		P 3 P 3	7 P 11		13 3	19 P	3 11 3 p	71 3 P 3		73 3 47	31 3 P 3		3 P 3	19 3 7 3	I7 P P	3 7 3 79
81 83 87 89	3 7 3 P	· 7 3 23 3	11 61 P	3	P 3 13	.p 29 7 11	3 41 3 P	9 3 11 3	7 p 71 83	3 p 3 29	73 3 19 3	43 11 P 7	P	11 83 83 3	P 7 P P	3 p	3 P 3	31 43 13 P	3 P 3	29 3 7 3
91 93 97 99	P 3 7	41 11 P P	3 7 3 P	7 3 P 3	P 43 73 67	3 19 3 P	9 3 37 3	P P 7 13	3 61 3 p	P 3 P 3	47 31	3 P 3 23	23 3 P 3			P 3 71 3				61 P 11
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11 13 17 19	P 3 P 3	p 7 p 23	3 43 3 P	p 3 p 3	13 47 19 P	3 P 3 7	79 3 7 3	31 P 23 P	3 7 3 P	7 3 37 3	P 71 29	3 13 11	61 3 13 3	P 67 7 P	3 P 3 P	p 3 31 3	7 P 59 P	3 11 3 P	P 3 P 3	11 23 47 7
21 23 27 29	13 71 23 7	P 3	3 19	53 7 11 P	3 p 3 P	P 3 P 3	37 P P P	3 11 3 7	P 3 7 3	†† P 79	3 7 3 P	7 3 P	p 23 p 11	3 P 3 19	p 3 11 3	P 89 7 13	3 P 3 P	p 3 71 3	7 11 31 P	3 p 3 p
31 33 37 39	3 29 3 p	3 79	P	3 13 3 31	p 3 11 3	19 7 P . P	3 89 3 53	P 3 P 3	p 11 p p	3 P 3	11 3 7 3	23 P P I 3	3 7 3 P	7 3 p 3	P P P	3 P 3 P	p 3 23 3	37 P 7 P	3 P 3 P	p 3 19
41 43 47 49	13	17 F	P 3	3 17	P	3 P 3 83	P 3 P . 3	р 7 Р 13	3 37 3 P	3 23	83	41 3	3 7	р р 13 р	3 7 3 11	7 3 P 3	31 p 11	3 P 3	13 3 43 3	P 61 7 P
5 I 5 3 5 7 5 9	F	3	1 3 2 2 3	61	79 3	43	41 17 11 7	3 P 3	17	13	3] F	11 19 p 47	. 3	13 3 · 7 3	. p 41 19 11	3 7 3 13	7 3 11 3	59 P	37 3
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8 8 8	1 3 7 9		3 7 3	7 I 1 8 8 P 1 1 3	7 3 1 P	3 F 7 3 3 3 3) I) 7 P I	3 8 P 3 1	3 I p I 3 8	7 3 3 9 6	3 1 3 1	P 1 3 P 1 3	p 1129 127 4	3 5	3 4	7 2	3 3 9 P	P 4 3 P 3	I 3
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11 13 17 19	17 3	P 3 67 3	P 17 11	P 3	3 11	P 13		3	19 11 29 31	7	3	P	3	3 P	101 7 19	2 9	3. P	13 P	· P	3 17
21 23 27 29	3 37 3	29 53 13 7	P	23 23	17 7 P P	17 3	13 9 9	71 P 17 P	3 79 3 7	67 3 7 3	73 P 41	7	7 3 103 3	P 13 47 P	3 P 3 11	41 3 P 3	P 59 7 29	19 3	P	7 P P 79
31 33 37 39	7 79 P P	3 P 3 P	13 3 29 3	P P P	3 9 11	P 3 41 3	P 7 11 P	3 P 3 P	P 3 P 3	17 13 P	3 11 3 7	P 3 7 3	11 47 17 P	3 7 3 17	7 3 P 3	13 .19 83 11	3 P 3 103	P 3 11 3	P 7 P	3 P 3
41 43 47 49	3 11 3 13	P 3 73 '3	7 P P 37	3 P. 3 79	53 31 31	83 13 53 7	3 29 3 23	2.3 3. 11 3	37 7 P 19	3 31 9	61 3 P 3	13 11 71 P	3 P 3 7	3 7 3	17 P P 107	3 7 3 P	7 3 19 3	59 p 17 31	3 13 3 17	P 33 13 3
51 53 57 59	19 3 89 3	р 11 7 Р	3 P 3 P	11 · 3 P 3	7 P P	3 61 3 P	P 3 P 3	13 p 31 7	3 P 3 P	47 3 P 3	43 7 P P	3 19 3 P	P 3 P 3	P P 41 37	. 3 I 3 3 7	P 3 7 3	61 43 p 89	3 7 3 11	7 3 71 3	17 P 11
61 63 67 69	P 29 P P	3 P 3 P	31 3 P 3	13 43 7 P	3 P 3 19	59 3 P 3	7 P P 47	3 47 3 11	P 3 P 3	97 19 11 7	3 13 3 P	P 3 13 3	P 7 19 59	3 11 3 P	73 3 p 3	11 31 43 23	3 107 3 7	19 3 7 3	29 P P	3 7 3 P
71 73 77 79	3 7 3 P	7 3 P 3	P P 43 19	3 11 3 97	37 3 P 3	97 7 71	3 13 3 59	p . 3 13	7 8 ₃ 73	3 P 3 P	p 3 11 3	P P P	3 P 3 P	8 ₃ 3 31 3	P 7 23 13	3 71 3 P	3 p 3	79 61 P P	3 31 3 7	P 3 7 3
81 83 87 89	17 3 7 3	p 17 61 23	3 7 3 P	7 3 13 3	47 11 P 17	3 19 3 P	3 p 3	P 41 7 P	3 P 3 P	79 3 P 3	7 P P I 3	3 53 3 .67	29 3 P 3	19 P 59 7	3 P 3 P	37 3 F 3	P 7 13 P	3 P 3 P	3 P 3	p 23 p 19
91 93 97 99	P P 23 P	3 P 3	4I 3 7 3	P 19 37 P	3 7 3 P	7 3 P 3	P 17 19	3 43 3 P	p 3 17 3	29 P 7	3 P 3	19 3 P	7 23 11 p	3 P 3 P	P 3 P 3	67 P P 7	3 11 3 p	13 3 47 3	11 7 P 73	67 3 13
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INCOMPOSITS. TAB. VII.

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01 03 07 09	3 P 3	P 7 P P	3 P 3 29	p 3 31 3	79 19 P	P	P 3 7 3	13 P 97 71	- 3 7 3 P	P	P P P	3 P 3 P	43 3 47 3	47 53 7 P	3 3 11	23 .3 13 3	7 61 11 31	3 71 3 P	37 3 P 3	P P P	
11 13 17 19	p 41 61	3 P 3 P	19	109	3 p 3 11	P 3 P 3	.p	3 P 3	23 3 7 3	37 P	7 3	7 3 13		3 P 3 19	р 3 Р	59 P 7	3 P 3 P	P 3 11 3	7 19 41 13	3 p 3 3 1	
21 23 27 29	3 11 3 23	17 3 67 3	17 P	P 3	17	7 P	3 13 3 73	p 3 11	101	P 3	3 7		7 :3		p 31 29 13	3 P 3 83	53 3 P 3	P P 7 P	23 3	19 3 3	
31 33 37 39	3 P	53	13	3 13	P P	83	17 3 P 3	7 47	4I 3	3 17	P P	2 3 3	3 7	67 P	3 7 3 89	7 3 P 3	43, p 13 23	_	3 101	P 7	
41 43 47 49	P 7	P 3	3 37	P P	23	3 P	47 P) p	29	7	р 3	3 P	17	3	3	11 29 19	3	3 59	61	73	
51 53 57 59	3 17 7 3	7 3 8 F	3 F	7 3	3 F	3 P) P		3 I	P	3 3 11	59	7 29	3 19	II p	P 3	3 7	17	7 7	1 3	3
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8 8 8		3 I: 3 3 7	3 7 7 I	I	3 7 3 3	P 4	p I	3 1 3 P	• 1	7	3 2	3	p 3	7 3 I	3 13 P 97 1 1	7 1	3 1 7 3 1 7	p 1	7	p	1 3 1 3
9	3 7	3 8 P 3 1	P I	3 7	7		3 7 3	p 6	P 57 P	P	3 41	7	3 79 3 67	3 5 P	9 10 P	3	P 3 P 3	P P 7	3 2 3 1 9	3 3	7 7 P
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INCOMPOSITS. TAB. VIII.

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	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
01 03 07 09	3 11 3 P	59 3 P 3	7	3 P 3 41	P 3 P 3	P	17 3		· /	7	3 43		2 3 3	.3 P	P 73 7 19	3	P	7 41 113 23	3 P 3 P	3 P
11 13 17 19	p 3 107 3	103 11 19 7	3 61 3 59	103	P 7 13 P	3 23 3 P	47	47 P P 41	3 P 3	3	17 p p 23	7	3 P	17	P 3	3 59	13		P	7 P 11 P
21 23 27 29	7 37 13 P	3 29 3 71	p 3 41 3	P P P	3 P 3 47	13 3 73 3	P 7 P	3 P 3 11	P 3 P 3	43 P 11	83	7	31 13 P 97	3	. P	19		79 3 P 3	P 7	3 p 3 17
31 33 37 39	3 p 3 101	13 3 67 3	, 7 43 23 29	3 11 3 13	P 3 P 3	11 P P -7	3 P 3 P	P 3 P 3	9 7 37 11	3 109 3 p	p 3 11 3	9 37 P P	3 P 3 7	3	13 11 ·43 P	3 7 3 41	7 3 19 \3	P P P		89 3 P 3
41 43 47 49	19 3 11 3	79 P 7 P	3 P 3 P	P 3 P 3	7 11 P P	3 P 3 P	3 97 3	P 23 P 7	3 P 3 31	67 3 P 3	13 7 41 101	3 19 3 P	P 3 79 3	23 67 103 P	3 P 3 7	P 3 7 3	P P P	3 7 3 P	7 3 13 3	19 107 37 41
51 53 57 59	P 13 P 17	3 P 3 P	P 3 53 3	113 31 7 83	3 97 3 19	P 3 P 3	7 P P 107	3 P 3 P	P 3 83 3	P 19 P 7	3 P 3 11	109 3 23 3	101 7 11 P	3 13 3 P	p 3 13 3	p 103 47 · p	3 11 3 7	19 3 7 3	11 83 101 P	3 7 3 P
61 63 67 69	3 7 3 11	7 3 31 3	13 17 11	3 53 3 p	P 3 17 3	P P 7	3 11 3 P	29 3 P 3	7 89 P P	3 13 3 P	P 3 13 3	P 59 29 7	3 P 3 P	p 3 11 3	P 7 P 31	3 79 3 P	P 3 P 3	13 P 11	3 29 3	11 3 7 3
71 73 77 79	P 3 7 3	37 P P	3 7 3 109	7 3 11 3	29 41 31 P	3 13 3 61	17 3 13 3	р 11 7 р	3 73 3 P	3 17 3	7 P P 17	3 P 3 43	P . 3 P 3	19 P P 7	3 P 3 23	23 3 37 3	P 7 61 P	3 P 3 31	59 3 P	р р 13
81 83 87 89	P P P 73	3 13 3 7	P 3 7 3	73 19 P P	3 7 3 P	7 3 29 3	53 P 19 37	3 P 3 23	23 3 P 3	71 P 7 13	3 P 3 79	17 3 P 3	7 17 P P	3 1 P 3	3 17 3	P P II 7	3 P 3 29	43 3 P 3	P 7 P P	3 11 3 59
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INCOMPOSITS. TAB. XII.

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61 63 67 69	13 P P 29	3 37 3 7	113 3 7 3	59 11 P	3 7 3 P	7 3 P 3	17 131 19 P	3 13 3 P	P 3 13	P P 7 103	3 P 3 17	19 3 P 3	7 43 53 P	3 61 3 P	29 3 31 3	P P P	3 P 3 P	P 3 P 3	107 7 29 P	31 31 11
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81 83 87 89	71 3 13 3	41 7 11 P	3 P 3 31		P P 113 43	3 11 3 7	37 3 7 3	11 P P 13	3 7 3 47	7 3 127 3	P 41 P 11	3 97 3 P	31 3 11 3	103 67 7 19	3 23 3 83	P 3 103 3	7 11 P P	3 17 3 P	11 3. P 3.	P 29 17 7
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INCOMPOSITS. TAB. XIV.

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11 13 17 19	19 3 P 3	P 7	II		61 P	р 3	3 43	P P	P	3 11	7 P	19 3	3 17	59	79 3	7		3 7 3 53	7 3 F 3	103 P
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51 53 57 59	109 71 11			13 19 P 43	7 3	3 -p	11	31	11 3 107 3	P P 7 P	3 13 3 P	19 3 13 3	7 P 97 P	3 17 3 109	97 3 P 3	P 59 17 7	3 P 3 17	P 3 4I 3	P 7 89 13	3 P 3 73
61 63 67 69	3 67 3 131	P 3 137 3	P P P 109	3 41 3 7	47 3 7 3		3 7 3 P	7 3 13	P P 67 97	3 59 3 149	P 3 P 3	157 23 7 101	3 137 3 11	P 3 P 3	7 29 11 13	3 43 3 19	139 3 73 3	17 P P	3 11 3 29	р 3 р 3
71 73 77 79	29 3 89 3	P 7 P 47	3 13 3 11	p 3 13	103 23 11 P	3 P 3 7	149 3 7 3	19 41 p 61	3 7 3 P	7 3 53 3	11. p p p	3 29 3 P	P 3 P 3	101 31 7 11	83 3 P	79 3 11 3	7 P 13 89	3 P 3 P	47 3 61 3	83 11 101 7
81 83 87 89	11 P 19 7	3 P 3 P	41 3 97 3	23 7 P	3 71 3 P	19 3 11 3	P P P 13	3 P 3 7	p 3 7 3	P 11 P 137	3 7 3 103	7 3 31 3	P P 13 29	3 139 3 61	P 3 P 3	P P 7 47	3 19. 3 P	13 3 37 31	7 P 79	3 P 3 13
91 93 97 99	3 .97 3 p	11 3 17 3	61 P P 7	3 P 3 P	59 3 P 3	P 7 P 67	3 p 3	73 3 127 3	P P I 3 37	3 P 3 7	P 3 7 3	P 71 P .59	3 7 3 p	7 3 P 3	37 19 31	3 4I 3 11	P 3 P		3 P 3 23	23 3 • p
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INCOMPOSITS.

T A B. XV.

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	280	281	282	283	284	285	286	287	288	289	290	<u>291</u>	292	293	294	295	296 —	297	298	299
01 03 07 09	• p • 41 7 73	157	P 3 67 8	7 11 P P	3 P 3 P	11 3 29 3	37 P P 7	3 P 3 19	83 9 9	p 7 137 P	3 13 3 . p	p 3 13 3	19 P	3	P 3 7 3	p 163 19 23	3 7 3 29	7 3 61 3	17 P 41 13	3 17 3 11
11 13 17 19	3 109 3 P	9 31 31	9 89 7 P	3 23 3 P	P 3 157 3	7 P P 19	3 13 3 p	P 3 13 · 3	47 P P	3 29 3 11	67 3 P 3	43 7 11 37	131 3	p 3 19 3	p 67 23 13	3 11 3 7	P 3 7 3	43 P 113	3 7 3 P	7 3 P 3
21 23 27 29	7 3 P 3	11	3 13 3 p	127 3 13		3 11 3 47	p 3 p 3	7 P 23 P	i	P	P P	3 p 3 p		109 7 P 139	3 P 3 P	53 3 P 3	19 11 13	P 3	11 3 7 3	P 23 P 173
31 33 37 39	33																			
43 47	39 II 19 3 17 p 3 13 29 3 43 71 3 7 p 3 109 107 3 53 7 41 3 107 31 3 7 p 3 41 151 3 113 7 3 13 59 3 p P 3 79 43 29 3 61 7 3 17 p 3 p 103 3 151 p 3 p 31 3 7 11 3 47 3 7 47 3 p p 3 17 7 3 31 p 3 p 11 3 23 151 3 p 49 7 3 13 p 3 p p 3 17 p 3 103 II 3 7 13 3 7 19 3															3 P				
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T A B. XVI.

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	11 13 17 19	P P 13) F	11	F 7	17	3 P	7 11 17 67	P	3 P	19 43) P	3 29	23 7 19 P	173 3	3 89	P P P 43	3 101 3 7	19 3 7 3	29 P	7
	21 23 27 29	3 7 3 P	3 47	167	P 3	3 P	131 7	3 113 3 109	31 3 p 3	13 29	17 3	3 19	P 17	3 P 3 11	P 3 P 3	13 7 11 53	3 29 3 41	103 3 p 3	P P P	3 11 3 7	I 37 3 7 3
3	31 33 37 39	59 3 7 3	29 P P	3 7 3 11	23	13	3 19 3 P	P 3 P 3	79 73 7 59	11 3	9 3 P 3	41	3 163 3 P	P 3 P 3	17 P P 7	3 17 3 149	P 3 11 3	47 7 17 29	3 13 3 17	139 3 13 3	37 11 109 19
4	11 13 17 19	11 13 P 151	3 43 3 7	P 3 7 3	P 19 11	3 7 3 P	7 3 11 . 3	13 P 19 P	3 71 3 97	p 3 109 3	р 11 7 Р	3 37 3 61	3 P 3	7 157 P P	3 13 3 23	23 3 13 3	P P P	3 P 3 P	P 3 53 3	17 7 P P	3 17 3 43
5	3 7 9	3 41 3 P	11 3 53 3	13 P 79 P	3 127 3 7	37 3 7 3	137 P P P	3 7 3 23	7 3 P 3	P P 59 P	3 13 83	p 3 13 3	P P 7 P	3 1 P 3	3 P 3	7 71 83 63	-1	3 I 3 I P 3	P 13 11	3 53 3 P	89 3 P 3
6,69	1 3 7 1	23 3 07 3	P 7 71 P	3 53 3 P	97 3 P 3	83 41 P P	3 13 3 7	P 3 7 3	19 P 11 29	3 7 3 P	7 3 73 3	89 P 47 P	3 11 3 71	43 3 P 3	11 79 7 13	3 73 3 p	37 3 P 3	7 P P	3 I 23 3 P	3 11 3	31 p 13
71 73 77 79	7	P 17 19 7	3 11 3 03	p 3 13	11 7 37 17	3 31 3 29	19 3 P 3	P 37 P	3 P 3	P 3 7 3	P 47 P 13	3 7 3 P	7 3 P 3	р р р	3 37 3 P	11 1 3 P 3 2	p 1	3 19 3	P 3 43 1	7 P 27 71 I	3 P 3
81 83 87 89		3 57 3 P	3	07 11 31 7	3 23 3 P	3 43 3	53 7 73 13	3 51 3 P	P 3 17 3	P 89 67 17	3 P 3 7	p 3 7 3	P P P P	3 7 3 7	7 3 P 2 3	P 19 P 3	3 I P 3 I		61 7 7 3	3 P 3	P. 3 29 3
91 93 97 9 <u>9</u>		P 3 10 P 3 1	7 9 P 3	3 P 3 I I	P 3 13 3	P P P		3 p 1	7 9 1	3 P 3 13	39	P 17 137	3 I p 3 7	3 3 7 3 I	P P P	3 7 3 I		9	3 P 3 1 6	31 1	P 7 7
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INCOMPOSITS. TAB. XVII.

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01 03 07 09	3 P 3 P		13 P 7 31	3 P 3 p	p 3 23 3	7 P P 19	3 P 3 P	53 3 P 3	p p 53 7	3 13 3 P	61 3 13 3	79 7 p 113	3 P 3 11	p 3 19	127 P 11 47	3 P 3 7	3 7	67 p 37 13	3 7 3 P	7 3 41 3
11 13 17 19	7 3 101 3	163 17 P P	3 p 3	79 3 17 3	P P 7 17	3 13 3 31	p 3 13	7 P P P	3 11 3 37	P 3 P 3	11 P 137 7	3 P 3	p 3 59 3	7 P	3 P 3 23	23 3 11	19 P P	3 P 3 7	P 3 7 3	p 11 13 107
21 23 27 29	11 31 P P	3 7 3 19	7 3 13 3		3 P 3	17 3 11 3	P 17 7 67	3 43 3 23	23 3 17 3	7 11 19 13	3 P 3 P	11 3 157 3	р 149	47	19 3 P 3	7 13 P	P 3	P 3 29 3	31 149 . P P	3 P 3 7
31 33 37 39	3 103 3 7	3 7		7	7 3 163 3		3 P 3 127	71 3 19 3	P P 7 P	3 P 3 P	17 3 P 3	7 17 13 31	167 3	3 17	67 29	-	3 P	7 11	3 23 3 13	P 3 P 3
41 43 47 49	73	p	19 3	3 7	71	7	3 P	11	3	3 47	19 173 P	11 3	3 P	P P	53 3	F	17 P	3 41 3 P		P 7 83 17
5 I 5 3 5 7 5 9		11	1 3 1 F	F	17	7 3	17	3	1 1	31	P 3	71	3 11	P) 3 P	1 2 2	73 3	3 P	97 P	3 19 3 29
61 63 63	3 1	29	9 4 9 4 2 2		3 1	1 H 3 H 2 2 9	89	181	5 9 7 2	7	4	3 I	P 29	73 9 5 3 61	3 109 1 7		3 41 9 3 131	1 F	3 p 3	P 3 P 3
7 7 7 7	3 7	3 1 p 2	3 P 5 3 7 I	3 1 9 3 3 1	p 4	9 : 7 ! 7 !	3 3; p : 3 4: p :	7	7	3 F 3 7	3 1		7 3 10	7 I 2 2 3 2 5 2 5	3 11 p 1		9 11 3 151 P 7	r p) 3 1 1 9 7 3	7 53 61 11
8 8 8 8	1 3 7 1 9	7 P I P		9 3 1 3 3	9	3 3 1 3 3		7 1	3 13 P	1 13 3 F 9 F		3 7	p 2 3 8 7 3	3 3 P P 17	3 3 3	7 1 3 1	P 5	3 13	1 17 3 1 3 7	17 3
9 9 9	1 3 7 9	3 7 3 P	P 3 4	7 3 2 P 17	3 9 3 9	3 I P 3	3 1 7 7	3 I P 3	1 3 P 6 3 16	7 1	3 p 3 2		p 9 1 9	3 3 3 7	P 107 3 1 7 19 3 139	P 9	<u> </u>	2 7	3 109	3 P 3
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INCOMPOSITS. TAB. XVIII.

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340	341	342	343	344	345	346	347	3 4 8	349	350	351	352	353	354	355	356	357	358	359
37 31	67	3 79	P	P 3	3	P P	3	P	11 67	17 3	3 P	7	43	3 P	13 P	P 3	3 7	61	. 7 . 3
3	109	P P	р 3	3 127	•	_	3 149	31 37	р 3	3 19	13 P	23 3	3 P	17 7 107 P	3 17 3 11	3 P	13 71 11 23	3 59 3 7	P 3 7 3
3 7	P P	3 7 3 13	3 P	29 173	19 3	31	13 7	3	47 3 53 3	P P	11 3	P	P	3 p 3 71	3	7	3 139 3 P	113 3 11 3	17 P 37 19
p 101 p	3 11 3 7	P 3 7 3	13 P	7 3	3 P	59 19	47 3	3 11	13 181 7 P	53 3	3 41	11 167	89	3 P	P P P	3 13 3 157	P 3 13	7 P	p 3
3 59 3 79	P 3 P 3	97 11 23 29	3 61 3 7	_	P 179	7	7 3 P 3	P	3	3 101	113 7	13 3	3 13	23 P	3 P 3 19	29 3 43 3	103 31 P 7	3 73 3 11	127 3 103
17 3 P 3	13 7 P P	3 P 3 P	p 3 17 3		109	3	19 23 P	3 7 3 11	7 3 13 3	11) p	P	23 P 7 19	3 11 3 59	73 3 31 3	7 101 181 13	3 P 3 P	p 3 23 3	P 157 41 7
p 23 11	3 127 3 47	P 3 P 3	P 7 P P	3 11 3 P	3 13 3	11 17 P 37	3 P 3 7	71 3 7 3	P P 73	3 7 3 P		37 179 P 13	3 P 3 113	P 3 29 3	43 11 7 P	3 19 3 53	3 47 3	7 P 13 P	3 P 3 P
3 13 3 53	p 3 11 3	43 P 151 7	3 37 3 31	3 23	181 7 71 151	3 P 3 P	83 83 3	P 43 P 13	3 41 3 7	3 7 3	P 17 29 127	3 7 3 P	7 3 17 3	79 19 13	3 P 3 47	p 3 P 3	P 83 7 37	3 29 3 P	13 P 3
173 3 89 7	7 P 17 179	3 P 3	P 3 37 3	29 P P 7	3 P 3 , P	79 3 P 3	P 7 43 19	3 P 3 139	P 3 59 3	р р 13 р	3 151 3 7	P 3 7 3	p 41 11 43	3 7 3 23	7 3 19 3	31 17 127 89	3 11 3 13	53 3 17 3	11 P 7 17
73 103 3 13	3 31 3 11	53 3 P 3	7 163 11 41	3 17 3 P	p 3 29 3	P 13 7	3 11 3 17	23 3 P 3	11 7 79 31	3 19 3 p	13 3 61 3	P 29 47 11	3 P 3 7	P 3 7 3	P P P	3 7 3 29	7 3 P 3	19 11 P P	3 p 3 p M-
	11 37 31 71 3 73 P 13 3 73 P 10 P 3 53 P 3 P 3 P 3 P 3 P 3 P 3 P 3 P 3	II 3 37 67 31 37 7 31 23 3 7 7 39 9 3 149 9 7 9 9 11 101 3 P 7 3 P 7 3 P 7 3 P 7 3 P 7 3 P 7 3 P 7 3 P 7 3 P 7 3 103 17 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	11 3 23 79 71 23 3 P P P P P P P P P P P P P P P P P	11	III	II 3 23 P 3 P 31 3 79 7 3 11 19 3 3 7 P 3 11 19 3 3 7 P 3 11 19 3 3 7 P 3 11 19 3 13 149 3 7 P 3 P 3 P 7 3 29 7 7 9 3 19 7 P 3 P 17 3 29 7 7 9 3 19 9 3 19 19 19 19 3 19 19 19 3 19 19 3 19 19 3 19 19 3 19 19 3 19 19 3 19 19 3 19 3 19 19 3 11 3 7 3 19 19 3 11 3 19 <td< td=""><td>11 3 23 P 3 P 7 37 67 3 P P 3 P 31 3 79 7 3 11 P 71 23 3 11 19 3 53 3 7 P 3 P P 3 P P 3 109 P 3 127 7 3 P P 3 P 7 3 29 19 3 89 7 P 3 P 7 3 29 19 3 3 11 3 3 9 13 3 11 3 3 9 11 3 7 P 3 89 3 11 3 3 9 11 3 7 P 3 9 11 3 7 P 3 9 11 3 3 9 19 3 11 3 3 9 19 3</td><td>II</td><td>340 341 342 343 344 345 346 347 348 II</td><td>340 341 342 343 344 345 346 347 348 349 III</td><td>340 341 342 343 344 345 346 347 348 349 350 11</td><td>340 341 342 343 344 345 346 347 348 349 350 351 11</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 11</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 11 3 23 p 3 p 7 3 13 17 3 11 p 3 7 43 311 p 3 7 43 7 43 3 7 13 311 p 3 p 7 43 11 p 3 p 67 3 p 17 3 7 143 3 7 143 3 7 13 3 13 17 3 17 13 3 13 17 3 17 43 3 17 13 3 13 17 3 3 13 17 13 3 13 17 13 3 13 19 17 3 3 17 13 3 19 17 3 11 13 13 19 13 19 13 19 13 19 13</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 11</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 III 3 23 P 3 P 7 3 III P 3 P 7 3 III P 3 P 131 37 67 3 P 7 3 III P 3 P 67 3 P 17 3 P 17 3 P 17 1 3 P 1 3 P 19 3 P 67 3 P 17 3 P 17 3 P 17 3 P 1</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 III 3 23 P 3 P 7 3 II 17 3 II P 3 P 13I 3 37 67 3 P P 3 II 19 3 53 61 3 7 I3 3 II P 3 P I3I 3 37 67 3 P P 3 II P 3 P 7 3 II I 9 3 F 7 3 P I7 3 P P 3 71 23 73 II 19 3 53 61 3 7 I3 3 I37 I7 3 P 7 31 3 7 P 3 I3 P 7 3 II P 3 I3 P 7 3 I4 P 3 I3 I P 3 I4 P 7 3 109 P 3 P 7 3 I4 P 7 3 I4 P 3 I P 3 I P 3 I P 17 3 109 P 3 P 7 3 I4 P 7 3 P II 3 P I 3 I 3 P I 3 I 3 P I 3 I 3</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 III 3 23 P P 3 P P 3 P P 3 II 17 3 II P 3 P 13 I 3 P 3 3 I 3 P P 3 3 I 1 P 3 P P 3 I I 17 3 I I P 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 17 3 P P 3 P P 3 I I 17 3 P P 17 3 P P 17 3 P P 17 3 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 18 P 18 P P 18 I I 18 P 18 P</td><td>340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 III 3 23 P P 3 P P 3 P P 3 II 17 3 II P 3 P P 3 II 3 P 3 P P 3 II 17 3 P P 3 P</td></td<>	11 3 23 P 3 P 7 37 67 3 P P 3 P 31 3 79 7 3 11 P 71 23 3 11 19 3 53 3 7 P 3 P P 3 P P 3 109 P 3 127 7 3 P P 3 P 7 3 29 19 3 89 7 P 3 P 7 3 29 19 3 3 11 3 3 9 13 3 11 3 3 9 11 3 7 P 3 89 3 11 3 3 9 11 3 7 P 3 9 11 3 7 P 3 9 11 3 3 9 19 3 11 3 3 9 19 3	II	340 341 342 343 344 345 346 347 348 II	340 341 342 343 344 345 346 347 348 349 III	340 341 342 343 344 345 346 347 348 349 350 11	340 341 342 343 344 345 346 347 348 349 350 351 11	340 341 342 343 344 345 346 347 348 349 350 351 352 11	340 341 342 343 344 345 346 347 348 349 350 351 352 353 11 3 23 p 3 p 7 3 13 17 3 11 p 3 7 43 311 p 3 7 43 7 43 3 7 13 311 p 3 p 7 43 11 p 3 p 67 3 p 17 3 7 143 3 7 143 3 7 13 3 13 17 3 17 13 3 13 17 3 17 43 3 17 13 3 13 17 3 3 13 17 13 3 13 17 13 3 13 19 17 3 3 17 13 3 19 17 3 11 13 13 19 13 19 13 19 13 19 13	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 11	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 III 3 23 P 3 P 7 3 III P 3 P 7 3 III P 3 P 131 37 67 3 P 7 3 III P 3 P 67 3 P 17 3 P 17 3 P 17 1 3 P 1 3 P 19 3 P 67 3 P 17 3 P 17 3 P 17 3 P 1	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 III 3 23 P 3 P 7 3 II 17 3 II P 3 P 13I 3 37 67 3 P P 3 II 19 3 53 61 3 7 I3 3 II P 3 P I3I 3 37 67 3 P P 3 II P 3 P 7 3 II I 9 3 F 7 3 P I7 3 P P 3 71 23 73 II 19 3 53 61 3 7 I3 3 I37 I7 3 P 7 31 3 7 P 3 I3 P 7 3 II P 3 I3 P 7 3 I4 P 3 I3 I P 3 I4 P 7 3 109 P 3 P 7 3 I4 P 7 3 I4 P 3 I P 3 I P 3 I P 17 3 109 P 3 P 7 3 I4 P 7 3 P II 3 P I 3 I 3 P I 3 I 3 P I 3 I 3	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 III 3 23 P P 3 P P 3 P P 3 II 17 3 II P 3 P 13 I 3 P 3 3 I 3 P P 3 3 I 1 P 3 P P 3 I I 17 3 I I P 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 3 P P 3 I I 17 3 P P 17 3 P P 3 P P 3 I I 17 3 P P 17 3 P P 17 3 P P 17 3 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 17 18 P P 18 I I 18 P 18 P P 18 I I 18 P 18 P	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 III 3 23 P P 3 P P 3 P P 3 II 17 3 II P 3 P P 3 II 3 P 3 P P 3 II 17 3 P P 3 P

INCOMPOSITS. TAB. XIX.

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	360	361	362	36	3 36	4 30	55 3	66	367	368	369	370	37	1 3	72	373	74 3	75	76	77	378	379	1
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11 13 17 19	181	7	1	2	p I	3	3 3	31 19 7 11	3 P 3 73	131 3 11 3	. /	P 3		1	27 11 P	3 P 3 67	11 3 17 ,3	p 7 p 17	3 29 3 P	43 3 P 3	13	3	3 7
2I 23 27 29	3 13 3 7	7	I	7	3 7 3 7	7 3 3 3 3	59 P P	3 53 3 P	p 3 19 3	p 23 7 13	F	6			3 P 3 59	p 3 163 3	23 P 13	3 157 3 P	17 3 191 3	67 7 31 29	109	I	3 7 3
31 33 37 39	I 37 3 P 3	2	3 1		3 7	17 P 83	3 7 3 61	7 3 P 3	23 109 17 P	3 p 3	4	3 2		3 7 I 3 P	3 I 3 2 3 3	7 37 P P	3 11 3 29	13 3 P	61	3	1 5	3 7 5	3 7 9 1
41 43 47 49	11	4	7 3 6	P 3 7 3	19	3 3 7	P 3 7 3	11 P 13 67	7	F	3 1	p I P	7	3	167 P 7	107	3 P	p p	P 3		3 I		3 3 7
51 53 57 59	3	1 3 I		P. 7	3 P 3	P 3 P 1 3	11 139 P	3 P 3		3 1 3	7 P	3 7 3 3	3	97 53 73 P	3 P 3	3 F	13	3	7 3 F	I	9 7	3 P 3 7	P 3 P 3
6 6	1 3 7 9	p 3 2 p 5 3	P 9 7	P	13 3 41 3	19 7 P P	3 P 3	61 3		7 19	3 2 1 3 7	3 7 IC 3	p 13	3 7 3 11	83	7 F 8 F 8 I	89		1 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1	3 7 9 1 7	3 1	P 3	7 P P 43
777	7 4	7 P 6	3 3 1 1	3 P 3	37 P 11 7	3 P 3 P	79 3	4	P 7 I P 3	3 1 3 P	p 1 3 p 16	p 1 :	3 3 3 7	P 3 7 3	I	3 P	3 1 : 3 P	7 1 3 1 1 5	P 4	3 I C	7 3 7 3	р 7 р 1	3 13 63
8888	1 3 7 9 1	3 P 3 5 I	97 3 P I	7 13 3·1 11	3 P 3 P	3 11 3	157 F	7	3 P 3 9	P 1 3 P 3 :	7 P	3 3 I 3 47	3 P 3	p 19 41 p	1	3 3 3 7	9 3: 3 1 7 1	7 P 1 9 P	3 3 7	7 3 3 3 3 3	P P 29 23	3 43 3 P	19 3 P 3
9) I) 3) 7 9 9	3 P 3	P 17 7 53	3 P 3	3 17 3	7 P P 17	2	3 3 3 9	P 3 P 3	p P 31	3 79 3 P	71 3 P 3	29 7 P 23	3 13 3	3	9 I 3 3 6 3 I 4	9 1 P	3 P 3	P 3 7 1	P P I P	3 7 3 P	7 3 P 3	P P P
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3 7	47	3	3 P	107 41	19	23	. P	37 3	167 3 P 3		P 3	3 P	P P	. 3	3 43	7 173	151 3		107 167 179
47	67	3	19 P	7	3 59	13 19	P 3	3 41	. P		3 11	-p	3 P	3 89	11 29	P	3 p 3	P 7 P P	13 13
73	3	13 p	l p	3	89	7 3	3 P	71	P 3	3 103	P 7	P 3	3 139	47 113	3 13 3 19	p 3 13	67 P 79 7	3 61 3 p	73 3 P 3
3 P	7 37	167 3	31	37 P	, b	3 7	17 P	7	3 17	P	3 13 3 11	3 13	P 7	р 3	.p 3 71 3	7 29 41 31	3 11 3 P	P 3 P 3	11 59 43 7
p 19	3 P	29 3 67 3	7	p 3	3 P	P	11	3 7	P 163	3 7 3 139	7 3 P 3	p 17 37 11	3 23 3 P	9 11 3	P 37 7 13	3 19 3 P	127 3 83 3	7 11 P 23	3 P 3
3 17 3 p	31 3 P 3	P 83 17 7	3 13 3 17	9 11 3	P 7 P	3 23 3 P	83 3 P 3	p 11 p 47	3 47 3 7	3 7 .3	P P 53 13	3 7 . 3 107	7 3 P 3	p 19 61 29	3 p 3 p	17 3 P 3	P 17 7 P	3 P 3 P	89 3 17 3
11 3 13	7 59 P 73	3 p 3 101	P 3 P 3	17 79 109	3 17 3 173	P 3 P 3	137 7 17 13	3 P 3 17	P 3 P 3	89 41 23 P	3 43 3 7	173 3 7 3	P P 13 53	3 7 3 11	7 3 19 3	р 97 11 Р	3 31 3 P	13 3 p 3	p 71 7 P
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	71 73 77 79	P 3 I	P 63 7 P	3 P 3	p 3 199 3	7 11 79 19	3 29 3 P	11 3 43 3	F	2	3 3 3 4	3	7 I	3 99 3 P	17 3 19 3	7 7 P	3 19 7 3 7	3 7	9 P P	3 7 3 I P	7 P 3 31 3 23 3 P
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31 33 37 39	191 13 19	3 P 3 29	83 9 . 3	107 7 P 149	3 59 3 P	3 173	13 P 149 P	3 17 3 7	P 3 7 3	71 P 11 73	7	7 3 p 3		3 11 3 P	p 3 13	11 P 7 137	3 19 3 P	59 3 P 3	7 31 p	3 P 3 P
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888	1 3 7 9	3 7 3	7 3 5 10 3	P 3 9 43	3 P 3	p 3 p 3	7 P I	3 89 3 81	P 3 P 3	7 P 19	I	3 1 3 1 9	p 3 1 3 1 1 0 3	7	3 3 3	19 3 13 3	P 7 17	3 179 3 17	P 3 11	67 P P	8 ₃ 3 7	151 3 7 3
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61 63 67	13	103 3 13	P	3 P 3	p 3 109 3	7 59 11 61	2 9	2-3 3 P	181 19 p	3	3 223	7 19 P	. 3 P 3 167	P 3 31 3	9 53 13	3 P 3	19 3 7 3	191 37 P P	3 7 3 P	7 3 157 3
71 73 77 79	3 p	11 131 p	P		17	103	11	7 P P 17	3 P 3 83	p 3 19 3	13	3 73 3 61	11 3 47 3	7 83	3 P 3	13 3 P 3	163 P 31 P	2 3	P 3 7 3	P P P 59
81 83 87 89	11 p	7	3 P		3 19 3 29	3 P	59 P • 7 173	3 43 3 P	17 3 151 3	7 17 67 P		17	P P		P 3 P 3	P 7 79 23	3 p 3		29 13 11 19	3 227 3 7
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31 33 37 39	7 61 17 13	37 37 3 17		59 199		131 3 107 3	7 13 p	3 23	23 3 P 3	41 43 P 167	3 181 3 7	13 3 7 3	P 139 P	7	7 3 P 3	199 17 11 37	3 . p 3 p	P 3, 17	P 13 7 17	3 11 3 P
41 43 47 49	3 71 3 23	23 3 P 3		3	229 3 179 3	P P 11	3 61 3 17	13 9 9	53 7 43 41	3 11 3 13	29 3 P 3	11 19 P	37 37 3	4I 3 7 3	P 13 19	3 7 3 p	7 · 3 II 3	61 223 71 59	3 23 3 P	13 3 73 3
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INDEFEISIBLE, in our Law, fignifies what cannot be defeated or made void : As a Good

and Indefeisible Estate.

INDEMNITIES. When a Church is Approriate to an Abbey or College, then the Arch-Deacon loseth his Induction Money for ever: In Recompence whereof he shall have yearly out of the Church so appropriate One or Two Shillings, more or less, for a Penfion, as was agreed at the Time of the Appropriating. And this Pension is call'd an Indemnity.

INDIVISUM, in our Law, is used for that which two Persons hold in common, Kitchin, fol. 241. in these Words; Partition.

He holds pro Indiviso, &c.

INDORSEMENT, is any thing written on the Back of a Deed or Instrument; as a Condition, written on the Back of an Obligation, is

commonly call'd an Indorsement.
INDUCTION. When a C When a Clerk is Instituted into a Benefice, he is to exhibit his Mandate from the Bishop to the Arch Deacon, or other Person to whom it is directed; and hath a Right chereby to be Industed into his Living: And if he be refused Industion, he hath a Remedy both in the Ecclesiastical Court, and also an Action of the Case in the Common Law, against the Arch-Deacon. If the Industor, or Person to be Inducted, be kept out of the Church or House by Lay-Men, the Writ de Vi Laich lies for the Clerk; which is directed out of the Chancery to the Sheriff of the County, to remove the Force, &c. If another Clergyman, presented by the same Patron, keep Possession, a Spoliation is grantable out of the Spiritual Court; whereby the Tithes, &c. shall be sequestred till the Right be determined.

The Arch-Deacon rarely Inducts a Clerk by himself in Person, but issues out a Warrant to all Clerks and Letter'd Persons within the Arch-Deaconry, impowering any of them to do it in his stead. The usual Form and Manner of Industion is, for the Industor to take the Clerk by the Hand, and then to lay it on the Key of the Church, which must be then in the Door, and to say; By Virtue of this Instrument, which is the Arch-Deacon's Warrant, I Indust you into the Real, Assual, and Corporal Possession of the Restory or Vicarage of A. with all its Fruits, Prosits, Members, and Appurtements. This done, he opens the Door, and putte the Clerk in Possession of the Church, and thuts the Door upon him; who, after he hath tolled a Bell (if there be any) comes out, and desires the Industry to indorse a Certificate of his Industion on the Arch-Deacon's Warrant, and that all present will fignify it under their Hands.

If the Church Key cannot be had, 'tis sufficient that the Clerk lay hold of the Ring of the Door, and within the time limited read the Common-Prayer and Thirty Nine Articles in the Church Porch. If there be no Church, he may lay his Hand on the Wall or Fence of the Church-Yard, &c. there being no necessity of Niceness as to the Form of Industion; only that he must have Witness that he was truly possels'd of it. Within two Months after this, the Clerk must read the Thirty Nine Articles, and all the Service of the Day both at Morning and Evening Prayers; and declare his Affent and Consent; and he must then also read the Bishop's English Cortificate, in which

who must Sign that they heard him do it, and be ready to attest it vive voce, if required: And within three Months after Industion he must take also the Abjuration Oath at the Quarter-Sessions,

or in some one of the Courts in Westminster.

INFANGETHEF, is a Liberty granted from the King to some Lords of Manors, to try all Thieves, which are their Tenants, within their

own Courts.

INFERIOR Planets, are Mercury and Venus, fo. called, because they are next the Sun, the Centre of the Planetary System. An Account of their Motion and Phanomena to an Eye placed at the Earth is as follows.

1. The Periodical Times of their Motion thro' the Ecliptic are plainly equal; which is contra-ry to what appears in the Motion of the Superior Planets: And their Progress through the Ecliptic is measured by the Motion of the Sun; so that if the apparent Motions of the Sun, Venus, and Mircury, be confidered for many Years together, they will appear to run through the Zodiac in an equal Space of Time.

The Reason of this Diversity between the Supe-

rior and Inferior Planets is not from any real Diference in their Motions, but arifes folely from the different Polition of this Earth which we inhabit.

All the Planets are circulated round the Sun in one and the same Ratio; the more distant requiring a longer time for their Revolution, than those which are more near. Thus the Earth being farther from the Sun than Venus, is a longer time in moving round him; and Venus than Mercury: And to an Eye placed in the Sun the Motions of the Inferior and Superior Planets would appear alike uniform and proportionable to their Distance. But to an Eye at the Earth, as the Superiors, containing our Orbit within theirs, will appear to move sometimes flower, and sometimes swifter; now to be stationary, and now re-trograde; so the Motions of the Inferiors will appear to depend upon the Motion of the Sun, to whom they are so nearly joined as it were; and to us, that are in an Orbit so far without them, will appear to be equal to the Motion of that Great Luminary.

1. The San, Venus and Mercury, fingly confidered, are each affected with such an Inequality of Motion, that it is very rare for them all three, or indeed for any two of them, to agree in the same Degree of Velocity.

Indeed, if Venus and Mercury had no Motion of their own round the Sun, but kept an invariable Position with regard to him, it were reasonable to suppose, that they should move on almost equably, as the Sun doth. But fince that apparent Motion, with which they annually run through the Zodiac, is derived from a double Fountain, viz. from their own proper Motion round the Sun, which is not very unequable in it self; and from the Position of the Earth, which is continually various and changeable, in an Orbit that is without theirs; 'tis not strange that each of the Inferior Planets should appear to move unequally, and to go sometimes slower, and sometimes faster, by turns.

3. Although the Periodic Times of Venus and Mercury in the Ecliptic through the Course of also read the Billop's Congular, in which is the Declaration of his Conformity; and of all the Year are thus accurately equal to one anthis he must have two or three good Witnesses; other; yet the Periodic Times of Venus, if reckon'd T t

from any one present Position to the Sun, to a like subsequent one, if compared with the Periodic Times of Mercury in a like Position, will appear to be of a much longer Length.

For this Inequality of the Periodic Times, ac-

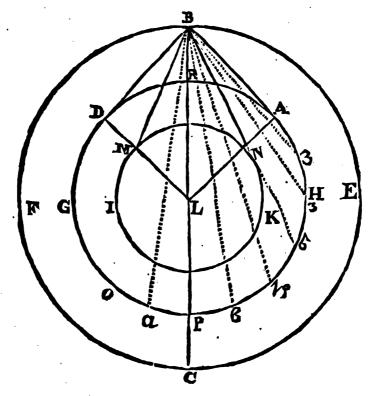
cording to the unequal Distance from the Sun, is agreeable to the established Law of the Heavenly Bodies: For Venus is nearer to the Sun than the Earth, and Mercury than Venus. Wherefore the Earth, and Mercury than Venus. Wherefore the Periodic Times of Venus, confidered in themselves, and with regard to the fix'd Stars, are not a little shorter than those of the Earth; and those of Mercury shorter than the Periodic Times of Venus. And though these Motions should be considered by a Spectatorat the Earth, he would find in them the same Inequality: For the Motion of Mercury

will be sooner, and oftner more fwift, than that of the Earth; and therefore their Periodic Times must be unequal.

4. These Inferior Planets are never either in Opposition or in Quadrature to the Sun; but always more near to him, than to occasion those Phenomena: For Mercury goes no farther from the Sun than about 28 Degrees, and Venus not above 48 Degrees; sometimes to the Eastward, and sometimes to the Westward. That neither of these Planets can come to be in Quadrature, much less in Opposition to the Sun, will be plain from the following Scheme.

Let the Circle BFCE be the Earth's Annual

Orbit; ADGH the Orbit of Venus; and NMK



that of Mercury. The greatest Elongation of Venus from the Sun is determined by the Acute Angle LBA, made by the Line BL drawn from the Sun to the Earth, and the Line BA, which is a Tangent, to the Orbit of Venus. In like manner the Acute Angle LBN will determine the greatest Elongation of Mercury from the Sun. the Quantity of these Angles, in a Proportion affign'd, may be had from the Semidiameters of the Orbits being found by Observation, and by Tri-gonometrical Calculation: Or, indeed, they will be discovered by Observation of the greatest Elongations themselves.

5. Our Modern Astronomers have observ'd, That Venus appears bigger when she begins to recede from the Sun towards the East, and when she is yet but a little distance from him; but, on the contrary, that she appears less in her Approach towards the Sun, and when she comes pretty near him: Whereas, when she recedes from the Sun towards the West, then she appears less; but when she approaches towards him again, she again appears larger. And the same things have I seen: But when she comes into the Position D,

been observed of Mercury, by the use of long and good Telescopes.

These Phenomena have quite overturn'd the Ptolemaic System of the Heavens, and may be accounted for thus: Since all the Planets, as well as the Earth, are Opake, Scabrous, and Spherical Bodies, reflecting every way from them the Rays of the Sun falling upon them; 'tis plain, that that Hemisphere of any Planet only, which is turned towards the Sun, will be enlightened; the other Half of it remaining in Darkness. And, fince also an Observer here can only see that Half or Hemisphere of any Planet, which is obverted, or turned towards the Earth, where he stands; if it be confidered what Part of Venus is enlighten'd by the Sun in her different Position or Situation towards him, and what Part is seen by an Eye at the Earth in its Annual Orbit BFCE; (See the preceding Fig.) it will be plain that Venus must appear least to us when she is in R; because, tho' she be then the most near to us possible, yet her obscure Hemisphere being towards us, there will be but very little of her enlighten'd part

then some part of her illuminated Disk will be turned towards the Eye in B; but a much greater part of her obscure or dark Hemisphere. And fince she is of a Spherical Figure, which to a distant Eye appears as a Plane, 'tis clear that the illuminated part of her Disk must appear in the form of Horns, turned from the Sun, or towards the West. And this is her Appearance when Venus is our Morning-Star, as she is commonly called. But this Planet moving on in her Orbit to G, very near one half of her illuminated Disk will become visible to the Eye at B; and, consequently, she will then appear in the form of an When she comes into the Position Half-Moon. O, more than half of her enlighten'd Hemisphere will be visible, and so she will appear Gibbose: And when she arrives at that part of her Orbit which P defigns, to an Eye at B, as before, she will appear, as we say of the Moon, at Full; that is, all her illuminated Disk will be visible. The same kinds of Phases Venus will put on, as she moves forward in her Orbit through Q, H, A; that is, in Q she will be Gibbose; in H like an Half-Moon; in A horned again; but her Horns will be turned a contrary way to what they were in D; that is, now to the Eastward, but still from the Sun: And this is her Appearance when she is the Evening-Star.

The same kinds of Phanomena belong to Mercury; respect being had to his particular Orbit and Period of his Revolution.

But here we must take care that we be not deceived by the general Confideration of her Phases only, so as to think that Venus will always appear brightest and largest in P, or in Q or O. The Appearance which Venus may seem to have in her Opposition, as it may be called in P, will be quite altered by her coming as near as she can to the Sun: And as to the Places O and Q, tho' Venus will shine with near a full Face ; yet she will be then so far from the Earth, that her Difsance from us will more than compensate for the Quantity of her Light: Wherefore you may expect to see her appear most bright and splendid when she is in D or A. For suppose her to move from Q to H; then will some part of her lucid Hemisphere be turned from us in B, and so cannot be seen; and yet the remaining luminous part comes still nearer to the Earth: And fince her Shining, or apparent Light, increases in a Duplicate Ratio, or as the Square of her Distance from us diminishes, her Light will be much more increased by her Approach to the Earth, than it will be lessened by our leeing less of her illuminated Disk. So also suppose her to move from H to A, or yet farther on ; here still the Quantity of her illuminated part decreases, but the duplicate Increase of her Approach to the Earth will yet But between A make her Splendour increase. and R, the Decrease of her visible Light will be greater than what her Access towards the Earth can compensate; and so her Light will continually diminish more and more, fill she will set Heliacally, and so become invisible. Thus also Heliacally, and so become invisible. while the Planet is moving from P towards Q. her Approach towards the Earth in B is inconsiderable, in comparison of the Parts of her illuminated Disk, which will be turned away from us; and, consequently, she will appear more obscurely in Q than she will in P: But between Q and H, and so towards A, her Approach to the Earth will Vol. II.

very much increase her Splendor, tho' less and less of her lucid Disk become still visible. And from the whole it is plain, that while she is moving in the Arch HA; the will appear brightest and largest.

6. The greatest Elongations of Venus, whether towards the East or West, are unequal, and must be express'd by an unequal Number of Degrees. And the same thing is also true of Mercury

This Phenomenon hath a double Original or Cause; for it depends on the Excentricity of the Orbits both of Venus and of the Earth. the Distance LA (in the former Fig.) of Venus from the Sun; or if LB, the Distance of the Earth from the Sun, be unequal; it cannot be, but that the Angle LBA, in the Triangle LBA, which is called the greatest Elongation, must al-so be unequal: And indeed both those Lines are subject to such an Inequality.

7. The same Directions, Stations, and Retrogradations, which we observe in the Course of the Superior Planets, are found to belong to these Inferiors; and with the same Circumstances of

Change.

For suppose the Earth, as before, in B, and immoveable there, and the Planet in P; itis then plain, that while the Planet moves Easterly from P to Q, to an Eye placed in B, it must appear Dires, or to move in Consequentia, as they speak; that is, according to the Order of the Signs: And so it will appear to do till it come to A. But yet, because the Arches P B, B y, I e, e Z, are equal; but the Angles that they subtend at B, are unequal; therefore the Planet will appear to move unequally through those Arches: For it will feem to move swiftest about P, and still slower and slower, the nearer it comes to A: And there it will begin to appear Stationary, or not to move at all: And while it runs over the Arch AR, it will meet with the former Lines $B \zeta$, $B \epsilon$, B J, $B \gamma$, and therefore must appear to be Retrograde, or to move backward, or in Antecedentia, as the Term is; that is, contrary to the Order of the Signs. Which apparent Retrograde Motion will continue till the Planet come to D; and then it will begin to be, or rather appear to be, Stationary again; and so on, as be-

And should you suppose the Earth, as it is, moving in the Orbit BFCE; when the Planet moves faster than the Earth, it will even then appear to be Direct; when at an equal Pace with it, Stationary; and when flower than it, it will appear Retrograde, as before; tho' the Times and Places of these Directions, Stations, and Retrogradations will not be the same, as if the Earth indeed flood still: As will be easily understood by a little Confideration of the Figure above; or by what is said on this Head under the Words Superior Planets in this Vol. II.

8. The Planes of the Orbits of the Inferior Planets being inclined to that of the Ecliptick, the same Phenomena will arise from thence in kind, as in the same Case of the Superiors; only it is worth taking notice of, that the Plane of the Orbit of Mercury making an Angle with that of the Ecliptick of very near 7 Degrees, he hath the greatest Latitude of any of the Planets; and there-Tt 2 fore fore will be subject to the greatest Anomalies of

9. It is sometimes, but rarely, observ'd of these two Inferior Planets, That their Bodies being interposed between us and the Sun, they appear like spots in the Plane of his Disk.

And 'tis plain, that this will happen whenever their Conjunction with the Sun falls on, or near either of the Nodes of their Orbits: Just as the Moon appears to eclipse or hide part of the Sun's Face, when her Conjunction happens in or near the Nodes of her Orbit.

INFINITEL'Y Infinite Fractions. In Phil. Collect. N. 3. Dr. Rihood proves that Infinitely Infinite Fractions, or all the Powers of Fractions, whole Numerator is 1, are all of them together equal to Unity, or to an Unite.

The Demonstration is Short and Universal. And from hence he deduces, by way of Corollary, that there are not only Infinite Progressions, or Progressions in Infinitum; but also, infinitely further than one kind of Infinity. That these Infinitely Infinite Progressions are not withstanding computable and aggregable into one Sum; and that not only into a Finite Sum, but into one so small, as to be less than any assignable Number. That of Infinite Quantities, some are equal, others unequal: That one Infinite Quantity may be equal to two, three, or more Quantities, whether Infinite or Finite.

INFINITE Series. In Vol. I. I have shewn that this Method of Infinite Series took its Rise from the Arithmetick of Infinites, and hath been pursued with wonderful Sagacity and Penetration by several of our Excellent Modern Algebraists. The Use of this Method in the Extraction of Roots I have, in some measure, shewn in the former Volume, from the Ingenious Mr. Ralphson and Mr. Ward: What here follows is more Universal; and is from Parsons's and Wastell's Arithmetick.

-A= to the Absolute Numb. in any Equation. n= to the Exponent of the highest Power. Let x =to Root or Quantity fought. N =any known Number taken at pleasure. n = an unknown Number.

1, p, q, r, s, &c. = to the respective Coefficients of the given Equation.

Then will N + n = x; and $x = x \times x^n = p \times x^{n-1} = q \times x^{n-2} = r \times x^{n-3}$ $x = x \times x^n = x$, represent any Equation whatfoever.

And because N + n is supposed equal to x, such a General Equation may be thus expressed:

$$rac{1}{1} imes \overline{N+n}^n = p imes \overline{N+n}^{n-1} = q imes$$
 the fame Signs, and the others the Dividend, but with contrary Signs, as being to be transpos'd to the other fide of the Equation: Therefore first,

But to bring this into a Series, it is necessary sirst to prove, That every Power raised from a Binomial, (without regarding the Co-efficients) confists, or is composed of two Ranks or Series of Powers; one increasing from ""-", or 1, to ",

and the other decreasing from N" to N"-1 or 1; and each Member in one is multiplied into its corresponding Member in the other respectively; as may appear thus:

$$\overline{N + n^{2}} = \begin{cases}
NN \\
Nn \\
nn
\end{cases} = \begin{cases}
N^{n} \times n^{n-n} & \text{or i.} \\
N^{n-1} \times n^{n-n} & \text{twice} \\
N^{n-n} \times n^{n}
\end{cases}$$

Again,

$$\frac{1}{N+n^{3}} = \begin{cases}
\frac{NNN}{3NNn} & \frac{N^{n} \times n^{n-n}}{N^{n-2} \times n^{n-2}} \\
\frac{N^{n-2} \times n^{n-2}}{N^{n-2} \times n^{n}} & \text{thrice} \\
\frac{N^{n-2} \times n^{n-2}}{N^{n-2} \times n^{n}} & \text{thrice}
\end{cases}$$

And so it will always be ad Infinitum. Q. E. D. Hence these two Corollaries.

That the Co-efficient of the second Term in any Power raised from a Binomial, is always = n the Exponent of the highest Power.

That the Root or Side of n" the unknown Quantity is always multiplied into the second Term of the known.

Now from the latter, it is evident we are (in this Case) but to make use of the two first Members of the Power of such Binomial; and by the first we may express the Co-efficient of the second Term, by n the Exponent of the Power: Therefore the former Equation will now stand thus;

Now to find the Value of n, or the unknown Quantity, it is plain, that those Members into which it is multiplied, will be the Divisor with the same Signs, and the others the Dividend, but

$$n = \frac{A \pm i \times N^{n} \pm p \times N^{n-1} \pm q \times N^{n-2} \pm r \times N^{n-3}, \, \, \mathfrak{S}_{c}.}{i \times_{n} N^{n-1} \pm p \times_{n-1} N^{n-2} \pm q \times_{n-2} N^{n-3} \pm r \times_{n-3} N^{n-4}, \, \, \mathfrak{S}_{c}.}$$

Whic**h**

Which Theorem exhibits all possible particular ones, for extracting of Roots, according to the first fort of Mr. Ralphson's; agreeing exactly with them, as will be found on Tryal; always remembring that the Signs in the Dividend must be

contrary to those in the Equation, and in the Divisor the same respectively.

But N+n=x: Therefore secondly.

$$x = \frac{A \pm 1 \times_{n-1} N^{n} \pm p \times_{n-2} N^{n-1} \pm q \times_{n-3} N^{n-2} \pm r \times_{n-3} N^{n-3}, \&c.}{1 \times_{n} N^{n-1} \pm p \times_{n-1} N^{n-2} \pm q \times_{n-2} N^{n-3} \pm r \times_{n-3} N^{n-4}, \&c.}$$

Which gives us all those of the second fort univerfally: But in this Case the Signs both in the Dividend and Divisor will be the same as in the given Equation respectively: As likewise it may be proper to take notice, that if any Term be wanting in the Equation, the same must be omitted in either Theorem respectively.

duce any particular Theorem, for finding the Root happens (which always will, except where the of any given Equation; we need only confider, last Term is wanting) the Theorem is determined.

that $N^{n-n} = r$, or $\frac{N^n}{r^n} = r$, that Unity will neither multiply nor divide; as also that = 0, or N'' = 0, and any Quantity, Now from either of these rwo Generals, to de- multiply'd into o, is = 0; and when either Case

Therefore,

By the first General Theorem, By the second General Theor. Suppose any Equation, as - N 2 $x^2 = A$ · N* $\|$ find " $x' \pm px = A$

And after the same manner for any Equation whatfoever.

Thus having the particular Theorem, the Ap plication in either Case is as follows:

Let N be any Number taken at Pleasure, as be-

T be = Theorem, in which N must always be of its last Value found.

Then the Process will be of the

First General Theorem.

N the 1st. $\pm T = N$ the 2d. Then N the 2d. $\pm T = N$ the 3d. Then N the 3d. $\pm T = N$ the 4th. Then N the 4th. $\pm T = N$ the 5th, &c.

T = N the 2d. Then T = N the 3d. Then T = N the 4th. Then T = N the 5th, &c.

Second General Theorem.

the true Root fought, if it have one: But if it be a Surd; then the Value of N will proceed into an Infinite Series, but may be profecuted near-er the Truth than any affignable: Which Series, to be added to, or subtracted from the last Value each Operation, will proceed in Number of Places, in a Geometrical Progression; whose first Term is

Some of which Values of N will terminate in 11, and Ratio = 2, Viz. First 2, then 2, then 4,

then 8, then 16, then 32, &c. Places.
It is likewise observable, That the first Geneof N, (as it shall be affected with - or -) until N be = x fought. So the last converges by N itfelf, whose Value, at each Operation, shall grow nearer and nearer, until it be == to x fought.

We may also take notice, that though N be assumed never so far from the true Root, yet it will converge to it by renewing the Operation. But the Work may be much shortned, in case we point the given Equation (if it will admit of it) both in the absolute Number and Coefficients, according to their respective Degrees of Adsection: And take first 1, then 2, then 4, &c. of those Points, (from the first) each Operation: For it is evident, the Coefficients increase in their Powers, as the highest unknown Term decreases; therefore the absolute Number is of the same Power with the highest unknown Quantity.

One Instance may be sufficient to explain it: Suppose therefore this Cubic Equation were to be pointed;

Viz.
$$xxx + 25xx + 836x = 53297$$

Or $xxx + pxx + qx = A$.

Then it would be xxx + 25xx + 836x = 53297For the absolute Numb. is a Cube and are pointed Co efficients q a Square p a Lateral accordingly.

And the like Method for any other Equation, where it will admit of it.

Now to apply this last, we are to take the First Operation xxx + 2xx + 8x = 53Second Operation xxx + 25xx + 836x = 53297

And consequently the Value of the Coefficients as well as the absolute Number alters, so long as there are Punctations.

But by a few Numerical Operations, the said Notification, as well as the Method of the Process of each Theorem, will be further illustrated: Therefore,

1. Suppose xx = 2 = A. Seek x by the first General Theorem.

Then
$$n = \frac{A - A^2}{2N} = T$$
, and take $N = 1$;

Therefore I + T (=,5) = 1,5 = N the 2d. :: 1,5 - T (=-,083) = 1,417 = N the 3d. :: 1,417 - T (=-,002783) = 1,414217 = N the 4th.

: 1,414217 - T (= -, 000003437622) = 1,414213562378 = N the 5th = x.

2. Suppose xx = 2 = A. Seek x by the second General Theorem.

Then $x = \frac{A + N^2}{2N} = T$, and take N = 1, as be-

Therefore T = 1,5 = N the 2d. : T = 1,416 = N the 3d.

: T = 1,414215 = N the 4th. : T = 1,414213562373 = N the 5th.

By which it is evident; First, That both Theorems amount to the same thing; the Difference being only in the last Figure, which would be corrected the next Operation. Secondly, That x will proceed into an infinite Series, if a Surd. Thirdly, That each Operation gives double the Number of Figures of the last.

3. Suppose $x \times x = 2839,8241 = 1$. Seek x by Theorem 1.

Then
$$n = \frac{A - N^4}{3 N^3} = T$$
, and take $N = 10$.

Therefore 10 -T(=-3)=7=N the 2d. $\therefore 7+T(=+4)=7,4=N$ the 3d. $\therefore 7-T(=-1)=7,3=x$, the true Biquidratick Root fought.

4. Suppose xxxx = 2839,824t = 1, as before. Seek x by the second Theorem.

Then
$$x = \frac{A+3N^4}{4N^4} = T$$
, and take $N = 5$.

Therefore T = 5,6 = N the 2d. : T = 8,2 = N the 3d. : T = 7,4 = N the 4th.

: T = 7,3 = N the 5th = x = true Root

From which two last Examples it appears; First, That either Theorem will find the true Root, if it have one. Secondly, That it matters not, whether N be taken above or below the Root, nor how far from it.

5. Suppose
$$xx + 587x = 987459$$
 or $xx + px = A$. Seek x by Theor. 1. (i. e.) $n = \frac{A - N^2 - pN}{2N + p}$
= T.

Because of the Punctations we are to take,

1. Operation
$$xx + 5x = 98$$

2. $xx + 58x = 9874$
3. $xx + 587x = 987459$ And suppose $N = 8$.

Therefore 8 - T (= -, 2) = 78 = N the 2d. $\therefore 78 - T (= -3,4) = 746 = N$ the 3d. $\therefore 746 - T (= -3,34) = 742,66 = N$ the

 $T_{742,66} - T (=-,012689) = 742,647311 = x \text{ fought.}$

6. Suppose xx - 20x = 53482, or xx - px = A. Seek x by the second General Theorem.

Then
$$x = \frac{A+N^2}{2N-p} = T$$
, and take $N = 250$.

Therefore T = 241 = N the 2d.

.: T = 241,4 = N the 3d. .: T = 241,475 = N the 4th. .: T = 241,477860 = N the 5th. = xfought.

From these two last it is plain; First, That there is no absolute Necessity for Punctation. Secondly, That Punctation does nevertheles soorten the Work, where it can be done.

But

But I hope I have said enough to make the whole Matter, as well as the Manner, of Proceeding plain and easy to the meanest Capacity: And tho' I have given Numerical Examples no farther than an affested Quadratic, yet 'tis the same to any Degree of Power or Affection whatsoever; regard being had to its proper and particular Theorem.deduc'd from either of the general ones.

Theorem, deduc'd from either of the general ones. INFINITESIMALS, (18 some Writers call them) are such Quantities as are supposed to be infinitely small.

INFLECTION.

INFLEXION of the Rays of Light. Sir Isaac Newton, in his Excellent Opticks, Book 3. makes these Experiments and Observations on this surprizing Phanomenon.

- 1. That in a well darken'd Room, a Hole, whose Diameter was 25 of an Inch, being made with a Pin in a Plate of Lead, to let in the Sun's Rays; he found that the Shadows of Hairs, Threads, Pins, Straws, &c. placed in that Beam of Light, were very considerably broader than they ought to be, if the Rays of Light bad passed on by those Bodies in Right Lines: And for Instance, that the Hair of a Man's Head, whose Breadth was about the 280th part of an Inch, did, at the distance of 12 Foot from the Hole, and 4 Inches from the Hair, cast a Shadow which was a 60th part of an Inch broad, or four times its own Breadth; at 2 Foot from the Hair, the Shadow was ten times as broad as the Hair; and at the distance of 10 Foot, it was 35 times as broad. And he found, that it was not material, whether the Hair was encompassed with Air, or with any other pellucid Substance: For if the Hair were placed between polished Glasses, with Water between them, the Shadows were all one; as were also the Shadows of Scratches made on the Surface of polished Plates of Glass, and of the Veins of such Glasses: And therefore the great Breadth of these Shadows must arise from some other Cause than the Refraction of the Air. It is plain also from this Experiment, that the Rays are bent, and turned aside, in passing by the Hair, &c. and that the Hair acts on the Rays of Light at a good distance as they pass by it. And he shews, that the Action is strongest on the Rays which pass by at the least Distances, and grows weaker as the Rays are further from it.
- 2. He observed that the Shadows of all Bodies in this Light were border'd with 3 parallel Fringes of colour'd Light; whereof that next the Shadow was luminous. It was difficult to distinguish the Colours, unless the Light pass'd very obliquely on a white Paper, and then they exhibited Colours in this Order from the Shadows, wz. Violet, Indico, Pale-blue; Green, Yellow, Red; Blue, Yellow, Red; Pale-blue, Pale-yellow, Pale-red.

3. He took accurately the Measures of these Fringes, which he there gives in a Table.

And in the 4th Observation he shews, That the Breadth of the Fringes (when cast obliquely on a smooth white Body) seem'd to be in the Progression of the Numbers, $1 \checkmark 1$, $4 \end{cases}$; and their Intervals in the same Proportion with them; i. c. the Fringes and their Intervals together to be in the continued Progression of $1 - \sqrt{\frac{1}{2}}$, $\sqrt{\frac{1}{2}}$, or thereabouts.

- 5. The Sun shining into a darkened Room thro' a Hole tof an Inch broad, at 2 or 3 Foot from it, he placed a Sheet of Pastboard, black'd well all over; and which had in the middle a Hole about tof an Inch square for the Light to pass through. Behind the Hole, on the Pastboard, he sastened with Pitch the Blade of a sharp Knife, to intercept some part of the Light which passed through the Hole. Both Pastboard and Knife were placed perpendicular to the Rays of Light. Then placing the Pastboard so that all the Light fell upon the Hole in it, and part of it on the Blade of the Knife there placed, while the other Part went by the Edge; he let that part which passed by, fall on a white Paper, 2 or 3 Foot beyond the Knife; and there saw 2 Streams of faint Light shoot out both ways from the Beam of Light into the Shadows, like the Tails of Comets. Their whole Length, measured upon the Paper at the distance of 3 Foot from the Knife, was about 6 or 8 Inches; so that they subtended an Angle at the Edge of a Knife of about 12 Degrees.
- their Edges were parallel and look'd towards one another; so that a Beam of Light might fall on both, and some of it pass through between them. And when the Distance between their Edges was about the 400th part of an Inch in breadth, the Stream of Light that passed through parted in the Middle, and left a Shadow between the two Parts: And this Shadow was so black and dark, that all the Light which passed between the Knives, seem'd to be bent and turned aside to the one hand or the other. As the Knives approach'd, the Shadow between the Streams of Light grew still broader; till at last, on their Contact, the whole Light vanished. Hence I gather (saith he) that the Light which is lest bent, and goes to the inner Ends of the Streams, passes by the Edges of the Knives at the greatest distance: And this Distance, when the Shadow begins to appear between the Streams, is about the 800th part of an Inch: And the Light, which passes by the Edges at less Distances, is more bent, and goes to those Streams which are further from the direct Light.
- 7. The Fringes above thentioned also appear'd in this Experiment. And he gathers from this and the former Observation, that the Light of the first Fringe passed by the Edge of its Knise at a Distance greater than the 800th part of an Inch; and the Light of the two or three Fringes at still greater Distances; and consequently, that the Rays, which caused the Areams of Light, passed nearer to the Knives Edges than any other.
- 8. Two Knives, whose Edges were ground truly strait, were placed so (by sticking their Points into a Board, with their Edges towards one another) as to make an Angle of above 1°. 54. Here thro'a Hole, the 42d part of an Inch wide, the Beam of Light was let into the dark Room 3 which made the Fringe appear, at the distance of 10 or 15 Foot from the Hole, and on a Ruler held obliquely, at the distance of half an Inch from the Knives, parallel to the Edges of the Shadows, and without growing sensibly broader till they met in Angles equal so that made by the Edges

Edges of the Knives, where they met and join'd without croffing. But when the Ruler was plac'd at a much greater distance, the Fringes grew broader as they approached, and after meeting cross'd one another, and then grew yet much broader.

9. From hence he concludes, That the Distances at which the Fringes pass by the Knives are not increased nor altered by the Approach of the Knives; but that the Angles, in which the Rays are there bent, are much increased by that Approach: And also, that the Edge of the Knife, which is nearest any Ray, determines which way the Ray. shall be bent, and the other Knife increases the Flexure. In observing,

10. He found, that when the Fringes of the Shadows of the Knives fell perpendicularly on a Paper at a great distance from the Knives, they were in the form of Hyperbola's.

11. When he placed a Prism at the Hole (made with a small Pin) to refract the Light, he found that the Shadows of all Bodies held in the colour'd Light between the Prism and the Wall were bordered with Fringes of the Colour of that Light only in which they were held: And also, that the Fringes in the Red Light were largest, and those in the Violet, least. Wherefore, the Rays, which made these Fringes in the Red Light, pass'd by the Hair at a greater distance, than those which made the like Fringes in the Violet : And consequently the Hair, in causing these Fringes, alls alke on the Red Light, or least refrangible Rays, at a greater distance; and on the Violet, or most refrangible Rays, at a less distance; and by those Assistance disposed the Red Light into larger, and the Violet into smaller, and the Lights of intermediate Colours into Fringes of intermediate Rinnesses, anithant changing the Colour of any forth Bignesses, without changing the Colour of any sort of Light. When therefore the Hair, in the first of Light. and second Observation, being held in the common white Light of the Sun, cast a Shadow border'd with three Fringes of colour'd Light; those Colours ('tis plain) did not arise from any new Modifications impress'd on the Rays of Light by the Hair, but only from the various Inflections whereby the several sorts of Rays were separated from one another; which before Separation, by the Mixture of their Colours, compoled the White Bean of the Sun's Light; but, whenever separated, compose Lights of the several Colours which they are originally disposed to exhibit. And this mightily confirms his Doctrine and Theory of Colours, as indeed all kinds of Experiments and Confiderations do. See Colours.

These wonderful Properties of the Infiction of the Rays of Light are caused by a Body acting at a distance on the Rays; and yet this Action of Infiction is the stronger, the less such distance is: So that perhaps the Attraction which causes it don't exert its Sphere of Activity beyond such a distance. The Rays of Light also themselves, as they differ in Refrangibility, are diversly inficted, and separated into those three Fringes of Colours mention'd by Sir Is. Newton in his excellent Opnicks, Lib. 3. and before observed by Grimalius to arise from any small Bodies, such as Hairs, Wires, &c. placed in the Sun's Rays, let into a well darkned Room, by a very small Hole,

made only by the Point of a Needle in a Plate of Metal. And these Fimbrie, or colour'd Fringes, seem to be made by a kind of undulatory Motion or Inflection of the Rays, as they come near the Extremities of Bodies, the three different Colours of the Fringes arising from three such different Inflections.

INGENUITAS Regni, was formerly used to fignify the Freeholders, or Commonalty of the Kingdom, which were called Ingenui, Liberi, and Legales Homines: But the Word was not restrained only to Plebeians; fince in the Reign of Hen. I. it was given to the Chief Barons.

INGENUOUS, in the Civil Law Sense, is one that was born of a Woman that was made Free any time after his Conception, and before his Birth.

IN Groffe, is a Term in Law for what belongs to the Person of any Lord, and not to the Manor, Lands, Sec. as a Villain in Groffe, an Advow-som in Groffe. &c.

fon in Grosse, &cc.

INHOC, the same antiently with what is now in the North called an Intock; and in Oxfordsbire, a Hitchin, or Hitching; being an Out-part or Corner of some common Field plow'd up and sow'd (usually with Oats or Tares) and sometimes senced off with a dry Foot Hedge, and within that Year in which the rest of the Field lies fallow. It seems to be derived from in, within, and Hoke, a Corner.

INLAND, is an old Word found in Doems day and other old Books, and fignified that Part of any Land or Manor which lay next to the Mansion-House, and which was used by the Lord himself; whence it was called Terra Dominicalis, Demes in opposition to Utland or Outland, which was in Tenancy. These Inlands the Feudists call Terras Curtas, ac intra Curtem, Court Lands, or such as were appropriated to the Court or House of the Lord. So

INLANTAL, Inland or Demeine, was oppofed to Delantal, or Out-land, or Land-Tenanted.

fed to Delantal, or Out-land, or Land-Tenanted.

INMATES, are such Persons as are admitted (for their Money) to live in the same House with, and which go in at the same Door, jointly with others to whom the House belongeth; and which are not able also to maintain themselves. These are inquirable in a Court-Leet. See Kischin, Fol. 45.

Fol. 45.
INNATE IDEAS. Taking the Word Idea in the largest and most extensive Sense (see Ideas in Vol. II.) for whatsoever is the Object of our Understanding when we think; whether it be Phantasm, Notion, Species, &c. or whatever it is, the Mind can be employ'd about in Thinking.

ing.

The excellent Mr. Locke, in his most useful Essay on Human Understanding, hath plainly proved there are not any such things as Innate Ideas or Principles: Tho' some Writers will needs have such primary Notions, as have been called notal eviral, to be as it were Characters stampt on the Mind of Man, which the Soul receives in its very first Being, and brings into the World with it.

That which hath led Men into this Mistake, feems to have been, First, a Notion of the mighty Advantage of such Innate Ideas for the due Direction and Regulation of the Human Mind; and therefore 'tis reasonable to suppose our Gra-

cious Creator Thould have furnished the Nascent Mind with them: And, fecondly, that there are many Truths to which we pay so early and speedy an Assent, that they seem to be Innate, and interwoven as it were in our very Natures, and Hampt and impress'd originally on our Minds.

To the former 'tis easy to answer; That, if the fame Advantages will accrue to the Human Mind, from having a Power given it by God, by Study and Thought easily to gain such Notion or Principles; there is then no need of suppofing them Innate: And if this Power can and doth exert it self early and easily, and enables us to affent to the Truth of such neight Notions and Principles, as soon as ever the Terms expresfing them are understood, 'tis much more easy and natural to suppose the Power of obtaining them innate, than the Propositions and Notions themselves. Our Author might have thought it enough to Resute this Doctrine; by shewing (as he admirably and clearly doth) how we may attain to all the Knowledge we have, barely by the use of our natural Faculties, and without the help of any imnate Impressions: For it seems as unreasonable to attribute Truths to be owing to the Impressions of Nature and innate Characters, which we find we can gain by the Exercise of our Faculties; as to suppose those Colours to be muste in our Eyes; which on opening our Eyelids will be painted there from external Objects, by the Operation and Action of Light.

But because some prejudicate Notions have

long prevail'd per contra, and which one can hardly oppose without Censure, he gives us the Reasons at large, that made him doubt of the Truth of that received Opinion; which are in

fhort fuch as thefe.

That should they argue that there are certain Principles both speculative and prastical, which are universally agreed on by all Mankind: This doth not prove them innate, were it true in Fact, if another way can be assign'd how Men may come to such an universal Agreement in the

things they confent to.

But indeed there are none such, to which all Mankind give an universal Consent. If you take the Speculative Principles into view; such as, What soever is, is: "Tis impossible any thing should be and not be at the same time, &c. Though these have a settled Reputation as Musical and deserhave a settled Reputation as Maxims; and deservedly; yet are they so far from having an universal Affent from Mankind, that a great Part of it doth not so much as know them: As all Children and Idiots, and indeed every one that is not used to internal Reflexion, and abstratted Reasonings. But these have Souls; and these Souls have these Impressions, it seems, stampt upon them; only the Stamp cannot be seen; the Impression is there, but 'tis invisible; the Notion is there, but they don't know it; the Proposition is there, but the Mind is ignorant of its Truth! 'Tis plain therefore, 'is there to no purpose! Wherefore, he that hath a right Notion of the Wildom of GOD, will conclude it is not there at all.

If it be said, These innate Principles lie dormant and invisible there, till the Soul comes to the use of Reason; 'tis plain they were there before to no purpose: And if it be fully made appear, that the Exercise of our Reasoning Faculty will help us to them another way; 'tis highly probable they are

never so impressed, and innate, at all.

Vol. II.

And if our reasoning Faculties, assenting to the Truth of these Principles, as soon as we understand the Words they are express'd in; be an Argument that they are innate; it will prove too much: For it will conclude all other Propositions to be so too; which we consent to as soon as we understand the Terms: Such as two and two make four, &c. A Square is not a Circle; Redness is not Sweetness, &c. and ten thousand such others; to whole Truth the Mind, at first proposing, affects.

whole Truth the Mind, at first proposing, assents. Besides, no Proposition can be innate, unless their Terms are innate; or those Ideas which those Terms express. And as no one ever said that Words and Terms are innate; so in the whole Course of his Book Mr. Lock shews, how and after what manner both Simple, Compounded, and Abstract Ideas come into the Mind: And he shews, that the Notion of Principles being innate, came probably from hence: That there being abundance of plain and obvious Truths, to which the Mind pays a ready Allent as foon as the Terms that express them are understood, it was a much easier and shorter way for Men to suppose them innate there, than to trouble themselves about the Way and Manner of their coming into the Mind from without, by Observation and Expe-

INORDINATE Proportion, is where the Or-

der of the Terms are disturbed.

INSCRIBED Bodies: On Gunter's Sellor, are sometimes placed two Lines answering one another, and called the Lines of Inscribed Bodies, and are easily known there by the Letters D, S, I, C, O, T, which fignify the Dodecabedron, Sphere; Icossibedron, Cube, Ostabedron, and Tetrabedron.

The Uses of these Lines may be these.

- 1. The Radius of a Sphere being given, to find the Sides of the Five Regular Bodies inscribed
- 2. The Side of any of the Five Regular Bodies given, to find the Radius of the Circumfcribing Sphere.

If the Sphere be first given, apply its Radius over in the Points S, S, on each Leg of the Sector.

If any of the other Bodies be first given, apply its Side over between its proper Letters; so the Parallel taken between the Points of the other Bodies, shall be the Sides of those Bodies, and may be inscribed in the Sphere, whose Radius is the Distance between S and S.

INSCRIBED Hyperbola, is such an one as lies entirely within the Angle of its Assymptotes; as

the Conical Hyperbola doth.
INSECTIVOROUS Animals, are such as feed

on Insects: See Birds.

INSECTS, a kind of living Creatures so called by Aristosle and Pliny; because of their having certain Incisure, Cuttings or Indentings, in and about their Bodies. The Greeks called them Ersona. The Judicious, Mr. Ray-in his Methodus Insectorum thus distinguishes the several Kinds of

Insetts are (1.) either 'Auslaubeowla, or such as do not change their Form; Or, (2.) Merapospiinera; such as do really change their Form.

Thole

Those that do not change their Form are either (1.) "Arosa without Feet, or (2.) Pedata with Feet; and of these there are some Kinds that call their Skins.

Insies without Feet are either Terrestrial, or Land Infests, or Aquatick.

Terrestrial Insetts are either such as are produced on the Land, or in the Earth; and not in the Water; as the Lumbrici Terriftres; which are either of the larger fort, and are called Dew-Worms; or of a smaller fize: And of these there are Red and Green, with Yellow Tails: Which last are

commonly called Gilt-Tails.

Or such as are found in the Bowels of Animals: And of these some are found in the Intestines of Men; as (1.) the Lumbrici Teretes; (2.) Lumbrici Lati, which are called also Tania. (3.) Cueurbitini, which some will have to be only the Fragments of the Tania: (See Nich. Andri M. D. De Variis Vermium Speciebus.) (4.) The Ascarides, which are chiefly found in the Rettum.

Those Worms that are found in the Intestines of Beasts are of two sorts, the Oblongi and Pellu-eidi, of the thickness of a Horse-Hair; and therefore called Vermiculi Seriformes: And the Breves and Crassiores, which often are found in Horses, and are called the Bosss.

To this Genus of Terrestrial Insetts many Natural Historians refer Snails, whether with or without Shells.

Water Infests without Feet, not changing Form, are either of the

Greater fort, which have a peculiar way of moving, by first fixing their Head to the Ground, and then drawing up their Tail towards it, &c. Of these some are Teretes, round and smooth; of which are three forts; As the Medicinal Hirudines, or Leaches; the common Black-Horse-Leaches, and the Asp colour'd Sea-Leaches: But there is also a sort of this kind that is smaller and flatter, which is found sticking to Stones in the Bottoms of little Brooks.

Lesser sort, which have a different way of crawling or moving from the former. These also are either Round or Flat: Of the Round sort there is one that is Black, with two small Horns on its Head; and is found sticking to wet Stones in the watery Tops of Hills: And another, which is Red, of about a Fingers's length, with a Forceps at the Tail, found at the Bottom of Fish-Ponds and stagnant Waters.

The Flat fort are very small and thin, and are called Flukes; being sometimes found in Waters, and sometimes in the Branches of the Porus

Bilarius in Sheep.

Insects not changing Form, and having Feet, are either (1.) Hexapoda, with fix Feet; (2.) Octapoda, with eight Feet; (3.) with fourteen Feet; (4.) Polypoda, with many Feet.

Those that have but fix Feet are either,

1. Terrestrial; and these of a Larger kind; As (1.) The Yellowish Infect found in rotten decaying Oaks; (2.) The Black one on the Ground, called by Mouffet, Vermivorous; (3.) The Black one li- | Colour, found in Houses.

ving under Ground, with a Forceps at the Tail; (4.) A White fort, with square black Spots on its Back; (5.) The Farinarum, bred in Meal, of a whitish Colour.

Smaller fort: Some of which are found about the Bodies of Animals; As (1.) the Gmex, or Wall-Louse, of a stinking Smell; (2.) Rianus, the Tick; (3.) Pediculus, the Common Louse; (4.) Pediculus ferus seu Inguinalis, the Crab Louse; (5.) Pulex the Flea; of all which there are various kinds.

Others are not troublesome to Animals; 24 (1.) One that in Bignels and Figure resembles a Louse, but is very nimble and swift, and is found in Books and rotten Wood; (2.) Another there is with a very long Body, and a forcipitated Tail; (3.) The Black Infect, found often in the Flowers of the Chelidonium; (4.) A Subterra-neous fort, a little whitish; (5.) One that skips

like a Grashopper, but is much less.

2. Aquatick. As (1.) the Pediculus Marinus Grands, which adheres to Fishes; (2.) The Squilla Fluviatilis, with a Pyramidal Tail, and two Hairs, or Bristles at the End.

Insects not changing Form, and having eight Feet, are either with a Tail, as the Scorpion; or without, as the Spider; of which some spin no Web, have but two Eyes, and very long Legs, as the

Opilio, or the Shepherd.

Some do spin a Web; and of these they count three sorts: (1.) The Aranea Colcestrensis Abdomine tumido, subrotundo & elato; (2.) The Spider with the Thorax, or middle Part of its Body, as big as the Abdomen; (3.) The Spider with the long Abdomen, found among Reeds, Rushes,

2. The Ricini Octopodes, which are some more flat and compress'd; as the rambling Ticks that run o'er the Bodies of Animals, but don't fasten; and some more round and thick, which do ad-

here to the Skin. 3. The Syrones or Mites.

Insects not changing Form, and with fourteen Feet, and therefore by Mr. Ray called Teggapeguases narosia, are the Afelli: Of which there are three forts: As,

I. The Sea-Afellus; the longest and largest of all; living amongst the Rocks.

2. Asellus Lividus; which rolls itself up into a Ball. The Common Wood-Lice, Sows or Chess

Buggs.

Asellus Asininus, with a forked Tail, not rolling itself up. To this Species may be added the Afellus Marinus Figure breviorn, rolling itself up; (2.) Asellus Aquarum dulcium, with long Legs, and two Briftles on its Tail; (3.) Pulex Aquaticus, both in Fresh and Salt Water; (4.) Pediculus Aquaticus, which fastens upon Fish.

Insects not changing Form, with twenty-four Feet. These have the eight Fore-Feet lesser, and the sixteen Hinder ones larger. There are two kinds of them observ'd, both with long Bodies, one larger, and of an obscure Colour, among Rocks by the Sea-fides; the other of a Silver

There

There is a Kind with thirty Feet, of an oblong Shape, Chesnut Colour, and full flattish Body, usually lying under Logs and Trunks of Trees. 'Tis very agile and swift.

Insects not changing Form, with many Feet (called aroxivered) are some on Land; and either roundish in Body, with all their Legs rising out of the middle of the Belly (nearly) as the Julus; or more flat and compress'd, with their Legs not rifing as before from a Point in the middle of their Body, but growing along on the Sides; as the Scolopendra. And some of this Kind are

Aquatick; of which Mr. Ray makes three Differences: (1.) the Corniso Luggs, used for Baits in catching Fish, with 38 Legs, and a smooth roundish Body; (2.) The Scolopendra Marina, Corpore plano; (3.) Animalculum Bicorpor, or rather Bicaudatum, lying in the Clefts of Stones under the Salt Water.

Infects which do really undergo a Change of their Form are called Melapogospera; of which Swammerdam hath given the best Account: Tho' he shews that this Word is improperly used, fince there is by no means any real Transformation, but only an Explication of the Parts of the Animal, latent before in Miniature (as it were in the Ovum or Nympha, like the Plant in the Seed) and an Encrease of all the Parts by proper Degrees.

The first Species of Transmutation or Change (which Swammerdam makes the second) is Instantaneous; there being no sensible Rest or Stop between the Old and the New Form: And the Infects of this Order don't lose their Motion at the Time that they shift the Pellicula, at least not to Appearance. And Swammerdam describes the second Order of Change to be, when the Vermiculus (leaving the former Shape of the Nympha, with which it appeared in the Egg, and sub-fifted without Food) now beginning to feed, hath its Members or Parts visibly increased, and stretched out, and takes the Form of a new Nympha, which is not without Motion; and from thence becomes a Flying Insect. Of this fort are,

1. The Libella, or Perla, which are produced from an Insect of fix Feet, (vid. Mouffet, p. 322.) who takes it for the Pulex Marinus, as in the preceding Page he calls it the Locusta Aquatica. Out of the Crustaceous Skin, or Husk, of this Insect, the Libella breaks by a Fiffure, which begins between the Eyes, and is continued to the Roots of the Wings, and is there join'd to the Lateral

Fiffures.

2. The Cimices Silvestres, whose Characteristick Marks (according to Willoughby) are (1.) A long Proboscis, not spiral, but strait; (2.) Their uper Wings to the middle are thick, and like Leather; thence to the Ends thin and membranous; (3.) There is the Figure of St. Andrew's Cross on their Backs.

3. The Locusta; which Willdughby refers to the Insecta Αμεθαμόρφωτα.

4. The Grylli Campestres.
5. The Grylli Domestici, or Crickets.
6. The Gryllo Talpa, Mole Cricket.

The Cicada, or Grashopper.

8. The Blatta, according to Swammerdam.
9. The Tipule Aquatice, which run very swiftly on the Surface of the Water, and have a Vol. II.

Sting in their Mouths like the Cimices or Ticks. 10. The Scorpius Aquaticus, with a Sting also in its Mouth.

11. The Musca Aquatica; called by Androvan-

dus, Apes Amphibia. 12. The Hemerobius, or Ephemera, or Diaria, of Swammerdam.

13. The Forficula, or Auricularia. fet, p. 175.

The Second Species of Transmutation includes fuch Infells as undergo a double Metamorphofis, or Change of Shape.

I. Into a Chrysalis, or something analogous to

.. Into a Flying Infest.

These Kinds of Insects, a while before their Change, lie quite still without Food or changing Place; and in respect of their Wings are

1. Κωλεύπτερα, or Vaginipennia, as the Scarabai,

Beetles.
2. 'Aγίλυτες; whose Wings are open and expanded: And the Wings of these are either Farinaceous, as the Papiliones, &t. or Membranous, as the Apes, Musica, &c. and these are either Δίπτερα, with two Wings, or Τετράπτερα, with

four Wings.

The Scarabei may be divided (1.) In respect of their Horns, into the Nasicornis, Bucerota and Cervus Volans, or Taurus. (2.) In respect of their Antenna, they are of many kinds; of which the most eminent are those called Capricorni.
(3.) With regard to their Motion, as the Saltatrices. (4.) With regard to their Colour, as Cantharides.

To the Beetle Kind may be referred the

Cicindela, or Glow-Worm: The Staphylinus, called by Willoughby husineheomte-

Proscarabaus, or Oyl-Eeetle; so called from its emitting from its Joints a kind of Oyl, on its be-

ing pressed or squeezed.

The Anelytra, with farinaceous or mealy Wings, are called Papiliones, Butter flies; and these are either Diurnal, or Nosturnal, or the Pha-

The Specifick Distinction of the Diurnal is, that they always fettle with their Wings erect; are produced from an angulous Aurelia, and have their Antenna Studded (Clavata.) Of these there are about 50 kinds observed in England.

The Nosturnal Butterflies, or the Phalana, are vastly numerous; and cannot very clearly be methodized. But for Memory and Distinction's

fake they may be divided into,

1. The Geometrigense, which come from the Eruca, (called Geometra, from the manner of its Walk, which is Ansatini, by curling up its Back like the Handle of a Cup, &c.) with 8 or 10 Feet.

2. Such as come from Eruca, with 14 Feet. Of this Kind, which is very numerous, there hath been distinguished the Phalana Fasciata; whose Wings are in Patches or Area's of different Co-lours. Phalana Lineata, whose Wings are mar-Phalena Punctata; ked with transverse Lines. whose Wings are mark'd with one or more Points. And these excepted, all the others are distinguished into greater and lesser, and of a mid-dle size between both. One of the larger Kinds may be distinguish'd also by their inner Wings running out beyond the upper, when they fit or U u z

rest: And another by the Appearance of the Figure of Eyes upon the Wings: And a third, by their long Tails and narrow sharp Wings; which by some are called Phalene Predatrices, or Acceptatine.

The Anelytra, with membranous Wings, are Bees, Flies, Wasps, Bombylii, Crabrones, &c. And to this Kind the Culex Vulgaris (vid, Swammerdam, p. 95. Hist. Insects) or Gnat is referr'd; as also

the Formica, or Ant.

And hither must be referr'd such Water Insects as are cover'd by a Theca; according to the Observations of Willoughby. And these have either

1. An immoveable Theca, or Case, which is fixed to the Stones; and this Case is either of a round Figure, or of one more compressed and flat.

2. A moveable portable Theca; and these are commonly called Phryganea.

And this Theca is either,

1. Strait; and that either composed of Straws and little Festuca, lying parallel one to another; of which there are two kinds; a Greater, where the Festuca are two Inches long; and a Lesser, which is very common, and are called Straw-Worms: Or else the Festuca lie transversely, and are shorter; having sometimes pieces of Shells and Stones intermix'd with them. Others, whose Cases are strait also, have no Festuca; but always either Sand or Gravel. And of these, some have the Theca round, and are called Cod-Baits: Others are stat and compressed.

2. Crooked or Herned; which run tapering. Of these Mr. Ray reckons sour kinds; a greater and lesser Black fort, and a greater and lesser Ash-

colour'd one.

These all produce Flies with large Wings, like Butter-flies.

The Third Species of Transmutation is a fimple Change from a Vermiculus to a flying Insect; but yet with a sensible destine, Rest or Stop, between one Form and the other.

This Change Swammerdam thus describes:

"The Vermicle, excluded from the Egg, gets
Nourishment, by little and little, from without; and under that first Skin or Covering hath
its Members increased by degrees; not slipping
it, or putting it off, as other Vermiculi do when
they change into Numphe, but assuming the
Figure of a Numpha in it; For a time 'tis quite
motionless, till the superfluous Moisture is evaporated, and then in a few Days recovers its
Motion again; and then casting off this Skin,
which is as it were double, it becomes a Fie."

Of this Kind are our Flesh-Flies; and all the Nympha Vermifurmes; the Vespa Ichneumones, &c.

As to the Generation of Insects, Dr. George Gorden, in Philos. Transact. No. 237. from the Observations he had made about the true Origin of Caterpillars, concludes very well; (1.) That we ought not to believe that any Insects are bred of Corruption, and not ex Que, only because we cannot discorn the particular Manner of their Propagation; because there are and may be more full Discoveries made of that Kind accidentally, where the Process is not visible to the naked Eye. (2.) The Female Insects of all Kinds of Flies and Butter-slies do put their Spawn near

those Places where the Eruca's, which are hatched out of them, are to have their Food. '(3.) There is a kind of Gluten, by which the Female fastens her Eggs to the bearing Buds of Trees, &c. so that the Rains cannot wash them off. (4.) These Eggs will not be hurt by the greatest Frost.

Mr. Andry, in his Book De la Generation de Vers dans le Corps de l'Homme, Paris 8vo. 1700. takes notice, that the Ancients were mistaken in denying that Infests did breath, on the Account of their wanting Lungs: For modern Observations do convince us, that Insects have a greater Number of Lungs than other Animals. The Ancients thought also that Infests had no Blood, because many of them had no red Liquor like our Blood: But 'tis not the Colour, but the Use of the Liquor that is to be regarded. They of the Liquor that is to be regarded. believed also that Insets had no Hearts; whereas our Microscopes do now discover, that when Infects have several Lungs, they have also several Hearts; and in particular 'tis found that Silk-Worms have a continued Chain of Hearts, from the Head almost to the very Extremity of the Tail. And 'tis this Number of Hearts and Lungs that occasion those Insects to give Signs of Life a long while after they are divided into several He observes also that 'tis wrong to call Parts. Insects imperfect Animals, since they want no Parts either necessary or convenient for their use, and to render them compleat in their Kind.

Mr. Poupart affirms that the Earth-Worms and Round-tail'd Worms, which are found in the Intestines of Men and Horses, &c. also Snails and Horse-Leaches, are Hermophradites; but that such Worms as become Flies, and Silk-Worms, are not so, being of no Sex, but are Nests sull of real Animals, which we see in time come out with Wings. Histoire de l'Acadam. Royale des Sciences Anneé 1699.

Writers about Insects.

Historia Generalis Insectorum, Pars prima. By 3. Swammerdam. Ultraject. 1669. 410.

Job. Goedartius de Insectis cum Appendice. By Dr. Lister. 1682. 4to.

Malpigbius de Bombyce.

Experienze intorno alla Generatione de gl' Insetti. By Fr. Redi. 1668. 4to.

Monfett Theatr. Insectorum Lond. 1634. cum

Fig.

Mart. Lister Historiæ Animalium Angliæ Tres. Tractatus: Unus de Uraneis; Alter de Cochleis, tum Terrestribus tum Fluviatilibus; Tertius de Coehleis Marinis. Lond. 1678. Ejusdem Exercitatio Anartomica de Cochleis & Limacibus. Lond. 1694. 8vo.

INSINUATION of a Will, in the Civil, Law, fignifies the first Production of it, or the leaving it Penes Registrum, in order to his Pro-

INSTALLMENT, is a Settlement or fure Placing of any Person in his proper Place: See 20 Car. 2. Car. 2. Tis sometimes consounded in the Law with Abatement: The Word is chiefly used for the Induction of a Dean, Prehendary, or other Ecclesiastical Dignitary, into the Possession of his Stall, or Proper Seat, in the Cathedral Church

Church to which he belongs. 'Tis sometimes called Installation.

INSTAURUM, is used in old Deeds for a Stock of Cattle; and was commonly taken for the whole Stock upon a Farm; as Cattle, Waggons, Ploughs, and all other Implements of Husbandry. So Instaurum Ecclesia was used for the Books, Vestments, and Utensils belonging to a Church. And Instaurate Terra was Land ready stock'd with all things necessary for the Use of the Farmer. Instauratio is often used in this Sense by our old Historians and M.S.

INSTITUTION, is the Act of the Bishop, or one Commissioned to Act for him; whereby any Clerk is invested with the Spiritualities of a

Rectory or Vicarige.

The Clerk kneels down before the Bishop while he pronounces the Words of Institution, (Institute to Rectorem Ecclesia de A. B. cum Cura Animarum, & accipe Curam tuam & meam) and the Clerk holds the written Instrument, with the Episcopal Seal annexed, in his Hand during the Ceremony. But the Clerk must have Induction after this, without which be hath no Right to his Temporalities, if the Benefice be not a Donative.

Before the Clerk is Instituted, he must subscribe the 39 Articles of Religion, in the Presence of the Ordinary (or his Substitute:) And the Ordinary is not bound to Offer them, but the Clerk is to offer to Subscribe them; and he must Subscribe them without Reserve, Exception or Qualification, or else his Institution is ipso facto void and null; and the Church is still vacant.

At the same time the Ordinary requires the Clerk to subscribe the other 2 Articles mention'd in Can. 26. about the King's Supremacy, and

the Lawfulness and Use of the Liturgy.

The Clerk must also, before Institution, subscribe to that Part of the Declaration enjoin'd by the Act of Uniformity, 14 Car. 2. c. 4. Viz. I will conform to the Liturgy of England as by Law establish'd.

Before Institution he must also take the Oaths mention'd in the first Statute of William and Mary, c. 8. instead of the former Oaths of Allegiance and Supremacy, required by Stat. 1 Eliz. c. 1.

And then he must take the Oath against Simony, enjoin'd by Cam. 40. and the Oath of Canonical Obedience. All this before Institution.

And he is to have Certificates given him of his subscribing the Declaration, contain'd in the Act of Uniformity, in English, in a distinct Instrument, under the Hand and Seal of the Bishop; and of his other Subscriptions and Oaths in Latin.

The Clerk ought to have, by all means, Witnesses of his Institution, his taking the Oaths, making Subscriptions, &r. and therefore he should defire some present to write their Names on the Back of his Instruments; and make Mimorandums who they are, and where they live.

The Church, by Institution, is full, against all Persons but the King; and the Clerk by it may enser upon the Glebe, and take the Tithes; but he cannot Lett or Grant them; nor Sus for

them, if they are refused to be paid.

After Institution the Clerk is to receive a written Mandate from the Ordinary to the Arch-Deacon, or other proper Person, in order to his Induction; which see.

INSTRUMENTS. Besides the several useful Instruments, both Mathematical and Mechanical, which are described under their proper Names in this Volume and the former; I have at the End of this Volume given you the Figures and Descriptions of some others, which are not only very Curious and Accurate, but in a great measure also New and Non-descript.

INSULATA Columna, in Architecture, is a Pillar which stands alone, like an Island, as it were, in the vast Ocean of the Air. Evelyn's

Parallel.

INSULT, is a Word used in the Military Art, for attacking any Post with open Force, without using Trenches, Saps, or any common Approaches. 'Tis usual to Insuls thus the Countersfearp of any Place, that they may not give the Enemy time to fire their Mines, which they have prepared.

INSUPER, is a Word used by the Auditors of the Exchequer: In their Accounts they say, Somuch remains Insuper to such an Accountant: That is, So much remains due on such an Ac-

count.

INTAGLIO'S, are Precious Stones engraved with Heads of Great Men, or Inscriptions, &c.

fuch as are often fet in Rings, or Seals.

INTER Canem & Lupum, was an Expression formerly used for Twilight. In the North this is called in some places Day-light's Gate; and in others, betwixt Hank and Buzzard. In Herefordsbire 'tis called corruptly the Muck-Shade, i. e. Mock-Shade.

INTERDICT, was a Censure formerly inflicted by Bishops or Ordinaries in Times of Popery; forbidding all Sacraments and Divine Offices (except Baptism to Children, and the Sacrament of the Eucharist, and Extream Unction at the Point of Death) to be performed within any Parish, Town, Country, or Nation; and sometimes they prohibited them within such Places to be present at Divine Service in any other Place. This Censure was commonly insticted on a Pretence that the Privileges of the Church had been violated by the Lords, Magistrates, or Princes of any Place or Nation. In the Reign of our King John this Kingdom lay under a Papal Interdict for above six Years together: It began A.D. 1208. In our Common Law the Word

INTERDICTION is used also in the same Sense as in the Canon Law; where 'tis design'd to be Censura Ecclesiastica prohibens administrationem divinorum: And thus 'tis used 24 H. 8. c. 72. INTEREST. Besides the Ways of Com-

INTEREST. Besides the Ways of Computing Interest, both Simple and Compound, which you will find in Vol. I. I shall here give you another very plain, easy and ready Method, of Computing all Simple Interest and Discount; as also the Way to find the Amount or present Value of any Sum of Money; or of any Annuity, or other Yearly Payment, &c. for any Term, not exceeding an Hundred Years: And this from the Accurate and Useful Tables of Mr. John Smart, of the Town-Clerk's Office in London. And in order to this, the following Table of Shillings, Pence and Farthings, reduc'd to the Decimal Parts of a Pound, are previously necessary.

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SHILLINGS, PENCE, and FARTHINGS, reduc'd to the Decimal Parts of a POUND.

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$\left - \left -\frac{5}{1} \right \cdot 021875 \right - 1 \left -\frac{1}{4} \right \cdot 051042 \right - 1 \left -\frac{7}{1} \right \cdot 08125 \right 13 - \left -65 \right $	
$\left - \left - \frac{5^{\frac{1}{2}}}{3} .022917 \right - 1 \left - \frac{1}{2} .052083 \right - 1 \left - \frac{7^{\frac{3}{2}}}{3} .082292 \right 14 \right - \frac{1}{2} .7$	
$-\left -\frac{5\frac{3}{4}}{0023958}\right -1\left -\frac{3}{4}\right .053125$ $\left -1\right -\frac{8}{8}\right .083333$ $\left 15\right -\frac{75}{8}$	
$\begin{bmatrix} -6 & .025 & -1-1 & .054167 & -1-8\frac{1}{4} & .084375 & 16 \end{bmatrix} = \begin{bmatrix} .8 & .084375 & .84$	
$ - \begin{vmatrix} -6\frac{1}{4} & .026042 \end{vmatrix} - 1 - 1\frac{1}{4} & .055208 \end{vmatrix} - 1 - 8\frac{1}{2} .085417 \end{vmatrix} 1785$	
$ - \left -6\frac{1}{3} \cdot 027003 \right - 1 - 1\frac{1}{3} \cdot 05625 \right - 1 - 8\frac{1}{4} \cdot 086458 \left 18 \right - 9 $	
$ - -7 .029167 -1 -2 .058333 -1 -9\frac{1}{4} .088542 $	

Examples of the Use of the preceding Table.

What Decimal Part of a Pound is 7 d.? Look in the Table for 7 d. and even with it you will find .029167, which is the Decimal required.

What Decimal Part of a Pound is 17 s. 6 d.? You will find the Decimal of 17 s. to be .85, and the Decimal of 6 d. to be .025; which added, makes .875, and answers the Question.

What is the Value of this Decimal .09375 in Shillings, Pence and Farthings?

Look in the Table, and you will find it to be

1 s. 10 d. $\frac{1}{3}$.

Note, If you cannot find in the Table the exact Decimal fought for, take that which is nearest to it, and you can never err above half a Farthing.

Knowing thus the Use of these Decimal Tables, all the Bufiness of Simple Interest will very easily be understood and dispatch'd as followeth:

Simple Interest.

The Yearly Interest of any Sum of Money is had, by only multiplying the Principal Sum by the Hundredth part of the Rate of Interest: For the Product in Decimals is the true Answer.

Examples.

1. What is the Interest of 75 Pounds for one Year, at the Rate of 6 l. per Cent.?

75 = Principal.

.06 = the Hundredth part of 61.

1. is. d. 4.50 the Product; which is 4 10 00

2. What

2. What is the Yearly Interest of 157 l. 17 s. 6 d. at 5 l. per Cent.?

157.875 is the Decimal for 157 l. 17 s. 6 d.

7.89375 which is the Decimal answering to 7 l. 17 s. 10 \(\frac{1}{2}\) d. the Interest of 157 l. 17 s. 6 d. for one Year at 5 l. per Cent.

And so for any other Rate or Sum whatsoever.

When thus the Interest for one Year is found, divide it by 365; the Quotient will be the Interest for one Day.

Thus or being the Interest of one Pound for one Year; if you Divide that Decimal by 365 (continuing the Work as long as you please) you will have .00002739726028, &c. —— for a Quotient; which will be the Interest of one Pound for one Day; and at one per Cept.

Then will this Decimal .000027, &c. found as above; if you multiply it continually by the Principal, the Number of Days, and the Rate of Interest, become of itself an Interest Table for any Sum of Money, for any Time, and at any Rate.

Example.

What is the Interest of 150 l. for 365 Days, at 6 l. per Cent.?

:	.00002739	726028
-	4109589	04200 365
J	50000000	33000

9,0000000198000 Which Decimal gives the Answer near enough for any Use; to be 9 Pounds.

By the same Rule .02 Divided by 365, will give in the Quotient the Interest of one Pound for one Day, at a per Cost. and .03 Divided by 365, will do the same at 3 per Cent. And thus these Numbers following were found.

The Interest of one Pound for one Day, at all Rates, from 1, to 10 per Cent.

At 1 l. per Cent. is .000027397260 Sec. as above.

2 .000054794512
3 .000082191781
4 .00013698630
6 .000164383561
7 .000191780822
8 .000219178082
9 .000246575342
10 .000273972603

And when thus the Interest of one Pound for one Day, and at any Rate, is found; Then that Interest multiplied by 2, 3, 4, 5, 6, 7, 8, and 9, 8°c. gives the Interest of any Sum of Money, at the same Rate.

Take an Example at 3 l. per Cent.

And then 'tis easy to find, that the Interest of 11. being, as before, .500082, .c. That of

Because moving the Point of Separation still one Place nearer to the Lest Hand, multiplies any Decimal by 10, 100, 1000, &c. as is shewn under Decimals.

And thus the following Tables of Daily Inte-

The Reason of the Stars above, set to some of the Numbers, is only to shew that in the Contraction of a Decimal Fraction to sewer places, is is proper to add one to the last Figure retain'd, when the next Figure to it, which is omitted, exceeded 5.

INTEREST

INTEREST for One Day, at 3, 4, 5, and 6 Pound per Cent.

per Annum.

				At 5 l. per (1	Cent. per An.
Principal.	Interest.	Principal.	Interest.	Principal.	Interest.	Principal.	Interest.
10000000	821.9178	10000030	1095.8904	10000000	1369.8630	10000000	1643.8356
9000000 8000000	739•7260 657•5342	8000000	986.3014 876.7123	9000000 8000000	1232.8767 (1095.8904	8000000	1479.4521
7000000	575.3425	7000000	767.1233	7000000	958-9041	7000000	1150.6849
6000000	493-1507	6000000	657.5342	6000000	821.9178	6000000	986.3014
5000000	410.9589	5000000	547.9452	5000000	684.9315	5000000	821.9178
4000000	328.7671	4000000	438.3562	4000000	547.9452	4000000	657.5342
3000000 2000000	246.5753	3000000	328.7671	3000000	410.9589	3000000 200000	493.1507 328.7 6 71
1000000	164.3836 82.1918	2000000	219.1781 109.5890	1000000	273.9726 136.9863	1000000	164.3835
900000	73.9726	900000	98.6301	900000	123.2877	900000	147.9452
800000	65.7534	800000	87.6712	800000	109.5890	800000	131.5068
700000	57-5342	700000	76.7123	700000	95.8904	700000	115.0685
6၁၀၀၀၀	49.3151	600000	65.7534	600000	82-1948	600000	98.6301
500000	41.0959	500000	54-7945	500000	68.4932	500000	82.1918
400000	32.8767	400000	43.8356	400000	54-5945	400000	65.7534
300000 2000 3 0	24.6575 16.4384	200000	32.8767 21.9178	300000	41.0959 27.3973	300000 400000	49.3151 32.876 7
100000	8.2192	100000	10.9589	100000	13.6986	100000	16.4384
99000	7-3973	90000	9.8630	90000	12.3288	90000	147945
80000	6-5753	80000	8.7671	80000	10.9589	8onoo	13-1507
70000	5-7534	70000	7.6712	70000	9.5890	70000	11.5068
60000	4.9315	60000	6.5753	60000	8.2192	60000	9.8630
50000	4.1096 3.2877	50000	5.4795	50000	6.8493	50000	8.2192
30000	2.4658	30000	4.3836	40000	5.4795 4.1096	40000 30000	6.5753
20000	1.6438	20000	3.2877 2.1918	20000	2.7397	20000	4.9315 3.2877
10000	.8219	10000	1.0959	10000	1.3699	10000	1.6438
9000	•7397	9000	1.9863	9000	1.2329	9000	1.4795
8000	.6575	8000	.8767	8000	1.0959	8000	1.3151
7000	•5753	, 7000	.7671	7000	.9589	7000	1.1507
6000	4932	6000	.6575	6000	.8219	.6000	.9863
5000 f	.4110 .3288	5000	•5479	5000	.6849	5000	.8219
3000	.2466	3000	.4384	3000	•5479 •4110	4000 3000	.6575 .4932
2000	.1644	2000	.2192	2000	.2740	2000	.3288
1000	,0812	1000	.1096	1000	.1370	1000	.1644
900	.0740	. 900	0986	900	-1233	900	.1479.
800	.0658	800	.0877	800	1096	800	.1315
700	.0575	700	.6767	700	.0959	700	.1151
600 .	, .049 3.	600	.0558	600	.0822	600 500	.0986
409	0319	500	.0438	500 400	.0548	400	.0658
300	.0247	300	-0329	300	.0411	300	.0493
200	.0164	200	.0219	200	.02741	200	.0329
100	-0082	100	.0110	100	.0137	100	.0164
90	.0074	90	.0099	90	.0123	90	.0148
- 80	.0066	80	.0088	80	.0110	80	.0132
70 60	.0058	70 60	-0066	70 60	.0096	70	.0115
50	-0041	50		50	.0068	60 50	.0099
40	.0033	40	0044	40	.0055	40	.0066
30	.0025	30	-0033	30	•004T	30	.0049
20	.0016	20	•0022	20	.0027	20	.0033
10	.0008		1100.	10	.0014	10	.0016
- 8	.0007	9 8	.0010	9 8	.0012	9 8	.0015
	•0007		.0009		.0010		.0013
7 6	10005	7 6	.0007	7 6	.0008	7 6	.0012
1771	,9004	5	.0005	5	.0007	5	.0008
4	•0003	4	.0004	4	.0005	4	.0007
3	10002	3	.0003]] 3	.0004	3	-0005
2	.0002	1 2	.0002	1 2	.0003	2	•0003
	10001	ı	1000.	1	1000.]]]	.0002
i						INT	EREST
1							

INTEREST for One Day, at 7, 8, 9, and 10 Pound per Cent.

per Annum.

At 7 1 nor (ent per An	At 8 1 nor	Cent per An.	At 9 l. per	Cent. per An	Atiol. per	Cent. per An
Principal.	Interest.	Principal.	Interest.	Principal.	Intereft.	Principal.	Interest.
10000000	917.8082	·	2191.7808		2465.7534	10000000	
9200000	726.0274	10000000	1972.6027	10000000	2219.1781	9000000	2739.7260 2465.7534
8200000	:534.2466	8000000	1753-4247	8000000	1972.6027	8000000	2191.7808
7000000	1342,4658	7000000	1534-2466	700000	1726.0274	7000000	1917.8082
6000000	150.6849	6202000	1315.0685	6000000	1232.8767	5000000	1643.8356
5000000 4000000	958.9041	5000000 4000000	1095.8904 876.7123	5000000 4000000	986.3014	4000000	1369.863d 1095.8904
3000000	575.3425	3000000	657.5342	3000000	739.7260	3000000	821.9178
2000000	383.5616	2000000	438.3562	2000000	493.1507	2000000	547.9452
1000000	191.7808	1000000	219.1781	1000000	246.5753	1000000	273.9726
900000	172.6027	900000	197-2603	900000	221.9178	900000	246.5753
700000	153.4247 134.2466	700000	175-3425	700000	197.2603 172.6027	70000	219.1781
630000	115.0685	600000	153.4247 131.5068	600000	147.9452	600000	191.7808 164.3836
500000	95.8904	500000	109.5890	500000	123.2877	500000	136.9863
4000 00	76.7123	400000	87.6712	400000	98.6301	400000	109.5890
300000	57.5342	300000	65.7534	300000	73.9726	200000	82.1918
200000 100000	38.3562	100000	43.8356	100000	49·3151 24·6575	100000	54-7945
90000	17.2603		21.9178		22.1918	90000	27,3973
80000	17.2003	80000	19.7260	90000 80000	19.7260	80000	24.6575 21.917 \$
70000	13.4247	70000	15.3425	70000	17.2603	70000	19.1781
60000	11.5068	60000	13.1507	60000	14-7945	60000	16.4384
50000	9.5890	50000	10.9589	50000	12.3288	50000	13.6986
30000	7.6712	. 40000	8.7671	40000	9.8630	40000 30000	10.9589
20000	5.7534 3.8356	30000 20000	6.5 753 4. 3836	20000	7·3973 4·9315	20000	8,2192 5,4795
10000	1.9178	10000	2.1918	10000	2.4658	10000	2.7397
9000	1.7260	9200	1.9726	9000	2.2192	9000	2.4058
8000	1.5342	8000	1.7534	8000	1.9726	8000	2.19í8
7000	1.3425	7000	1.5342	7000	1.7260	7000	1.9178
5000	1.1507 -9589	6000	1.3151	5000	1.4795	6000 5000	1.6438
4000	.7671	5000 4000	1.0959 .8767	4000	.9863	4000	1.3699 '
3000	•5753	3000	.6575	3000	.7397	3000	.8219
2000	.3836	2000	-4384	2000	.4932	2000	-5479
1000	.1918	1000	.2192	0001	-2466	1000	.2740
900	.1726	900	•1973	900	.2219	900	.2456
700	.1534	800	•1753	800 700	1973	800 700	.2192
600	.1151	70 0 600	•1534 •1315	600	.1726	600	.191 8 .1544
500	.0959		1096	500	.1233	500	.1370
.400	.0767	400	•n877	400	.0986	400	.1096
300	-0575	. 300	.0658	300	•0740	300	.0822
200	.0384	200	.0438	200 100	·0493	200 100	.0548
100	The residence of the last of t	001	.0219	-	.0247		.0274
90 80	.0173 .0153	90 80	.0197 .017 5	90 80	.0222	90 80	.02 4 7 .0219
70	.0134	70	.0173	70	.0173	70	.0192
60	.0115	60	•0132	60	.0148	60	.0164
50	.0096	50	0110	50	.0123	50	.0137
40	•0077 •0058	40	.0088	40	.0099	40	.0110
30 20.	.0038	30 20	.0006	30 20	.0074 .0049	30 20	.0082 .0055
10	.0019	10	.0022	10	.0025	10	,0027
	.0017	9	.0020	9	.0022		.0015
9 8	.0015	9	.0018	8 .	.0020	9	.0022
7 6	.0013	7	.0015	7	.0017	7 6	,0019
	•0012	6	.0013	6	-0015		0016
5 4	.0010 .0008	5 4	.0009	5 4	.0012 ,0010	5 4	.0014 .0011
3	•0006	3	•0007	3	.0007	3	•0008
2	-9004	3 2	.0804	2	.0005	2	-0005
I	.00∩2	1	•0002	I	.0002	1	.0003
1		•		Xx			The
L				A			- 00

The Use of the preceding Tables.

When the Interest of any Sum of Money is required for any Number of Days, multiply the Principal Sum by the Number of Days; and the Interest of that Product for one Day answers the Question.

For, the Interest of one Pound for one hundred Days, is equal to the Interest of one hundred

Pounds for one Day.

Example.

What is the Interest of 2651. for 438 Days, at 6 l. per Cent. per Ann.?

265 l. Multiply'd by 438, (the Number of Days) the Product will be 116070 l. the Interest of which Sum take out of the Table of 6 l. per Cent. thus;

The Interest for one Day of 100000 is 16.4384 10000 is 1.6438 6000 is .9863 70 is .0115

Principal 116070 Int. 19.0800

Answer 191. 1 s. 7 4 d.

And thus, by these Tables, the Interest of any Sum of Money, for any Time, and at any Rate of Interest, from 3 l. to 10 l. per Cent. per Ann. is readily found.

For the more easy finding the Number of Days, from any one time given, to any other, the following Table is made.

The Number of Days from any Day in any one Month, to the same Day in any other Month.

```
From January Febru. March April May June July August Septem. Octob. Novem Decem.

Feb. 31 Mar. 28 Apr. 31 May 30 June 31 July 30 Aug. 31 Sept. 31 Oct. 30 Nov. 31 Dec. 30 Jan. 31 Mar. 59 Apr. 59 May 61 June 61 July 61 Aug. 61 Sept. 62 Oct. 61 Nov. 61 Dec. 61 Jan. 61 Feb. 62 Apr. 90 May 120 June 120 July 122 Aug. 122 Sept. 123 Oct. 122 Nov. 123 Dec. 122 Jan. 122 Feb. 123 Mar. 120 Apr. 121 July 150 Aug. 153 Sept. 153 Oct. 153 Nov. 153 Dec. 153 Jan. 153 Feb. 153 Mar. 151 May 151 July 150 Aug. 153 Sept. 153 Oct. 153 Nov. 153 Dec. 153 Jan. 153 Feb. 153 Mar. 151 May 151 July 150 Aug. 152 Oct. 214 Jan. 214 Feb. 215 Mar. 212 May 212 June 212 July 212 Sep. 212 Oct. 214 Nov. 214 Dec. 214 Jan. 214 Feb. 215 Mar. 212 May 212 June 212 July 212 Sep. 243 Oct. 242 Nov. 245 Dec. 244 Jan. 245 Feb. 245 Mar. 243 Apr. 243 May 242 June 243 July 242 Aug. 243 Oct. 273 Nov. 273 Dec. 275 Jan. 304 Apr. 304 Apr. 304 Mar. 304 Apr. 304 July 303 Aug. 304 Sept. 304 Oct. 304 Dec. 334 Jan. 334 Feb. 337 Mar. 335 May 334 June 335 July 334 Aug. 334 Sept. 335 Oct. 334 Nov. 335 Jun. 365 Feb. 365 Mar. 365 Apr. 365 May 365 June 365 July 365 Aug. 365 Sept. 365 Oct. 365 Nov. 365 Dec. 366
```

This Table shews the Number of Days, from any Day in any one Month, to the same Day in any other Month; as from the 1st, 5th, 10th, or 20th of May, to the 1st, 5th, 10th, or 20th of Nevember, is 184 Days: Which is thus known.

I find May at the Head of one of the Columns; and looking down that Column, I find

November, and even with it 184.

But if the Question is from the 5th of May, to the 10th of November, I must add 5; and the Number of Days will be 189. On the contrary, if it be demanded from the 10th of May, to the 5th of November, 5 must be subtracted, and the Number will be 179. And thus any Number of Days, not exceeding a Year, are found by Inspection.

If the Time exceed a Year; as from the 10th of May 1706, to the 10th of November 1707, add 365 to the Number found in the Table, and

the Answer will be 549 Days.

And as you may thus very easily, and accurately enough, solve all Questions and Cases of Simple Interest; so he next shews how to find the Discount of any Sum of Money for any Time, and at any Rute of Interest, thus.

1. To find the Annual Discount of one Pound, at 1 l. per Cent. Divide .01 by 1.01. If at 2 per Cent. Divide .02 by 1.02. At 3 per Cent. Divide .03 by 1.03, &c. and the Quotients will be the several Discounts required.

Thus the Discount of one Pound for one Year

1per Cent. .009900990099 2 - - .0196078431373 - - .029126213592 4 - - .038461538462 - - .047619047619 6 — — .056603773585 7 - - .065420560748 8 — — .074074074 - .082568807339 10 - - .09090909090909

And then the Discount of 1 l. being multiply'd by any Principal Sum, the Product will be the Annual Discount of that Principal.

Example.

What is the Discount of 100 l. at 6 l. per Cent. per Annum?

No. 5660, &c. being the Discount of 11. for one Year, at the Rate of 6 per Cent. as above; that multiplied by 1001. will produce 5.5660377, &c. Which Decimal being reduced, gives us 51.13s. 2 1d. and no more: And therefore that is to be look'd upon as the true Discount of 1001. at 61. per Cent. for one Year.

And yet nothing is more common, than to allow 6!. for the Discount of 100!. for a Year, at 6!. per Cent. But he that doth so, certainly wrongs himself: For he ought to receive so much Money as, at 6!. per Cent. Interest, will amount to 100!. in one Year, which less than 94!. 63. 9 \frac{1}{2} d.

will not do.

The several Discounts of 11, for one Year (as above) and at the aforesaid Rates, being divided by 365, will give the Discounts for one Day, at the same Rates; Viz.

The Discount for one Day at

1 l. per Cent000027126000
2000053720118
3000079797845
4000105374078
5000130463144
6000155078832
7000179234413
8 — .000202942669
9000226215911
10 :000249066002

And when thus the Discount of one Pound for one Day, and at any Rate, is found; if you multiply that by 2, 3, 4, 5, 6, &c. it will give the Discount of any Sum of Money whatsoever at the same Rate.

Examples at 3 per Cent.

The Discount for one Day of

```
11. - is - .000079797845

2 - - .000159595691

3 - .000239393536

4 - .000319191382

5 - .000478787073

7 - .000558584918

8 - .000638382764

19 - .0007979784555

100 - .007979784546

1000 - .079797845458

Ec.
```

And after this manner the following Tables of Discount are framed.

Vol. II.

Xx2

DISCOUNT

 $\mathsf{Digitized} \ \mathsf{by} \ Google$

DISCOUNT for One Day, at 3, 4, 5, and 6 Pound per Cent.

per Annum.

·				_					
At 2 le per C	ent per An.	At 4 l. per Cent. per An.			As & l. per (ept. per An	At 6 l. per Cent. per An.		
Principal.	Discount.	Principal. Discount.			Principal.	Discount.	Principal.	Discount.	
				П		}			
10000000	797.9785	10000000	1053.7408	l	10000000	13046314	10000000	1550.7883	
9000000	718.1806	9000000	948.3667	П	9000000	1174-1683	9000000	1395.7095	
8000000	638.3828	8000000	842.9926	H	8000000	1043.7052	8000000	1240.6307	
7000000	558.5849	7000000	737.6185	П	7000000	913.2420	7000000	1085.5518	
6000000	478.7871	6000000	632.2445 526.8704		6000000	782-7789	6000000	930.4730	
5000000	398.9892	\$000000 4000000	421.4963	П	5000000	521.8526	50,00000	775-3942	
4000000	319.1914	3000000	316.1222	ı	4000000		4000000	620.3153	
3000000	239-3935	2000000	210.7482		3000000 2000000	391.3894 260.9263	3000000 200000	465.2365	
2000000	159-5957	1000000	105.3741	۱	1000000	130.4631	1000000	31c-1577 155-0788	
	79.7978						<u></u>		
900000	71.8181	900000	94.8367		900000	117.4168	900000	139.5709	
800000	63.8383	800000	84.2993	۱	800000	104.3705	800000	124.0631	
700000	55.8585	700000	73.7619		700000	91.3242	700000	108.5552	
600000	47.8787	600000	63.2244		600000	78.2779	600000	93.0473	
500000	39.8989	500000	52.6870	Г	500000	65.2316	500000	77.5394	
400000	31.9191	300000	42.1496	ı	/ 400000	52.1853	400000	62.0315	
300000	23.9394	1	31.6122	1	300000	39.1389	300000	46.5236	
200000	15.9596	100000	21.0748	1	200000	26.0926	200000	31.0158	
100000	7.9798		10.5374		100000	13.0463	100000	-15.5079	
90000	7.1818	90000	9.4837	1	90000	11.7417	90000	13.9571	
80000	6.3838	. 80000	8.4299		80000	10.4371	80000	12-4-63	
70000	5.5858	70000	7.3762		70000	9-1324	70000	10.8555	
60000	4.7879	60000	6.3224		60000	7.8278	60000	9.3047	
50000	3.9899	50000	5.2687	1	50000	6.5232	50000	7-7539	
40000	3.1919	40000	4.2150	ı	40000	5.2185	49000	6.2032	
30000	2.3939	30000	3.1612	l	30000	3.9139	30000	4.6524	
20000	1.5960	20000	2.1075	l	20000	2.6093	20000	3.1016	
10000	.7980	10000	1.0537	1	10000	1.3046	10000	1.5508	
9000	.7182	9000	-9484	1	9000	1.1742	9000	1-3957	
8000	.6384	8000	.8430	ı	8000	1.0437	8000	1.2406	
7000	.5586	7000	•7376	ı	7000	.9132	7000	1.0856	
6000	.4788	6000	.6322	ł	6000	-7828	6000	.9305	
5000	.3990	5000	.5269	ı	5000	.6523	5000	•7754	
4000	-3192	4000	-4215	L	4000	-5219	4000	.6203	
3000	•2394	3000	.3161	l	3000	-3914	3000	.4652	
2000	.1596	2000	.2107	l	2000	.2609	2000	-3102	
1000	.0798	1000	.1054	1	1000	.1305	1000	.1551	
900	.0718	900	.0948	1	900	.1174	900	•1396	
800	.0638	800	.0843	l	800	.1044	800	•1241	
700	•0559	700	•0738	Ī	700	.0913	700	1085	
`600	.0479	600	•0632	ı	600	.0783	600	•0930	
500	•0399	500	•0527	١	500	.0652	500	•0775	
400	.0319	400	.0421	l	400	.0522	400	0620	
300	.0239	300	.0316	١	300	.0391	300	.0465	
200	•0160	200	.0211	١	200	.0261	200	•0310	
100	.0080	100	.0,105	١	100	.0130	100	.0155	
90	.0072	90	.0095	1	90	•0117	90	.0140	
80	.0064	80	.0084		. 80	.0104	80	.0124	
70	.0056	70	.0074	١	70	10001	70	.0109	
60	.0048	60	.0063	1	60	.0078	80	.0093	
50	.0040	50	.0053	1	50	.0065	50	.0078	
40	.0032	40	.0042	1	40	.0052	40	.0062	
30	.0024	30	.0032	1	30	.0039	30	•0047	
20	•0016	20	.0021	1	20	.0026	20	.0031	
10	.0008	10	1100.	1	10	.0013	10	.0016	
0	.0007	0	.0009	1		•0012			
9 8	.0006	9	.0008		9 8	.0010	9 8	•0014 •0012	
7	0006	7	•0007	1	7	.0009	7	•0012	
6	.0005	6	•0006	-	6	.0008	6	•000g	
5	.0004	5	.0705	1	5	.0007	5	•0008	
4	.0003	1 4	0004	1	4	•0005	4	•0006	
3	.0002	3	.0003	I	3	•0004	. 3	•0005	
2	.0002	2	.0002	1	2	•0003]	.0003	
τ .	٠٥٥٥ ن	1 . 1	10001		1	10001		.0003	
				.!_	·				
1	•						DISC	OUNT	
1									

INT

DISCOUNT for One Day, at 7, 8, 9, and 10 per Cent.

per Annum.

4t 7 l. per (Cent. per An.	At 8 l. per	Cent per An-	At 9 l. per	Cent. per An	Attol. per	Cent. per Ai
Principal	Discount.	Principal.	Discount.	Principal.	Discount.	Principal.	-
10000000	792.3441	10000000	2029.4267	10000000	2262.1591	10000000	2490.6620
9200000	613.1097	9000000	1826.4840	9000000	2035.9432	9000000	2241.5940
8200000	:433.8753	8000000	1623.5414	8000000	1809.7273	8000000	1992.5280
7000000	254.6409	7000000	1420.5987	7000000	1583.5114	7000000	1743.4620
6 000000	075.4065	6202000	1217.6560	6000000	1357-2955	6000000	1494.3960
5000000	896-1721	5000000	1014.7133	500000	904.8636	5000000	1245.3300
40 00000	716.9377 537.7032	4000000 3000000	811.7707 608.8280	4000000 3000000	678.6477	4000000	996.2640 747.1980
2000000	358.4688	2000000	405.8853	2000000	452.4318	2000000	498.1320
1000000	179.2344	1200000	202.9427	1000000	226.2159	1000000.	249.0660
900000	161.3110	900000	182.6484	900000	203.5943	900000	224.1594
800000	143-3875	800000	162.3541	800000	180-9727	800000	199.2528
700000	125.4641	700000	142.0999	700000	158.3511	700000	174-3462
6၁၀၀၀၀	107.5406	600000	121.7656	600000	135.7295	600000	149-4396
5,00000	89.6172	500000	101.4713	500000	113.1080	500000	124.5330
400000	71.6938	400000	81.1771	400000	90.4864	400000	99.6264
300000	53.7703	300000	62.8828	300000	67.8648	300000	74-7198
200000	35.8469	200000	40.5885	200000	45.2432	200000	49.8132
100000	17.9234	100000	20.2943	100000	22.6216	100000	24.9066
90000	16.1311	90000	18.2648	9,0000	20-3594	90000	. 22.4159
80000	14.3388	80000	16.2354	80000	18.0973	80200	19.9253
70000	12.5464	70000	14.2060	70000	15.8351	70000	17-4346
60000	10.7541	60000	12,1766	60000	13.5730	60000	14.9440
50000	8.9617 7.1694	50000	10.1471	50000	11.3108	50000	12.4533
40000	5.3770	40000	8.1177 6.0883	40000	6.7865	4000 0 40000	9.9626
30000 20000	3.5847	30000	4.0589	30000 20000	4.5243	20000	7.4720 4.9813
10000	1.7923	20000 10000	2.0294	10000	2.2622	10000	2.4907,
	1.6131						
9000 8000	1.4339	9000 8000	1.8265	9000 8000	2.0359 1.8097	90∋0 80 00	2.2416 1.9925
7000	1.2546	7000	1.6235	7000	1.5835	7000	1.7435
6000	1.0754	6000	1.4200	6000	1.3573	6000	1.4944
5000	8962	5000	1.0147	5000	1.1311	5000	I-2453
4000	.7169	4000	.8118	4000	.9049	4000	•9963
3000	•5377	3000	.6088	3000	.6786	2000	•7472
2000	.3585	2000	.4059	2000	.452+	2000	-4981
1000	.1792	1000	.2029	0001	. 2252	1000	•249 L
900	.1613	900	-1826	900	.2036	900	.2242
800	.1434	800	-1624	800	.1810	8 00	.1993
700	.1255	700	•1421	700	.1584	700	.1743
600	.1075	600	-1218	600	1357	∕. δοο	.1494
500	.0896	500	1015	500	.1431	500	.1245
400	.0717	400	-0812	490	.0905	400	.0996
300	.0538	300	•0609	300	.0679	300	.0747
200	.0358	200	•0406	200	.0452 .0226	200	.0498
100	.0179	100	•0203	100		100	.0249.
90	1910.	` 90	.0183	90	-0204	90	.0224
80	-0143	80	.0162	80	1810	,, \$ 0	; ;: •0199
70 6 0	.0125	70	.0142	70	0128	79	.0174
1	.0108 .009 0	60	•0122	60	.0136	601	.0149
50 40	•0072	50 40	1010.	50 40	.0090	50 40	.0125
30	.0054	3 0	1990.	30	0068	40 30	.0075
20	.036	20	.0041	20	.0045	20	10050
10	.oc18	. 10	.0020	10	von13	104	.0025
	.0016		.0018		.0020	+ 9 (11-1)	.0022
. 9 8	.0014	9	.0018	9 8	.0020	8	40020
7	.0013	7	.0014	7	.0016	17!	.0020
6	•0011	6	0012	6	•0014	6	•0015
5-	0009	5	.0010	9	.0011	1 7 1 1 1 g	6012
4	-0007	4	8000	4	•0009	4	10010
3	.0005		•0006	3	.0007	3	•0007
- 2	.0004	3 2 1	.0004	2	.0005	ž	-0005
	.00∩2	т.	.0002	1	.0002	1.4	
1 1	- 100.12 ·		.0002		10002		30002

The Use of the preceding Tables.

When the Discount of any Sum of Money is required for any Number of Days, multiply the principal Sum by the Number of Days, and the Discount of that Product for one Day answers the Question.

Example.

What is the Discount of 265 l. for 438 Days, at 61. per Cent. per Annum?

265 l. Multiplied by 438, (the Number of Days) the Product will be 116070 l. the Discount of which Sum take out of the Table of 61. per Cent. thus;

```
The Discount for one Day of 100000 is 15.5079
                             10000 is 1.5508
                              6000 is
                                        .9305
                                70 is
                                        .0109
```

Principal 116070. Dif. 18.0001

Answer 181.

And thus by these Tables, the Discount of any Sum of Money, for any Time, and at any Rate, from 3 l. to 10 l. per Cent. per Ann. is found readily.

Compound Interest.

The Amount of any Sum of Money in any Number of Years, at Compound Interest, will be always had by the continued Multiplication of the Principal by 1.03, if the Rate of Interest be 3 l. per Cent. by 1.04, if 4 l. per Cent. by 1.06, if the Rate be 61. per Cent. &c.

```
So I.
                                     [1.03
                                                                     ist Year,
   1.03
                                      1.0609
                                                                     .2d Year,
            Multiply'd by 103, the 1.092727
   1.0600
  1.092727 Amount (at 31. per 1.127509 At the End of the 4th Year, 1.125509 Cent.) will be
                                     1.159274
                                                                     5th Year,
  J.I 59274
                                      1.194052
                                                                     6th Year,
  1.194052
                                     1.229874
                                                                    7th Year.
```

And thus Table the First, following, of the Amount of 1 !. is form'd.

The Present Value of any Sum of Money, payable at the End of any Number, is found by the Reverse of the former Method; viz. by the con- rest, is 3, 4, 5 or 6 l. per Cent.

```
.970874
                                                                           rst Year,
970874
                                    .942596
                                                                           2d Year,
942596 Divided by 103; the
                                   .915142
                                                                           3d Year,
.915142 present Value (at 31.4
888487 per Cent.) will be
                                   .888487 > Payable at the End of the 4th Year,
                                    .862509
                                                                           5th Year,
862609
                                    .837484
                                                                           oth Year,
1837484
                                   .813092
                                                                          , 7th Year.
```

And thus the Second of the following Tables may be form'd.

The Amount of any Annaity or other yearly Third Yearly Paym. 1.

Payment, in any Number of Years, at 3 l. per

Cent. per Ann. Compound Interest, will be found

3.6 thus:

Multiply the first yearly Payment by 1.03 (when as in this Case, the Rate of Interest is 31. per Cent. otherwise by 1.06, &c. whatever that be) and to the Product add the fecond Yearly Payment; which Addition will give the Amount in two Years: Multiply that Amount again by 1.03, 1.06, &c. and to the Product add the third yearly Payment; which Addition will give the Amount in three Years, &c.

Example of 1 l. per Ann. at 3 l. per Cent.

First yearly Payment 11. the Amount in 1 Year. Multiplied by 1.03

1.03 Second Yearly Paym. 1. Multiplied by 2.0909

3.0909 Amount in 3 Years. Multiplied by -- 1.03

3.183627 Fourth Yearly Paym. 1.

4.183627 Amount in 4 Years,

And thus the Third Table following is constructed.

The present Value of any Annuity, or other Yearly Payment, to continue any Number of Years, is thus found.

Find the present Value of that yearly Sum payable at the End of 1, 2, 3, 4, or 5, &c. Years by Division; as is above directed; the first of which Values will be the present Value of that Annuity, or Yearly Payment for one Year: The first and second of those Values ad-2.03 Amount in 2 Years, ded together, will be the present Value for two Years: The first, second, and third, so added, will give the Value for three Years, &c.

Ex.im-

Example of 11. per Ann. at 31. per Cent.

I find the present Value of 1 /. payable at the End of several Years, to be, as here under express'd.

Then the present Value of i l. per Ann. at 3 l. per Cens.

And thus the Fourth Table following is Form'd and Composed...

TABLĚ

TABLE I.

The Amount of One Pound in any Number of Years not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

1			•					
Te.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
I	1.030000	1.040000	1.050000	1,060000	1.070000	1.080000	1.090000	1.100000
2	1.ဝင်၁၅၁ဝ	1.081600	1.102500	1.123600	1.144900	1.166400	1.188100	1.210000
. 3	1.092727	1.124864	1.157625	1.191016	1.225043	1.259712	1.295029	1.331000
4	1.125509	1.169859	1.215506	1.262477	1.310796	1.360489	1.411582	1.464100
3	1.159274	1.216653	1.276282	1.338226	1.402552	1.469328	1.538624	1,610510
6	1.194052	1.265319	1.340096	1.418519	1.500730	1.586874	1.677100	1.771561
7	1.229874	1.315932	1.407100	1.503630	1.605781	1.713824	1.828039	1.948717
8	1.266770	1.368569	1.477455	1.593848	1.718186	1.850930	1.992563	2.143589
9	1.804773	1.423312	1.551325	1.689479	1.838459	1.999005	2.171893	2.357948
10	1.343916	1.480244	1.628895	1.790848	1.967191	2.158925	2.367364	2.593742
11	1.384234	1.539454	1.710339	1.898299	2.104852	2.331639	2.580416	2.853117
12	1.425761	1.601032	1.795856	2.012196	2.252192	2.518170	2.812665	3.138428
13	1.468534	1.665074	1.885649	2.132928	2.409845	2.719624	3.065805	3.452271
14	1.512590	1.731676	1.979933	2.260904	2.578534	2.937194	3.341727	3.797498
15	1.557967	1.800944	2.078928	2.396558	2.759032	3.172169	3.642482	4.177248
16	1.604706	1.872981	2.182875	2.540352	2.952164	3-425943	3.970306	4-594973
17	1.652848	1.947900	810262.2	2.692773	3.158815	3.700018	4.327633	5.054470
18	1.702433	2.025817	2.406619	2.854339	3.379932	3.996019	4.717120	5.559917
19	1.753506	2.106849	2.526950	3.025600	3.616528	4.315701	5.141661	6.115909
20	1.805111	2.191123	2.653298	3.207135	3.869684	4660957	5.604411	6.727500
21	1.860295	2.278768	2.785963	3.399564	4.140562	5.033834	6.108803	7.400250
22	1.916103	2.369919	2.925261	3.603537	4.430402	5.436540	6.658600	8.140275
23	1.973587	2.464716	3.071524	3.819750	4.740530	5.871464	7.257874	8.954302
24	2.032794	2.563304	3.225100	4.048935	5.072367	6.341181	7.911083	9.849733
25	2.093778	2.665836	3.386355	4.291871	5-427433	6.848475	8.623081	10.834700
26	2.156591	2.772470	3.555673	4.549383	5.807353	7.396353	9.399158	11.918177
27	2.221289	2.883369	3.733456	4.822346	6.213868	7.988001	10.245082	13.109994
28	2.287928	2.998703	3.920129	5.111687	6.648838	8.627106	11.167139	14.420994
. 29	2.356566	3.118651	4.116136	5.418388	7.114257	9.317275	12.172182	15.863093
30	2.427262	3.243398	4.321942	5.743491	7.612255	10.062657	13.267678	17.449402
31	2.500080	3.373133	4.538039	6.088101	8.145113	10.867669	14-461769	19.194342
32	2.575083	3.508059	4.764941	6.453387	8-715271	11.737083	15.763329	21-113777
33	2.652335.	3.648381	5.003189	6.840590	9.325340	12.676050	17.182028	23.225155
34	2.731905	3.794316	5.253348	7.251025	9.978114	13.690134	18.728411	25.547671
35	2.813862	3.946089	5.516015	7.68608.7	10.676581	14.785344	20.413968	28.102438
36	2.898278	4.103933	5.791816	8.147252	11.423942	15.968172	22.251225	30.912681
37	2.985227	4.268090	6.081407	8.636087	12.223618	17.245626	24.253835	34-003949
38	3.074783	4.438813	6.385477	9.154252	13.079271	18.625276	26.436680	37-404344
39		4-616366	6.704751	9.703507	13.994820	20.115298	28.815982	41.144779
40	3.262038	4.801.021	7.039989	10.285718	14-974458	21.724521	31.409420	45.259257
41	3.359899	4.993061	7.391988	10.902861	16.022670	23.462483	34.236268	49.785182
42	3.460696	5.192784	7.761588	11.557033	17.144257	25.339482	37-317532	54.763701
43	3.564517	5.400495	8.149667	12.250455	18.344355	27.366640	40.676110	60.240071
44	3.671452	5.616515	8.557150	12.985482	19.628460	29.555972	44-336960	66.264078
45	3.781596	5.841176	8.985008	13.764611	21.002452	31.920449	48.327286	72.890486
46		6.074823	9.434258	14.590487	22.472623	34-474085	52.676742	80.179534
47		6.317816	9.905971	15.465917	24.045707	37.232012	57.417649	88.197488
48		• • • •	10.401270		25.728907	40.210573	62.585237	97.017236
49	4.256219	1 6.833349	10.921333	17-377504	27.529930	1 43.427419	08.217908	1106.718960
1								

TABLE I. continu'd.

Being the Amount of One Pound, in any Number of Years, from 50 to 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

<u></u>	·				····	7		
Ye.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
50	1	7.105983	11.467400	18.420154				117.300806
51		7.390951	12.040770	19.525363		50.653741		129.129942
52		7.686589	12.642808	20.696885				142.042936
53		7.994052	13.274949	21.938698			1 ' ' '	
54	1	8.313814	13.938696	23.255020	,	-))		
55		8.646367	14.635631		<u> </u>			
56		8.992222	15.367412	26:129341	44-207052			1 2 2
57 58		9.351910	16.135783	27.697101 29.358927	47.301545			
59		10.115026	16.942572	31.120463	, ,		148.162017	
60		10.519627	17.789701	32.987691				
_					57-946427			
61	6.068351	10.940413	19.513145	34.966952	62.002677	109.357629	191.874108	334.929812
62	- · · · · · · · · · · · ·	11.378029	20.593802	37.064969 3 9. 288868			209.142778	368.422794
63 64		12.306476	21.623493	41.646200				
65		12.798735	22.704667 23.839901	44.144972	75.955945 81.272861		248.482535	445.791580
66		13.310685				148.779846	270.845963	490-370728
67	7.034882	13.310055	25.031896 26.283490	46.793670 49.601290	1	160.682234		539.407812
68	7.245929	14.396836	20.283490	52.577368			321.792088	593.348593
69	7.463307 7.687206	14-972710	27.597665 28.977548		99.562750 106.532142	187.419758		
70	7.917822	15.571618	30.426426		113.989392	202.413338 218.606406	382-321180	
71		16.194483						789.746978
72	8.155357 8.400017	16.842262	31.947747 33.545134		121.968650 130.506455	236.094918	454-235794	868.721675
73	8.652018	17.515953	35.222391		139.641907	254.982511	495.117016	955-593843
74	8.911578	18.216591	36.983510		149.416840	275.381112 297.411601	539.677547	1051.153227
75	9.178926	18,945255	38,832686		159.876019	321.204529	588.248526 641.190894	1156.268550
76	9.454293	19.703065	40.774320		171.067341			
77	9.737922	20.491187	42.813036		183.042054	346.900892 374-652963	698.898074 761.798901	1399.084945
78	10.030060	21.310835	44.953688		195.854998	404.625200	830-360802	1538.993440
79	10.330962	22.163269	47.201372		209.564848	436.995216	905-093274	1692.892784 1862.182062
80	10.640891	23.049799		105.795993	224.234388	471.954824	986.551660	2048.470269
81	10.960117	23.971791		112.143753				
82	11.288921	24.930663	54.641489	118.872378	256.725050		1075 341319	2253.240295 2478.564325
83	11.627588	25.927889		126.004721		504.527167	1277.613021	2726.420757
84	11.976416	26.965005		133.565004		642.080241	1392.598193	2999.062833
85	12.335709	28.043605		141.578904		693.456488	1517.932030	3298.969117
86	12.705780	29.165349		150.073639			1654.545913	3628.866028
87	13.086953	30.331963		159.078057	360.071426	808.847648	1803.455045	3991.752631
88	13.479562	31.545242	73.224821	168.622741	385.276426	873-555450	1965.765999	4390.927894
89	13.883949	32.807051	76.886062	178.740105	412.245776	943.439896	2142.684939	4830.020684
90	14.300467	34.119333	80.730365	189.464511		1018.915088	2335.526583	5313.022752
91	14-729481	35.484107				1100.428295		5844.325027
92	15.171366	36.903471	89.005227	212.882325	505.018802	1188.462558	2774.839124	6428.757530
93	15.626507	38.37961n	93.455489	225.655264	540-370118	1282.529562	2024.574656	7071.633282
94	16.095302	39.914794	93-123263	239.194580	578.190020	1 286.2227281	2296.786375	7778.796611
95	16.578161	41.511386	103.034676	253.546255	518.669748	1497.120546	593.497148	8556.676272
96	17.075506	43-171841	108.186410	268-759020	61.976620	1616.890100	016.011802	9412.343899
97	17.587,771	44.090715	113.595731	284.884572[708-314994	1746-2414054	1269.433962 1	0252.5782801
98	18.115404	40.094004	119.275517	301.97764617	757-897044	1885.04071814	L6 5 2. 68 2018. 1	1288-026118
99	18.658866	43.502450	125.239293	320.096305 :	310.94983 7 ¦2	2026.815975	1072-51449ch	2527-820720
100	19.218632	50.504948	131.501258	339.302084	67.716325	2109.761253	529.040791	3780.612703
			:					

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TABLE II.

The Present Value of One Pound, payable at the End of any Number of Years not exceeding 100, Discounting at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

					, 			
Te.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
<u> </u>	.970874	.961539	.952381	•943396	•934579	.925926	.917431	1909091
2	.942596	.924556	.907029	.889997	.873439	.857339	.841680	.826446
	.915142	.888996	.863838	.839619	.816298	.793832	.772184	.751315
3	1 1 1	.854804	.822702	.792094	.762895	•735030	.708425	.683013
4	.862609	.821927	.783526	.747258	.712986	.680583	.649931	.620921
_5 6	.837484	•790315	-746216	•70496n .	.666342	.630170	.596267	-564474
0	9,000	.759918	-710682	.665057	.622750	.583491	.547034	.513158
7 8	.813092 .789409	.730690	.676839	.627412	582009	.510269	•501866	.466507
	.766417	.702587	.644609	.591898	.543934	.500249	. 460428	.424098
9 10	.744094	.67,5564	.613913	.558395	.508349	.463194	.422411	-385543
		.649581	.584679	.526787	•475093	.428883	-387533	-350494
II	.722421	.624597	.556837	.496969	.444012	.397114	•355535	.318631
12	.701380	.600574	.530321	.468839	.414965	.367698	.326179	.289664
13	.680951 .661118	•577475	.505068	.442301	.387817	.340461	.299246	.263331
15	.641862	.555265	.481017	.417265	.362446	.315242	.274538	.239392
			458112	.393646	.338735	.291891	.251870	.217529
16	623167	.533908	436297	.371314	.316574	.270269	.231073	.197845
17		.513373	415521	-350344	.295864	.250249	.211994	.179859
18		.493628 .474643	-395734	-330513	.276508	.231712	194490	.163508
19	.570286 .553676	.456387	.376890	.311805	-258419	.214548	.178431	.148644
		·	.358942				.163698	
21	•537549	.438834	.330942	.294155	.241513	.198657	.150182	.135131
22	.521892	.421955	-325571	•277505 •261797	.210947	.183941	.137781	.122846
23	.506692	.405726	.310068	.246979	.197147	.170315	.126405	.101526
24		-390121	.295303	.232999	.184249	.146018	.115968	.092296
25	.4.77606	-315717						
26		.360689	.281241	.219810	.172196	135202	.106392	.083905
27	-450189	.346816	.267848	.207368 .195630	150402	.125187	.097607	.076278
28		•333477	•255094	.184557	140563	.115914	.089548	.069343
29		.320651	.242946	.174110	.131367	.107328		.063039
30		.308319	-231377			•099377	•075371	-057309
31	-399987	.296460	.220359	.164255	.122773	.092016	.069148	.052099
32	-388337	.285052	.209866	•154957	.114741	.085200	.063438	.047362
33		-274094	.199873	.146186	.107235	.078889	.058200	.043057
34		.263552	.190355	.137012	.093663	.073045	.054395 .048986	.039143
35		.253416				.067635		.035584
36		.243669	.172657	.122741	.087535	.062625	.044941	.032349
37		.234297	.164436	.115793	.981809	.057986	•041231	.029428
38		.225295	.156605	.109238	.076457	.053690	.037826	.026735
39	-315754	.216621	.149148	.103056	.071455	.049713	.034703	.024304
40		.208289	.142046	.097222		-046031		:022095
. 41	.297658	.200278	.135282	.091719	.062412	042621	.029209	.020086
42		-192575	.I 2884n	.086527	.058329	.039464	•026797	.018260
43	.280543	.185168	.122704	.081630	•054513	.036541	.024584	.016600
44	•272372	-178046	198911	.077009	.050946	.033834	.022555	.015091
45		-171198	-111297	.072650	.047614	.031328	.020692	.013719
46		.164614	.105997	.068538	.044499	.029007	.018984	.012472
47	.249259	.158283	.100949	.064658	.041587	.026859	.017416	.011338
48		152195	.096142	.060998	.038867	.024869	.015978	.010307
49		•146341	.091564	.057546	.036324	.023027	.014659	.009370
50	-228107	140713	.087204	.054298	.033948	.021321	.013449	.008519
			·····			-		

.TABLI

TABLE II. continu'd.

Being the present Value of One Pound, payable at the End of any Number of Years from 51 to 100, Discounting at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 101. per Cent. per Ann. Compound Interest.

								
Te.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
51		135301	.083051	-051215	.031727	.019742	.012338	.007744
52	-	130097	.079296	.048316	.029651	-018280	.011319	-007040
53	·208750	-125093	.075330	.045582	.027718	.016925	•010385	.006400
54	.2 02670	.120282	.071743	•043201	.025899	.015672	.009527	.005818
55		.115656	.068326	.040567	•024204	.014511	£008741	.005289
56	.191036	.111207	.065073	.038271	.022621	·013436	•008019	∙0048ø8
57	.185472	.106930	.061974	.036105	021141	012441	.007357	.004371
58	.180070	.102817	-059023	.034051	.019758	.011519	-006749	- 003974
59		.098863	.056212	.032133	.018465	.010666	.006192	.003613
60	.169733	.095060	-053536	.030314	.017257	.009876	.005681	.003284
61	.164789	.091404	.050986	.028598	.016128	.009144	-005212	.002986
62	1 ***********	.087889	.048558	.იარე8ი	.015073	.008467	-004781	.002714
63	1///// 1	-084508	.046246	-025453	:014087	.007840	.004387	.002458
64	1	-081258	•044744	.024012	.013166	.007259	-004124	.002243
65		.078133	-041946	.022653	-012304	.006721	.იივნ92	.002039
66		.075128	•039949	.021370	.011497	.006223	.003387	-001854
67		-072238	•038047	.020161	-010747	.005762	:003 [08	.001685
68		.069460	.036235	.019020	.010044	.005336	.002851	+001534
69		.065788	.034509	•017943	•009387	.004940	.002616	-001393
70	.126297	.064219	.032866	-016927	-008773	.004574	-002400	.001166
71	.122619	.061749	-031301	015969	.008199	.004236	•002202	.001151
72		.059374	.029311	•01506 5	.007862	.003922	.002020	.001046
73		.057091	•02839 i	.014213	.007161	.003631	.001853	.000951
74		-054395	.027039	•013458	.006693	.003362	·001700	.000865
75	.128945	-052784	.025752	.012649	.006255	\$11500	-001560	.000786
76		.050754	.024525	•011933	.005846	-002883	.00143T	.000715
7.7		.043851	.023357	.011258	.005463	.002669	.001313	•000649
78	•099700	.046924	.022245	.010620	.005105	.002471	.001104	-000591
79	•096796	-045120	.521186	.010019	.004772	.002288	.001105	-000537
80	-093997	•043384	.020177	.009452	.004460	-002119	.001014	4000488
81	-091240	.041716	.019216	.008917	.004168	.001962	.000930	-000444
82	-038582	.045111	.018301	.008412	.003895	001817	.000853	-000403
83	. 086002	.038569	.017430	.057936	.003640	.∞1682	-000783	1000367
84	.083497	.037085	.016600	•007487	.003402	.001557	•000718	1000333
1 1	.03:065	.735659	.015809	.007063	.003180	-001442	.000659	•000303
86	.078704	.034287	.015056	.006663	.002972	.001335	•000604	-000276
87	.076412	.032969	.014339	.006286	.002.777	.001236	•00a554	•000251
88	.074186	•031701	.013657	.005930	.002596	.001145	.000509	-000228
89	.07:026	.030481	.013006	.005595	.002426	•001060	-000467	•000207.
90		.029309	.012387	.005278	-002267	186000	.000428	881000
24	.067891	.028182	.011797	.004979	002119	.000909	1000393	.000171
92	.065914	.027098	.011235	.004697	.001980	.000841	•000360	.000156
93	• • • • • • • • • • • • • • • • • • • •	.026056	.010700	.204432	.001851	•000779	.000331	-000141
94	.062130	.025055	161010	.004181	.001730	.000721	•000303	.000129
25	.060320	•024090	.009705	.003944	.001616	.000668	.000278	.000117
96	.058563	.023163	.009243	.003721	.001511	810000	.000255	.0001¢6
97	.056858	.022272	-008√03	.003510	•00141 <u>a</u> .	.000573	.000234	.000097
98	•055202	.021416	.008384	1003312	.001313		-00015	" onnn88
1001	•	.020592	.007985	.003124	.001233	.000491	.000197	•00008q
1.00	•052033	.019800	•007604	•002947	.001152	.000455	.81000.	•nono7.4
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TABL

TABLE III.

The Amount of One Pound in any Number of Years not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

Te.	3 per Cent.	4 per Cent.	s per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	o per Cent.	10 per Cept.
_		<u> </u>						
. 1	1.000000	1.000000 2.040000	2.050000	1.000000	1.000000	1.000000 2.080000	1.000000	1-000000
2	2.030000	3.121600	3.152500	2.060000 3.183600	2.070000 3.214900	3.246400	2.090000 3.278100	2.100000 3.310000
'3	3.090900 4.183 <i>0</i> 2 <i>7</i>	4.246464	4310125	4.374616	4-439943	4.506112	4.573129	4-541000
4	4.309136	5.416323	5.525631	5.637093	5.750739	5.866601	5.984711	6.105100
	6.468410	6.632975	6.801913					
6	7.662462	7.898294	8.142008	6.975319 8.393838	7.153291 8.654021	7.335929 8.922803	7·523335 9·200435	7.715610 .9.487171
J8	8.892336	9.214226	9.549109	9.897468	10.259803	10.636628	11.028474	11.435888
19		10.582795	11.036564	11.491316	11.977989	12.487558	13.021036	13.579477
10	ال <i>ه م</i> د ا	12.006107	12.577893	13.180795	13.816448	14.486562	15,192930	15.937425
11	12.807 196	13.486351	14-206787	14.971643	15.783599	16.645487	17.560293	18,531167
12	14-192030	15.025805	15.917127	16.86994t	17.888451	18.977126	20.140720	21.384284
13	15.617790	16.626838	17.712983	18.882138	20.140643	21.495297	22.953385	24.522712
14	17.086724	18.291911	19.598632	21.015066	22.550488	24.214920	26.019189	27.974983
15	18.598914	20.023588	21.578564	23.275970	25.129022	27.152114	29.360916	31.772482
16	20.156881	21.824531	23.657492	25.672528	27.888054	30-324283	33.003399	35.949730
17	21.761 \$88	23.697512	25.840366	28.212880	30.840217	33.750226	36.973704	40.544703
, 8	23.414435	25.645413	28.132385	30.905653	33.999033	37.450244	41.301338	45.599173
19		27.671229	30.539004	33.759992	37.378965	41.446263	46.018458	51.159090
20	l ' '	29.778079	33.065954	36.785591	40.995492	45.761964	51.160119	57-274999
21	28.676486	31.969202	35.719152	39.992727	44.865177	50.422921	56.764530	64.002499
22	30.536180	34-247970	38.505214	43.392290	49.005139	55.456755	62.873338	71.402749
23	32.452884	36.617889	41.430475	46.995828	53.436141	60.893296	69.531938	79.343024
24	34.426470	39.082604	44.501999	50.815577	58.176677	66.754759	76.789813	88.497327
25	36.459164	41.645908	47.727099	54.864512	63.249038	73.105940	84.700896	98.347059
26	38.553042	44.311745	51,113454	59-156383	68.676470	79.954415	98-323977	109.181765
27	40.709633	47.084214	54,669126	63.705766	74.483823	87.350768	102.723134	121.099942
28	42.930922	49.967583	58.402583	68.528112	80.697691	95.338830	112.968216	134.209936
29	45.218850	52.966286	62.322712	73.639798	87.346529	103.965936	124.135356	148.630930
30	47.575416	56.084938	66.438848	79.058186	94.460786	113.283211	136.307538	164.494023
31	50.002678	59.328335	70.760790	84.801677	102.073041	123.345868	149.575216	181.943425
32	52-502759	62.701469	75.298829	90.889778	110.218154	134.213537	164.036986	201.137773
133		66.209527	80.063771	97.343165	118.933425	145.950620	179.800315	222.251550
.34	57.730777.	69.857939	85.066959	104.183755	128.258765	1 58.626670	196.982343	245.476705
35	60.462082	73.652225	90.320307	111-434780	138-236878	172.316804	215.710754	271.024376
-36		77.598314	95.839323	119.120867	148.913460	187.102148	236.124722	, ,,
37		81.702246	101.628139	127.268119	160.337402	203.070320	258.375947	1 22 26 17 6
38		85.970336	107.709546	135.904206	172.561020	220.315945	282.629782	1 7 1 17 12 2
:39	72.234233	90,409150	114.095023	145.058458	185.640292	238.941221	309.066463	401.447789
.40	1	95.025516		154.761966	199.635112	259.056519	337.882444	
41			127,839763	165.047684	214.609570	280.781040	369.291864	487.851824
42	1		135,231751	175-950545	230.632240	304-243523	403.528132	537.637007
43		110.012382	142.99 3339	187.507577	247.776496	329.583005	1440.845064	592.400707
44	10/	115.412877	159.700156	199.758032	285.749311	386.505617	481.421775	652.640778
4		121.029392		212.743514		·		
4					306.751763		574.186021	
	7 100.39650E	132.945390	178.119422		329.224386			
	8 104.408396 0 108.540648	139.263206	198 42 4662	256.564529	353.270093	490.132164 530.342737	746.866648	960.172363
1 7	01112.706867	11 52.667084	209.3419	290.335905	1406.528020	573-770156	1815.082557	1163,908560
}		1.,2.50,.50	1 2 2 3 4 7 5	1-7337739	14	1713-111119	13.7663777	1.103.900,00
}		ero, in a	· · · · · ·					

TABLE III. continu'd.

Being the Amount of One Pound, in any Number of Years, not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

		,			·		
Ye. 3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.		8 per Cent.	9 per Cent.	10 per Cent.
51117-180773		.220.815395			1		1281.299416
52 121.696197		232.856165			671.325510		
53126.347083						1058.834943	
54 131.137495				537-316442	785.114074	1155.130088	
55136.071620	191.159172	272.712618		575.928593	848.923200	1260.091796	1880.591474
56 141.153768	199.805547		418.822349	617.253594		1374.500058	2069.650522
57 146.388381	208.797762		444.951689			1499.205063	
58 151.780033			472.648790		1072.645.143		
59157-333434			502.007718	759,364844			2758.014978
60 163.053437				813.520383	1253.213294	1944.792134	
61168.945040	248.510313	372.262904	556.115872	871.466810	1354.470358	2120.823426	
62 175.013391		391.876049	601.082824		1463.827986		
63 181.263793				999.812351	1581.934225	2521.840312	4042.650129
64 187.701707			677.436661	1070.799215	1709.488963	2749.805940	
65 194.332758			719.082861	1146.755161	1847.248080	2998.288475	4893.707382
66 201.162741		480.637912	763.227832	1228.028022	1996.027927	3269.134438	
67 208.197623	321.077800			1314.989983	2156.710161	3564356537	5923 .4 85 9 32
68 215.443552		531.953298		1408.039282	2330.246974		6516.834526
69 222 9068 58	1 2				2517.666731	4236.902002	
70 230.594064		588.528511	967.932170		2720.080070	4619.223182	
71238.511886	379.862077	618.954936	1027.008100	1728-123566	2938.686476	5035.953268	8677.216754
72 246.667242	396.056560	650.902683	1089.628586	1850.092216	3174.781394		9545.938429
73255.067260		684.447817	1156.006301	1980.598671	3429.763905		
74263.719277		719.670208	1226.366679	2120.240578	3705.145017	6524.983625	11552.685499
75 272 630856			1300.948680	2269.657418	4002.556619		12708.954049
76,281.809781			1380.005601	2429.533438	4323.761148		
77291.264075	487.279686	836.260724	1463.805937	2600.600778			
78 301.001997	507.770879	879.073761	1552.634293	2783.642833		9215.120019	
79311.032057		924.027449	1646.792350	2979.497831		10045.480821	18611-820623
80321.363019		971.228821	1746.599891	3189.062679		10950.574095	20474-002586
81 332-003909	574.294776	1020.790262		3413.297067	6358.890253	11937-125764	22522-402954
82 342.964027	598.266567	1072.829775		3653.227862	6868.601474	13012.467082	24775.643250
83 354-252947	623.197229	1127.471264		3909.953812	7419.089592	14181.589120	27254.207575
84365.880536		1184.844827		4184.650579	8013.616759	15462.202141	29980.628332
85 377.856952		1245.087069		4478.576119			32979.691165
86390.192660	704.133728	1308.341422	2484.560646	4793.076448	9349 62587	18372.732363	36278.660282
87402.898440	733.299078	1374.758493	2634.634285	5129.591799	10098.095594	20027.278276	39907.526310
88415.985393		1444.496418		5489.663225	10906.943242	21830.733321	43899.278941
89429.464955		1517.721239		5874.939651	11780.498701	23796.499320	48297.006835
90443.348904	827.983334	1594.607301	3141.075187	6287.185426	12723.938597	25939.184258	53120.227519
91457-649371	862.102667	1675.337666	3330.539698	6728.288406	13742.853685	28274710842	58433.250271
92472.378852	897.586774	1760.104549	3531.372080	7200.268594	14843.281980	30820.434817	64277.575298
93 487.550218	934-490244	1849-109776	3744-254405	7705.287396	16031.744538	33595.273951	70706.322827
94 503.176724	972.869854	1942.565265	3969.90 966 9	8245.657514	17315.284101	36619.848607	77777.966110
95 519.272026	1012.784648	2040.693528	4209.104250	8823.853540	18701.506829		
96 535.850187	1054-206024	2143.728205	4462.650504	9442.523285	20198.627376	43510.132130	94113.438993
97552.025602	1007.467876	2251.014615	4731.409535	10104 499918	21815.517566;	47427.044021	103525.782892
98 570,512462	11142.266501	2365.510246	5016.294107	10812.814912	23561.7589711	51696.477983	113879.301182
991588.628867	11180.061254	12484.7858621	5318.271753	11570.71195c!	25447.099089	50350-101002	125208.297300
100 607.287733	1237.623705	2610.025156	5638.368058	12381.661793	27484515664	61422.675492	137796.127030

TABLE IV.

The Present Value of One Pound per Annum, for any Number of Years to come, not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

1							·	
Te.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Lent.	9 per Cent.	10 per Cent.
	.970874	.961539	.952381	.943396	.934579	.925926	.917431	.909091
2	1.913370	1.836:95	1.859410	1.833393	1.808018	1.783265	1.759111	1.735537
3	خمُ شا	2.775091	2.723249	2.673012	2.624316	2.577097	2.531295	2.496352
4		3.629896	3.545950	3.4651.06	3.387211	3.312127	3.239720	3.169865
5		4.451823	4-329477	4 212364	4.100198	3.992710	3.889651	3.790187
6		5.242137	5.075612	4917325	4.766540	4.622880	4.485919	4.355261
7	6.230283	6.002055	5.786374	5.582382	5.389290	5.206371	5,032953	4.868419
8		6.732745	6 463213	6.209794	5.971299	5.746640	5.534819	5.334926
و		7.435332	7.107822	6.801692	6.515233	6.246889	5.995247	5.759024
10	1 6	8.110896	7.721735	7.360087	7.023592	6.710082	6.417658	6-144567
11		8.760477	8.3064:5	7.886875	7.498675	7.138965	6.805191	6.495061
12	1	9 385074	8.863252	8.383844	7.942687	7.536079	7.160725	6.813692
13		9.985648	9.393573	8.852683	8.357652	7.903177	7.486904	7.103356
14		10.563124	9.898641	9.294984	8.745459	8.244238	7.786151	7.366633
15		11.118388	10.379653	9.712249	9.101915	8.559480	8.060689	7.606080
(<u>-</u>		11.652297	10.837770	10.105895	9.446649	8.851370	8.312559	7.823709
16		12.165670	11.274067	10.477260	9.763224	9.121639	8.543632	8.021553
18		12.659298	11.689587	10.827603	10.059088	9.371888	8.755625	8.201412
19	1 1116	13.133941	12.085321	11.158116	10.335595	9.603601	8.950115	8.364920
20	1 4 -	13.590328	12.462211	11.469921	10.594016	9.818149	9.128546	8.513564
21		14029162	12.821153	11.764 177	10.835525	10.016805	9.292244	8.643694
22	1 ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '	14.451117	13.163003	12.041582	11.061242	10.200745	9.442426	8.771540
23		14.556943	13.488574	12.303379	11.272189	13.371061	9.580207	8.883218
24		15.246965	13.798642	12.550357	11.469335	10.528760	9.706612	8.934744
25		15.622082	14-093945	12.783356	11.653585	10.674778	9.822580	9.077040
26		15.982771	14-375185	13.003166	11.825780	10.809980	9.928973	9.160945
27	1 3	16.329587	14.643034	13.210534	11.986710	10.935167	10.026580	9.237223
28		: 6.663065	14.898128	13.406164	12.137113	11.051081	10.116128	9.306566
29	1	16.983716	15.141074	13.590721	12.277676	11.158408	10.198283	9.369606
30	1	17.292035	15.372452	13.764831	12.409043	11.257785	10.273654	9.426914
31	·	17.588495	15.572811	13.929086	12.531816	11.349802	10.342802	9.479013
32	0.01.2	17.873553	15.802677	14.084043	12.646557	11.435002	10.406240	9.526376
33	1	18.147647	16.002550	14.230229	12.753792	11.513891	10.464441	9.569432
34	1	18.411199	16.192905	14.368141	12.854014	11.586936	10.517836	9.608575
1 3		18.564515	16.374195	14.478246	12.947674	11.654570	10.566822	9.644159
30		18.909284	16.546952	14.620937	13.035209	11.717195	10.611763	9.676508
37		19.142580	16.711288	14.736780	13.117018	11.775181	10.652994	9.705917
38		19.367866	16.867893	14.846019	13.193475	11.828871	10.690820	9.732651
39		19.584486	17.017041	14.949074	13.264930	11.878595	10.725523	9.756956
40		19-792775	17.159087	15.046297	13.331710	11.924615	10.757360	9.779051
41		19,993053	17.294369	15.138016	13.394122	11.967237	10.786569	9.799137
42		20.185628	17.423208	15.224543	13.452451	12.006701	10.813366	9.817397
4		20.370797	17.545913	15.306173	13.506963	12.043242	10.837951	9.833998
4	1 24.254276	20.548843	17.662774		13.557910		10.860505	9.849089
4		20,720041	17.774070	15.455832	13.605523	12.108474	10.881197	9.861808
4	6 24.775451	20:854655	17.880067	15.524370	13.650022	12.137411	18100601	9.875280
4				15.589028	13.691609	12.164269	10.917597	9.886618
4	25.266709		18.077158	15.650026	13.730476	1	10.933576	
4	9 25.501659	21.341474	18.168722					9.906295
. 59	0 25.729766	21.482186	18.255925	15.751860	13.800748	12.233487	10.961633	9.914814
1-								

TABLE IV. continu'd.

Being the Present Value of One Pound per Annum, for any Number of Years to come, not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 l. per Cent. per Ann. Compound Interest.

			· · · · · · · · · · · · · · · · · · ·					
Te.	3 per Cent.	4 per Cent.	5 per Cent.	6 per Cent.	7 per Cent.	8 per Cent.	9 per Cent.	10 per Cent.
51	25.951230	21.617487	18.338977	15.813076	13.832475	12.253229	10.974021	9.922558
52	26.166242	21.747594	18.418074	15.861392	13.862126	12.271508	10.985341	9.929599
53	26.374993	21.872677	18.493403	15.906974	13.889838	12.288434	10.995725	9-935999
54	26.577663	21.992958	18.565146	15.949975	13.915736	12.304105	11.005253	9.941817
55	26.774430	22.108614	18.633472	15.990543	13.939941	12.318616	11.013993	9.947106
56	26.965466	22.219821	18.698545	16.028814	13.962561	12.332052	11.022012	9.951915
57	27-150938	22.326751	18.760519	16.064919	13.983702	12.344493	11.029369	9.956286
58	27.331008	22.429568	18.819542	16.098980	14-003460	12.356012	11.036118	9.960260
59		22.528431	18.875754	16.131113	14-021926	12.366678	11.042310	9.963873
60	27.675566	22.623491	18.929290	16.161428	14.039185	12,376554	11.047991	9.967157
61	27.840356	22.714896	18.980276	16.190026	14.055311	12.385698	11.053203	9.970143
62	28.000346	22.802784	19.028834	16.217006	14.070384	12.394165	11.057984	9.972857
63	28.155675	22.887293	19.075080	16.242458	14-084371	12.402005	11.062371	9.975325
64		22.968551	19-119114	16.266470	14.097637	12.409264	11.066395	9.977568
65	28.452894	23.046683	19.161071	16.289123	14.109941	12.415989	11.070087	9.979607
66		23.121811	19.201020	16.310493	14-121440	12.422209	11.073475	9.981461
67	29.733052	23.194049	19-239066	16.330654	14.132187	12.427971	11.076582	9.983146
68		23.263509	19.275301	16.349673	14.142231	12.433307	11.079433	9.984679
69	28.967127	23.330297	19309811	16.367616	14.151618	12.438247	11.082049	9.986271
70	1 -	23.3945:6	19.342677	16.384544	14.160391	12.442822	11.084448	9.987338
71	29.246043	23.456266	19.3739.78	16.400513	14.168590	12.447057	11.086650	9.988489
72		23.515640	19.403789	16.415578	14.176252	12.450979	11.988670	9.989535
73		23.572731	19.432180	16.429791	14.183413	12,454610	11.090523	9.990487
74		23.627626	19.459219	16.443199	14.190106	12.457973	11.092223	9.991351
75		23.680410	19.434970	16 45 5848	14.196361	12.461086	11.093782	9.992138
76		23.731163	19.509495	16.467781	14.202207	12.463969	11.095213	9.992852
77		23.779965	19 532853	16.479039	14.207670	12.466638	11.096526	9.993502
78		23.826889	19.555098	16.489659	14-212776	12.459109	11.097730	9.994093
79		23.872009	19.576284	16.499678	14.217547	12.471397	11.098835	9.994630
80	30.200766	23.915393	19.596461	16.509131	14.222007	12.473516	11.099849	9.995118
81	30.492006	23.957109	19.615677	16.518048	14.226175	12.475478	11.100778	9.995562
82	1 2 2	23.997220	19.633978	16.526460	14.230070	12.477295	11.101632	9.995965
83		24.035789	19.651408	16.534396	14.233710	12.478977	11.102414	9.996332
84		24.072874	19.668007	16.541883	14-237113	12.480534	11.103132	9.996665~
85	30.631154	24.108533	19.633816	16.548947	14.240292	12.481076	11.103791	9.996969
86	30-709858	24.142820	19.698873	16.555610	14.243264	12.483311	11.104396	
87		24.175788	19.713212	16.561896	14-246041	12.484548	11.104390	9.997495
88		24.207489	19.729869	16.567827	14.248637	12.485692	11.105459	9.997723
89		24-237970	19.739875	16.573421	14.251062	12.486751	11.105925	9.997930
90	31.002410	24.267279	19,752262	16.578699	14.253329	12.487734	11.106354	1
91	31.070301	24.295461	19.764059	16.583679	14-255448			
92		24.322558	19.775294		14.257428	12.489484	11.107107	
93	31.200209	24.348614	19.785994		14-259279		11.107437	
94		24.373667	19.796185				11.107741	
9:		24-397757	19.805891			12.491652		
90		24.420900			14.264135		·	. [
9		24 443193						9.999034
9	31.493281	24.454608	19.832321	16.611475	14.266866	12.493373		
99	31.546875	24.485200	19.840306	16.614599	14.268099	12.493864		
100	31.598908	24.505000			14.269252	12.494319		
F.S	33-333333	25.000 200	20.000000	16.666067	14.285714		-	10.000000
1								
1	,	•	•					

The

The Use of the preceding Tables.

The Amount or present Value of any Sum of Money, for any Number of Years, not exceeding 100, at any of the aforesaid Rates of Interest, is thus found:

Look in the first or second Table for the Number of Years, and even with that Number, under the Rate of Interest, is the Amount or pre-fent Value of 1 l. which Amount or present Value so found, being multiply'd by the principal Sum, the Product is the Amount or present Value requir'd.

After the same manner, the Amount or pre-fent Value of any Annuity, or other yearly Payment, is found by the third or fourth Table.

Examples.

Quest 1. What will 125 l. amount unto in 15 Years, at 5 l. per Cent. per Ann. Compound Inte-

In Table I. even with 15 Years, and under 51. per Cent. I find the Amount 2.078928 of 1 l. to be Which multiply'd by the Principal - - 125

The Product will be - - - 259.866, &c.

Answ. 259 l. 175. 4 d.

Quest. 2. What is the present Value of 2591. 17s. 4d. to be paid at the End of 15 Years, discounting at the Rate of 51. per Cent. per. Ann. Compound Interest?

In Table II. even with 15 Years, and under 5 l. per Cent. I find the present >.481017 Value of 11. to be

Which multiply'd by the Prin-

The Product will be -125.000, &c.

Answ. 125 l.

Quest. 3. What will 151. per Ann. amount unto in 21 Years, at 81. per Cent. per Ann. Compound Interest?

In Table III. even with 21 Years, and under 81. per Cent. I find the >50.422921 Amount of 1 l. per Ann. to be Which multiply'd by - -

The Product will be - -: -756.343815

Answ. 7561.65. 10 d.

Quest. 4. What is the present Value of 15 l. per Ann. for 21 Years to come, at 81. per Cent. per Ann. Compound Interest?

In Table IV. even with 21 Years, and under 81. per Cent. I find the 10.016805present Value of 11. per Ann. to be Which multiply'd by

The Product will be 150.252075

 $An \int w$, 150l. 5s. $0\frac{1}{3}d$.

Quest. 5. What will 1501. 5 s. 0 1 d. amount unto in 21 Years, at 81. per Cent. per Ann. Compound Interest?

In Table I. even with 21 Years, and). under 81. per Cent. I find the Amount >5.033834 of 11. to be

Which multiply'd by I 50.252

The Product will be - - -756.343, &c.

Answ. 756 l. 6 s. 10 l d.

Which Answer is the same with that given to the third Question, and shews the Agreement of the Tables one with the other.

Quest. 6. One baving the Lease of an Estate, Value 60 l. per Ann. more than the reserv'd Rent, 12 Years to come, would know what Sum ought to be paid, to add 28 Years to the Term, and thereby make it 40 Years to come, computing at the Rate of 61. per Cent. per Ann. Compound Interest?

I find in Tab.IV. the present Value > of 1 l. per Ann. for 40 Years to come, > 15.046297

of 1 l. per Ann. 101 40 101.

at 6 l. per Cent. per Ann. to be
I find in the same Table the Value

for 12 Years to come, 8.383844 at the same Rate, to be

> 6.662453 The Difference is - -Which multiply'd by -

> The Product will be - - 399.747180

Answ. 399 l. 145. 11 4d.

Quest. 7. A has the Possession of an Estate of 1001. per Ann. 15 Years to come, B has the Reversion of the same Estate for ever, after the Expiration of the said 15 Years. It is demanded, What is the present Value of A's Term of 15 Years? And, What the present Value of B's Reversion, computing at the Rate of 51. per Cent. per Ann. Compound interest? interest?

I find in the last Line of Table I find in the last some the Fee IV. under 5 l. per Cent. the Fee 2000. Simple of 11. per Ann. to be worth) 201. which multiply'd by 100, the Product is

I find in the same Table, the Value of 1 l. per Ann. 15 Years to come, at the same Rate, to be 10.379658; which multiply'd by 100, the Pro->1037**.965**8 duct is

> The Difference is 962.0342

Answ.1037 1. 19 s. 3 d. the Possess. 15 Ys. tocome. 9621. 01. 8 td. the Revers. after the said (15 Years. 2000 l. - - the Fee Simple.

Quest. 8. For a Lease of certain Profits for seven Years, A makes two Offers, either to pay 1501. as a Fine, and 300l. per Ann. or 1700l. Fine, wishout any Rent. B bids 650l. Fine, and 200l. per Ann. And C 2001. Fine, and 4051. per Ann.

The Question is, which is the best Offer, and what the Difference, computing at the Rate of 51. per Cent. per Ann. Compound Interest?

The Amount of 11. in 7 Years

1. s. d. at 51. per Cent. (in Table I.) multiply'd by 1501. is
The Amount of 11. per Ann. in

7 Years, at 5 l. per Cent. (in Table \$2442 12 00! III.) multiply'd by 300l. is

Therefore A's first Offer, at the \$2653 13 04

The Amount of 1 l. in 7 Years, at 5 l. per Cent. multiply'd by 2392 01 05 amount to in the same time

The Amount of 1 l. in 7 Years,

at 5 l. per Cens. multiply'd by

650 l. is

The Amount of 1 l. per Ann in

7 Years, at 5 l. per Cens. multiply'd

1628 08 00's

by 200 l. is

Therefore B's Offer, at the End 3 co o4

The Amount of 1 l. in 7 Years,

at 5 l. per Cent. multiply'd by

200 l. is

The Amount of i l. per Ann. in 7 Years, at 5 l. per Cent. multiply'd 3297 10 03 by 405 l. is

Therefore C's Offer, at the End 3578 18 08

The Amounts of the said Offers, at the End of the said Term, being thus known, look (in Tab. II.) for the present Value of 1 l. payable at the End of 7 Years, at 5 l. per Cent. which will be found to be .710682. Which said Value being multiply'd by the said several Amounts, the Products will be the present Value of the said several Offers, Viz.

l. s. d.
The present Value of A's 1st will be 1885 18 23
A's 2d 1700 00 00
B's - 1807 05 06
C's - 2543 09 08

Therefore the present Value of what Coffers is more than As 1st. 657 11 05
A's 2d. 843 09 08
B's - - 786 04 02

Which answers the Question.

Or thus;

A's 1st Offer is 300 l. per Ann. l. s. d. the present Value of which, for 7 1735 03 06 Years, at 5 l. per Cent. is

And a Fine of — 150 00 00

1885 18 93

A's 2d Offer is 2 Pine of 1700 00 00

Vol. II.

B's Offer is 200 l. per Ann, the present Value of which, for 7 1137 05 06 Years, at 5 l. per Cent. is

And a Fine of - 650 00 00

C's Offer is 405 l. per Cent. the

present Value of which, for 7

Years, at 5 l. per Cent. is

And a Fine of — 200 00 00

2543 09 08

Therefore C's is more than A's 1st 657 11 05
A's 2d 843 09 08
B's - 736 04 02

Quest. 9. A gives 1550l. for an Annuity of 100l. per Ann. for 99 Years. B put; 1550l. out at Interest. It is required to know, which will amount to the greatest Sum, at the End of the said 99 Years, at the Rate of 61. per Cent. per Ann. Compound Interest?

The Amount of 1 l. per Ann.

1. s. d.

in 99 Years, at 6 l. per Cent. (in 531827 03 06

Tab. III.) multiply'd by 100/l. is

The Amount of 1 l. in 00

The Amount of 1 l. in 99 Years, at 6l. per Cent. (in Tab, I.) 495149 05 51 multiply'd by 1550l. is

Therefore A's 100 l. per Ann.
will amount to more than B's 35677 18 of

Which answers the Question.

If the present Value of that Difference is required, find the present Value of 1 l. payable at the End of 99 Years, at 6 l. per Cent. (in Table II.) which multiply'd by the Difference, the Product will be the present Value thereof, viz. 111 l. 9 s. 2 d.

The prefent Value of the Difference is likewife thus found:

Pind the present Value of 1 l.

per Ann. for 99 Years to come
at 6 l. per Cent. (in Tab. IV.)

which multiply'd by 100 l. the

Product will be

1661 09 02

Which is the present Value of 1001. per Ann. for 99 Years, at 61. per Cent.

And from which subtract 1550 00 00

There will remain _____ III 09 0

Which is the present Value of the Difference.

Or thus:

The Interest of B's 1550 l. at 61, per Cent. is 93 l. per Ann. Therefore A receives 7 l. per Ann. more than B.

The present Value of 7!. per Am. for 99 Years to come, at 6!. It 6 06 6 per Cons. is

The present Value of 15501. to? 4 16 10 be paid at the End of 99 Years, is S

Therefore the present Value of } iri 09 03 the Difference, is

After the same manner, most other useful Questions in Compound Interest, are easily answerd.

INTERTIES in a Building, are those small Pieces of Timber that lie horizontally between the Sommers; or between them and the Sell or Realon.

INTERVAL of the Fits of easy Reflexion, and of easy Transmission of the Rays of Light, is the Spaces between every Return of the Fit,

and the next Return.

These Intervals Sir If. Newton shews how to colleft, and thence to determine whether the Rays shall be reflected or transmitted at their subsequent Incidence on any pellucid Medium. (See Light, &c. and Newton's Opticks, Book 2. Part 3.)

INTESTINES, are a long and large Pipe, which by feveral Turnings and Windings reaches from the Pylorus to the Anus: They are knit all along the Edge of a Membrane call'd the Mesentery, and are usually fix times as long as the Body to which they belong; that so the Chyle, which escapes the Lacteals of one of the Guts, may be taken up by those in the next. They have three Coats, of which the inmost is made up of short Fibres bound together by fine Blood-Vessels, and disposed as those of the Stomach: For the Length of a Fibre is the Thickness of the This Coat being much larger than the other, lies in Wrinkles or Plaits, which are call'd Valvula Conniventes. It hash also a great Number of little Glands, which in the small Guts lie in Clusters every where, but where they are knit to Liquor for the diluting of the thick Chyle, that it may the more easily enter the small Orifices of the Lacteals. The second Coat is made up of two Orders of Muscular Fibres, one running Araight, according to the Length of the Guts; the other goes round, describing rather a spiral than a circular Line. By the successive Motion of these two Orders of the Fibres, the Guts are in a continual Undulation; which is called the Vermicular or Peristaftick Motion of the Intestines. The third and external Coat is common, and comes from the Peritoneum.

The Intestines, the properly but one continued Pipe, yet are divided into fix Parts; three thin and small, and three thick and great. The thin and small are the Duodenum, the Jejunum, and Henn. Thick and great Gues are the Cecson, Colon, and Redum: See those Words.

INTESTINE Motion of the Parts of Fluids. Where the attracting Corpuscles of any Fluid are elastick, they must necessarily produce an Intestine Motion; and this greater or lesser, according to the Degrees of their Elasticity and attractive Forces.

For two elastick Particles, after meeting, will fly from one another (abstracting from the Resistance of the Medium) with the same Degree of Velocity that they met together with. (See Ela-flicity.) But when in leaping back from one another they approach other Particles, their Velocity will be encreased.

INTRENCHMENTS, are all Sorts of Works made to fortify any Post against an Enemy; There is usually a Ditch with a Parapet, or Rows of Fascines loaded with Earth, Gabions, Sand-Bags, or Hogsheads filled with Earth to cover the Men from the Fire.

INVADIATIONES, was a Term formerly used in the Law for Mortgages and Pledges: And

so Invadiare, was to Mortgage Land.

INVENTION, in Painting, Sculpture, & is the Art of finding out proper Objects for a Picture, by the Help of History or ancient Fables, &c.

INVENTIONES, was the Term formerly for what is now call'd Treasure-Trove, viz. Money or Goods found by any Person, and not challeng'd by any Owner: Which therefore by Common Law was due to the King (whence that old Rhyme used to this Day in many Countries by the Children, W bo bes loft? I have found,

In the King's Holy Ground.) And King Edw. I. we find, granted to the Barons of the Ports, Inventiones fuas per Mare & Terras,

INVERSE Method of Fluxions, is the Method of finding the Flowing Quantity from the Fluxion given; and is the same with what the foreign Mathematicians call the Calculus Integralis: On which Subject there is a Treatise publish'd in French by Mr. Carré, A.D. 1700, Printed at Paris.

Some call it Summatory Arithmetick; and the Reason and Foundation of it Mr. Hayes shews in

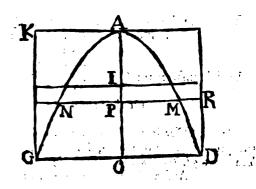
his Book of Flaxions.

He had, in Prop. 2. of his fourth Section, been shewing how to investigate the Area's of Hyperboliform Figures: And in Cor. 3. of that Proposition, he shews that 'tie manifest, that any Parabola, or the Complement of any Parabola, to the circumscribed Parallelogram; or an Hyperbola being given: And supposing the Ordinate (See Fig. 2. an-wer'd) PM = y; the Absciffa AP = x; PR = OD = b; the Axis OA = c: That all the PR, or b's are: to all the PM, or y's:: as m = 1: is

And if it be required to find what Proportion all the b's, advanced to any Power s, has to all the y's advanced to the same Power ", it may be

thus investigated.

Suppose the new Curve NG to be described, so that PN be always equal or proportional to PM or y", then it is manifest that the Sum of

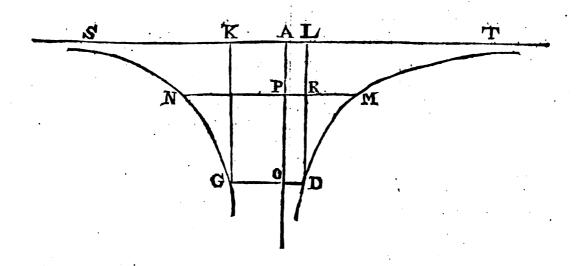


all the j' is equal to the Sum of all the PN, or to the curvilineal Space OAGN: And because y" is always equal or proportional to PN, and PN becomes equal to OG, at the same time

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that y" becomes equal to b'' = OD|''; 'tis like-

that to investigate the Proportion of all the y" to wise manifest, that the Sum of all the b^n is equal all the b^n is the same thing as to investigate the or proportional to the Sum of all the OG, or the Parallelogram AOGK. Whence it appears, the Parallelogram AOGK. Which may be done



thus: In Paraboloids and Hyperboloids, the General Equation expressing the Nature of such Curves is y''' = x, and consequently y'' = xNow suppose y'' = z, then $z = x^m$, and z^m x", which is an Equation, expressing the Nature of a Parabolitorm, or Hyperboliform Curve.

Let the faid Curve be ANG, and AP = x, AO = c, PN = z, and OG = d. Then (Hayes, Sect. 3. Art. 90.) $\frac{m}{n} \pm 1 : \frac{m}{n} : (m \pm n : m)$ all the d: to all the z. And because z was put equal to y"; therefore when z or PN becomes OG or d, then y" becomes b"; and consequently d is = b^n ; therefore $m = n : m : S : b' : S : \overline{b}''$

Hence we may easily deduce the 64th Prop. Arith. Infinit. first discovered by the Learned Dr. Wallis.

CONSECTARY I.

1. For we found before $z = x^m$, and it is also $m:m+n::1:1+\frac{n}{m}::y^n:b^n$. in the direct Series, and $1:1-\frac{\pi}{m}:$ all the y'': all the b''. in the Negative Series. Whence it is evident, that if the Exponent of the Power of the intercepted Diameter x, be taken for the Index of the Series, it will be as I is to the Power of the intercepted Diameter or Index of the Series (because Vol. II.

z = y'' = x'''; and consequently, x''' represents y" in the Dimension requir'd) increas'd by Unity ; fo are all the y'' to all the b''.

CONSECTARY, II.

2. Hitherto we have found the Proportion of all the y", or (multiplying both by the Fluxion x) $y^n x$ to all the $b^n x$, their absolute Value may be found thus: It was by the preceding Corollary, $m: m \rightarrow n:$ all the zx: all the dx; that is, so is the Space AOGN, to the Rectangle AOGK = dc: Therefore $\frac{m dc}{m = n}$ = all the $z \stackrel{\sim}{x} = S : y'' \stackrel{\sim}{x}$, (because z = y''.) But b'' = d; Therefore $S: y^n : = \frac{m d c}{m - n}$ I cb"

CONSECTARY III.

3. And if we suppose the Index $\Rightarrow \frac{n}{m} = \Rightarrow \mu_{\bullet}$ then the Value of all the y" x is $=\frac{1 c b^n}{1 = u}$; and again, If in the Place of b" we substitute c + "(because $y'' = x^{\frac{1}{m}}$, that is, when y becomes $= b_{s}$

and x = c, $c = b^{\mu} = c^{+\mu}$) we shall have all the $y^{\mu} \dot{x} = \frac{c^{1+\mu}}{1-\mu}$.

CONSECTARY IV.

4°. Hence Mercator's Lem. Prop. 16. Logarithmotechn. may be deduced, upon which the Learned Dr. Gregory's Geometrical Exercise chiefly depends. For because all the y^* x are = all the $x^{\pm \mu}$ x, it is evident, that (rejecting the invariable Quantities, if there be any) all the $x^{\pm \mu}$ x $=\frac{c^1 \pm \mu}{1 \pm \mu}$ (by putting the greatest x=c) $=\frac{c^1 \pm \mu}{1 \pm \mu}$ Whence we have the Demonstration of the fundamental Rule in Summatory Arithmetick, to find the flowing Quantity of a given Fluxion.

CONSECTARY V.

be divided into an infinite Number of x, the Sum of all the Rectangles contain'd under any Power of the Absciffi x, and all the x respectively, that is, the Sum of all the $x \to \mu$ x, or the Flowing Quantity, whereof $x \to \mu$ x is the Fluxion, is equal to $\frac{c \to \mu}{1 \to \mu} = \frac{x \to \mu + 1}{1 \to \mu + 1} = \text{to the Power}$ of x increased by Unity, and divided by the new Exponent. And seeing the Thread of my Discourse has led me on to this Head, I shall infish more at large on the same in the next.

PROP. I.

To find the flowing Quantity of any Fluxion.

The summing up of Infinites, or finding the Sum of all the Fluxions of an unknown Quantity, or the finding the Flowing Quantity from its Fluxion given, is not less difficult in many Cases, than the Reverse is easy. I shall begin with the easiest Examples, and proceed gradually to those that are more intricate and difficult.

Example I.

Let it be required to find the flowing Quantity of this Fluxion aax, or aax^0x ; to the Index of the flowing Quantity add 1, and then we have $aax^{0+1}x$; divide this by the fluxionary Letter x, and by the new Index 0+1, or 1, the Quotient aax is the flowing Quantity of the given Fluxion.

Example II.

Let it be required to find the flowing Quantity of ayx + axy; the flowing Quantity of the first Member ayx is = axy; and that of the second Member axy is = axy: Whence it is plain, that the flowing Quantity of ayx + axy is = axy.

Example III.

Let it be required to find the flowing Quantity of $3 \times x \times x$; increase the Index of the flowing Quantity x by 1, and then we have $3 \times^2 x$, which divide by the new Index 3, and by the fluxionary Letter x, then the Quotient $= \frac{3 \times^2 x}{3 \times x} = x^2$ is the flowing Quantity of the given Fluxion.

And Universally;

If it be requir'd to find the flowing Quantity of $m x^{m-1} x$, increase the *Index* of the flowing Quantity x by 1, and then we have $m x^{m} x$, which divide by the new *Index* m, and by the fluxionary Letter x, and there will arise x^{m} for the flowing Quantity requir'd.

Example IV.

Let it be requir'd to find the flowing Quantity of $\frac{a \cdot x}{x \cdot x}$; the Fluxion (Hayes, Art. 16.) express'd by the other way of Notation, is $a \cdot x^{-2} \cdot x$, and the flowing Quantity thereof is $-a \cdot x^{-1} = \frac{-a}{x}$. Thus the Flowing Quantity of $\frac{a \cdot x \cdot x}{x^{\frac{3}{2}}} = \frac{a \cdot x}{x^{\frac{1}{2}}} = a \cdot x^{-\frac{1}{2}} \cdot x \text{ is } = 2 \cdot a \cdot x^{\frac{1}{2}}.$

Example V.

Let it be required to find the flowing Quantity of $\frac{-3x}{x^4} = -3x^{-4}x$. To the *Index* of the Power of the flowing Quantity add 1, and divide by the new Exponent, and by x, the Quotient is $= x^{-3} = \frac{1}{x^4}$ = the flowing Quantity required.

Example VI.

Let it be required to find the flowing Quantity of $\frac{x^2 x}{\sqrt{rx}}$; this Fluxion may be express'd thus, $r^{-\frac{\pi}{2}} \times x^{\frac{1}{2}} x$, and then the flowing Quantity thereof is $\frac{1}{5} r^{-\frac{1}{2}} x^{\frac{5}{2}} = \frac{2\sqrt[3]{x^5}}{5\sqrt{r}}$.

Example VII.

The flowing Quantity of $x \sqrt{2rx}$, or $x \times \sqrt{2r^2}$ is $\frac{1}{2} \times \sqrt{2r}$, $x^{\frac{1}{2}} = \frac{1}{2} \sqrt{2rx \times x}$, and the flowing Quantity of $x \sqrt{2rx - xx}$ is found by reducing $\sqrt{2rx - xx}$ to an infinite Series, and multiplying the same by x, and then finding the flowing Quantity of every Term.

Example VIII.

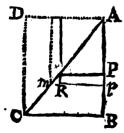
To find the Fluent of $a \times \sqrt{a \times - a a}$. In fuch Cases where the Fluxion is affected with a Vinculum, we must consider whether the fluxional Quantity, standing before the Radical Sign, be the Fluxion of the simple or compound Quantity under the Vinculum, for in such Cases the Fluent may be found by the General Rule.

Thus in this Example I observe, that $a \times is$ the Fluxion of $a \times -a a$, and therefore the Fluent of $a \times \sqrt{a \times -a a}$ or $a \times \times \overline{a \times -a a}$ is $\frac{1}{2} \times \overline{a \times -a a}$ $= \frac{2a \times -2aa}{3} \sqrt{a \times -a a}$.

In like manner the Fluent of $\frac{rx - xx}{2rx - xx^{\frac{1}{2}}}, \text{ or } \frac{2rx - xx^{\frac{1}{2}}}{2rx - xx^{\frac{1}{2}}}, \text{ or } \frac{2rx - 2xx \times \frac{1}{2}}{2rx - xx^{\frac{1}{2}}}, \text{ will be found (if to the Exponent } \frac{4}{2}, \text{ and by the fluxionary Quantity } \frac{2rx - 2xx}{2rx - 2xx}$ to be $\sqrt{2rx - xx}$.

These Rules may be demonstrated by Industion also; and because that Method, by particular Instances, may serve to give the Reader a clearer Notion of Summatory Arithmetick, I shall explain the same in the following Examples.

1. In the Rectangular Triangle ABC: Suppose AB = a, BC = b, AP = x, Pp = x, PM = y; then the Equation of the Triangle is



 $y = \frac{bx}{a}$, and the infinitely little Parallelogram Mp = to the Fluxion of the Triangle, is = yx

= (by Substitution) $\frac{b \times x}{a}$: And the flowing Quantity is $\frac{b \times x}{2a}$ = (putting $y = \frac{b \times x}{a}$) $\frac{x \cdot y}{2}$. it remains to be proved that the Sum of all the $y \times is = \frac{x \cdot y}{2}$.

Compleat the Parallelogram ABCD, then it is evident that the Triangle ABC is equal to the Sum of all the yx, and the Triangle ADC is equal to the Sum of all the xy. But both these Triangles are equal to the Parallelogram, and each is equal to $\frac{1}{2}$ the Parallelogram, and the Parallelogram is equal to xy; therefore all the $yx = \frac{xy}{2}$ = Triangle ABC.

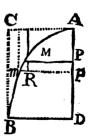
2. Let AMB be a Parabola, AP = x, PM = y, the Parameter = 1, then the Equation of the Curve is $x^m = y$, and the Fluxion of the Parabolick Space, viz. $MP = yx = x^m x$. Now it is evident, that the Sum of all those Parallelograms is equal to the Parabolick Space AMBD. And the flowing Quantity of $x^m x$ is $\frac{m}{m+1}x^{m+1} = \left(\text{putting } y \text{ for } x^m\right) \frac{m}{m+1}x$, which we must prove to be equal to the Sum of all the yx.

Compleat the Parallelogram ADBC, then it is manifest that the Space AMBD is equal to all the $y\dot{x}$, and the Space AMBC is equal to all the $x\dot{y}$. But by the Method of Tangents it is $\dot{y}:\dot{x}::y:t$; and $t\dot{y}=y\dot{x}$, and in the Parabola t=mx; ergo $y\dot{x}=mx\dot{y}$.

Whence
$$I = \frac{m x y}{y \dot{x}}$$
,

And $\frac{I}{m} = \frac{x \dot{y}}{y \dot{x}}$,

Adding I to each Side $\begin{cases} \frac{I}{m} + I = \frac{x \dot{y}}{y \dot{x}} + I \end{cases}$



That is
$$\frac{m+1}{m} = \frac{xy+yx}{yx}$$
.

Whence

Whence

$$m: m + 1::S: y : S: x y + S: y : ;$$
But
$$S: x y + S: y : = x y.$$
Therefore

 $m: m + 1::S: y \times : \times y$; And consequently

$$\frac{m}{m+1} \times xy = S: yx. \quad Q. \text{ E. D.}$$

And besides the Examples I have produced, there are others which occur, to which these Rules cannot be immediately applied; and that the Reader may not be at too great a Loss in such Cases, I shall endeavour to assist bim in that Particular. But first, It will be necessary to premise this.

LEMMA.

If a Binomial be to be rais'd to any Power, g. v. m, (which represents any Number, whole or broken, positive or negative) then the *Uncie* or Numbers presix'd to the several Terms are,

$$1 \times \frac{m-0}{1} \cdot 1 \times \frac{m-0}{1} \cdot \times \frac{m-1}{2} \cdot 1 \times \frac{m-0}{1} \cdot \times \frac{m-1}{2} \times \frac{m-1}{2} \times \frac{m-2}{3} \times \mathcal{E}_{c.} \text{ respectively.}$$

And if P + PQ represent the Quantity to be raised to the given Power; P the first Term, and Q the rest, divided by that first Term, and

 $\frac{m}{n}$ the Exponent of that Root or Dimension,

Then
A
B
$$\frac{m}{P+PQ^{n}} = P^{\frac{m}{n}} + \frac{m}{n} AQ + C$$

$$+ \frac{m-n}{2n} BQ + \frac{m-2n}{3n} CQ, \&c.$$

For Instance, if it be required to extract the fquare Root of rr - xx; that is, to raise (the Word raise being used indifferently for involving or evolving any Binomial) the Binomial rr - xx to the Power or Dimension, whose Exponent is $\frac{1}{2}$, then P = rr, $Q = \frac{-xx}{rr}$, m = 1, and n = 2; and consequently, $rr - x x | \frac{1}{2} = r - \frac{xx}{2r} - \frac{x^4}{8r^3}$ $-\frac{x^6}{16 r^5} - \frac{5 x^8}{128 r^7} -, \, \, \&c.$

Let it be required to raise the Binomial a +x to the Power whose Exponent is m, or let m be the Index of the Root of the Binomial, which is to be extracted. Then, P = a, $Q = \frac{x}{a}$,

fore
$$a + x|^m$$
 is $= a^m + ma^{m-1} x + m \times \frac{m-1}{2} \times a^m - 2x^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3}$

$$a^{m-3} x^{5} + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4}$$

$$a^{m-4} x^{4}, e^{n}c.$$

By the same Method any Trinomial, Quadrinomial, &c. or Infinito-nomial may be raised to any given Power, v. g. To raise the Infinite-nomial $a + bz + cz^2 + dz^3 + , &c.$ to the Power, whose Exponent is m. In the preceding Binomial Theorem,

Instead of x put bz+cz2+dz3, 80c. , and instead of x2 substitute b2+c2+d23, &c. 2 Then it is manifest that a+bz+cz +dz, &c. is $= a^m + ma^{m-1} \times \overline{bz + cz^2 + dz^3}, \mathfrak{Soc.}^{\dagger} + m$ $\times \frac{m-1}{a^{m-2}} \times \frac{bz+cz^2+dz^3}{bz+cz^2+dz^3} + m$ $\times \frac{m-1}{2} \times \frac{m-2}{3} \times a^{m-3} \times \overline{bz+cz^2+dz^3, \Theta c.}$ $+ m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times a^{m-4}$ $\times \overline{bz+cz^2+dz^3}, \, \mathcal{C}_{c.}|^4 +, \, \mathcal{C}_{c.}$

Example I.

Let it be required to find the flowing Quantity of this Fluxion x $\sqrt{rr-xx}$. Reduce $\sqrt{rr-xx}$ to an (Hayes's Art. 93.) Infinite Series, and then $\frac{x^4}{rr - xx|^2} \text{ is } = r - \frac{xx}{2r} - \frac{x^4}{8r^3} - \frac{x^6}{16r^5}$ $-\frac{5x^2}{128r^7}$ —, &c. And consequently, x $\sqrt{rr-xx}$ is $= r\dot{x} - \frac{x^2\dot{x}}{2r} - \frac{x^4\dot{x}}{8r^3} - \frac{x^6\dot{x}}{16r^5}$ $\frac{5x^{2}x}{128r^{7}}$ —, &c. And finding the flowing Quantity of every Term of this Series, then the Sum of all the $x\sqrt{rr-xx}$ is $= rx - \frac{x^3}{6r} - \frac{x^5}{40r^2}$ $\frac{x^7}{112 r^5} - \frac{5 x^9}{1152 r^7} -, \&c. Q. E. I.$

Example II.

It is required to find the flowing Quantity of It is evident from the (Hayes's Art. 16.) Notation of Powers, that $\frac{rr}{r+x}$ is $= rr \times$ $\overline{r+x}$ But $\overline{r+x}$ is = (Hayes's Art. and $\frac{m}{n} = (n \text{ in this Case being} = 1) m; \text{ there.} 93.) <math>r^{-1} - \frac{x}{r} + \frac{xx}{r^2} - \frac{x^2}{r^4} + \frac$ confeconsequently $\frac{rr}{r+x}$ or $rr \times \overline{r+x}|^{-1}$ is = r $-x + \frac{xx}{r} - \frac{x^{2}}{r^{2}} +, \quad e. \quad and \quad \frac{rrx}{r+x}$ is = $rx - xx + \frac{x^{2}x}{r} - \frac{x^{2}x}{r^{4}} +, \quad e. \quad and \text{ the flowing Quantity of } \frac{rrx}{r+x}$ is $= rx - \frac{xx}{2} + \frac{x^{3}}{3r} - \frac{x^{4}}{4r^{2}} +, \quad e. \quad Q. \quad E. \quad I.$

And if we divide the Series (Examp. 1.) by $rr - xx|^{\frac{1}{2}}$ reduced to an infinite Series, and multiply the Divifor by the Quotient, we shall have $rx - \frac{x^2}{6r} - \frac{x^5}{40r^3} - \frac{x^7}{112r^5} - \frac{5x^9}{1152r^7}$ Sec. $\Rightarrow x + \frac{2x^3}{6r^2} + \frac{32x^5}{123r^4}$, Sec. $rr - xx|^{\frac{1}{2}}$

SCHOLIUM

And in general, If the given Fluxion confifts of Universal Exponents and Coefficients, reduce the Part under the Vinculum to an infinite Series, which multiply by the Part before the Vinculum, and find the flowing Quantity of every Term; Lastly, divide this last Series or the Fluent by the Part under the radical Sign affected, with any the most convenient Exponent, and multiply the said Part under the said Exponent by the said Quotient; so shall you have a Series expressing the Fluent of the given Fluxion, and readily shewing when and whether the Series confists of a finite Number of Terms or not.

The Fluent of a Fluxion involving furd Quantities, may be investigated after another manner, which is sometimes preferable by much to the former: The Principles of this Method are,

- 1. Reduce the given Fluxion to its simplest Terms.
- 2. Assume a new Equation adsected with indetermined Coefficients; so that reducing the same to Fluxions, the Terms of this may be compared with those of the given Fluxion, in order to determine the unknown Coefficients.
- 3. Having determined the assumed Coefficients, substitute their respective Values in the assumed Equation, and you have the Fluent of the given Fluxion.

Since this Method deserves the Reader's Consideration, I shall endeavour fully to explain the same;

and that I may not be misunderstood, I sball begins with some easy Examples.

Example I.

Let it be required to find the Fluent of ax $\sqrt{ax-aa}$, the Fluxion reduced to its simplest Terms is $ax \times ax-aa|^{\frac{1}{2}}$. Now suppose the Fluent of this Fluxion to be $A \times \overline{aa-aa|^{\frac{1}{2}}}$, then it is evident, that the Fluxion of this Fluent must be equal to the given Fluxion, i.e. $\frac{1}{2}$ $A \times ax \times \overline{ax-aa|^{\frac{1}{2}}}$ is $= a \times x \cdot \overline{ax-aa|^{\frac{1}{2}}}$. Therefore (dividing by $ax-aa|^{\frac{1}{2}}$) $\frac{1}{2}$ $A \times ax = ax$, and $A = \frac{1}{4}$. Having thus found the true Value of the indeterminate Coefficient A ($wx \cdot \frac{1}{2}$) in the assumed Equation, substitute the same in place of A, and then we have $\frac{1}{4} \times \overline{ax-aa}$ equal to the Fluent of the given Fluxion.

Example II.

To find the Fluent of $\frac{rx-xx}{\sqrt{2rx-xx}}$, this Fluxion is expressed thus, $rx-xx \times 2rx-xx$ | Suppose the Fluent thereof to be $A \times 2rx-xx$ | Then the Fluxion of this Quantity is $\frac{1}{x}A \times \frac{1}{2rx-2xx} \times \frac{1}{x} \times \frac{1}{x} = \frac{1}{x} \times \frac{1}$

Example III.

To find the Fluent of $dx' \times x + fx''$. Affirme an Equation with indeterminate Coefficients, so that reducing the same to Fluxions, the Terms thereof may be compared with those of the given Fluxion. Let the said Equation be Adx' - x + 1 + Bdx' - 2x + 1 + Cdx' - 2x + 1,

Sec. $\times e + fx'' = S: dx' \times \times e + fx''$

Then.

$$r - n + 1 \times Adx' - n \times + r - 2n + 1 \times Bdx' - 2n \times + r - 3n + 1 \times Cdx' - n \times + r - 2n + 1 \times Cdx' - n \times + r - 2n + 1 \times Cdx' - n \times + r \times + r \times Cdx' - n \times + r$$

Whence, supposing $\frac{1}{p} = m + 1$, and putting x = 1.

$$\overline{r-n+1} \times Adx^{r-n} + \overline{r-2n+1} \times Bdx^{r-2n} + \overline{r-3n+1} \times Cdx^{r-2n}, \Theta_{c}.$$

$$\times e + fx^{n} + \frac{1}{p} \times n \times Adf \times x^{r} + \frac{1}{p} \times n \times Bdfx^{r-n} + \frac{1}{p} \times n \times Cdfx^{r-2n}, \Theta_{c}.$$

$$\times e + fx^{n} + \frac{1}{p} \times n \times Cdfx^{r-2n} + \frac{1}{p} \times n \times Cdfx^{r-2n}, \Theta_{c}.$$

$$\times e + fx^{n} + \frac{1}{p} \times n \times Cdfx^{r-2n} + \frac{1}{p} \times n \times Cdfx^{r-2n} + \frac{1}{p} \times n \times Cdfx^{r-2n}$$

Which being order'd, we have

$$p \times r - n + 1 \times Adf$$

$$+ p \times r - n + 1 \times Ade$$

$$+ p \times r - 2n + 1 \times Bdf$$

$$+ p \times r - 2n + 1 \times Bdf$$

$$+ p \times r - 2n + 1 \times Bdf$$

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From which Equation the unknown Coefficient A, B, C, &c. may be determined in this manner;

$$p \times r - n + 1 \times Adf + n \times Adf = pd$$
And dividing by pd,
$$r - n + 1 \times Af + \frac{1}{p} \times n \times Af = 1,$$
Subflitting $m + 1$ for $\frac{1}{p}$,
$$r - n + 1 \times Af + m + 1 \times n \times Af = 1.$$

Whence $A = \frac{1}{r - n + 1 \times f + mn + n \times f} = \frac{1}{mn + r + 1 \times f}$

Secondly,

 $p \times \overline{r-n+1} \times Ade + p \times \overline{r-2n+1} \times Bdf + n \times Bdf = 0$,

And by Transposition, Division and Restitution.

Whence
$$B = \frac{n - r - 1 \times Ae}{r - 2n + 1 \times f + mn + n \times f} = \frac{n - r - 1 \times Ae}{mn + r - n + 1 \times f}$$

In like manner

$$C = \frac{\frac{2n-r-1 \times B_c}{mn+r-2n1 \times f}},$$

Whence it is evident that $Adx^{n-1} + Bdx^{n-2} + Cdx^{n-2} + Cd$

$$\frac{\times x^{r-2n+1} + \frac{d}{mn+r+1 \times f} \times x^{r-n+1} \times \frac{n-r-1 \times de}{mn+r-n+1 \times f} \times \frac{n-r-1 \times de}{mn$$

In which it may be observed, That the Exponents of the Terms of the Indeterminate Series $\begin{vmatrix} confist \\ r+1 \end{vmatrix}$ before the Radical Sign may be taken different from those above, provided that the Exponent of the first Term be not less than r-q-1, and that the following Exponents proceed regularly:

That the Exponents of the Terms before the Radical Sign may be continually increased or decreased by n; for in either Case the Terms of the Fluxion of this assumed Equation will become homologous to those of the given Fluxion : That when the Exponents increase regularly by , the Fluent will consist of a finite Number of Terms, when $\frac{r+1+m\pi}{n}$ is equal to a positive whole Number: And that when the Exponests decrease regularly by a, the Fluent will Fluent, we shall have

 $\frac{r+r}{z}$ is equal to a positive whole Number.

This General Theorem may eafily be applied to find the Fluent of any given Fluxion included

in the General one $dx' \times x \times \frac{1}{x} + \int x^{n} |$.

To find the Fluent of a x x ax - aa! the same equal to the General Fluxion, viz.

$$dx' x \times e + fx'' = ax \times \overline{ax - aa}^{\frac{1}{2}}$$
.
Then $d = a$, $f = 0$, $f = a$, $n = 1$, $m = \frac{a}{2}$, $e = -aa$; and if we substitute the said particular Values of d , r , f , n , m , e in the General Fluent, we shall have

$$\frac{d}{mn+r+1\times f} \times x^{r-n+1} + \frac{d}{mn+r+1\times f} \times \frac{n-r-1\times de}{mn+r-n+1\times f} \times x^{r-2n+1} + \frac{d}{mn+r+1\times f} \times \frac{n-r-1\times de}{mn+r-n+1\times f} \times \frac{2n-r-1\times de}{mn+r-2n+1\times f} \times x^{r-2+1} + \mathcal{S}_{c.} \times \frac{n-r-1\times de}{nn+r-n+1\times f} \times \frac{2n-r-1\times de}{mn+r-2n+1\times f} \times x^{r-2+1} + \mathcal{S}_{c.} \times \frac{1}{e+fx^{n}} = \frac{a}{\frac{1}{2}+1\times a} \times x^{n-1+1} \times \frac{1}{2} \times \frac{1$$

I have bitherto explained the General Methods of finding the Fluent of any Fluxion by help of Series's, and therefore shall not farther insist on these or other Methods invented for the same Purpose, but refer the Reader (who desires to have a fuller Account of them) to a late Learned Treatife, writ by that excellent Analyft G. Cheyne, M. D. and entitled Fluxionum Methodus Inversa.

Since the Business of Infinite Series is sometimes tedious and too perplex'd, several other particular Methods have been invented to find the slowing Quantity of a Fluxion. It shall suffice, in this Place, to give the Reader an Idea of them, which will become more plain and familiar by several other Examples, to be seen in their proper Places.

Example I.

Let it be required to find the Flowing Quantity of x \sqrt{2 r x - x x}. On the Center C, with



the Radius CB = r, describe the Semi-circle AMB, and suppose AP = x; then is PB = Vol. II.

2r = x, and $MP = \sqrt{2rx - xx}$, and $Pp \Rightarrow$ x; therefore the Fluxion of the Area, viz. the Parallelogram Mp is $= x\sqrt{2rx-xx}$, and consequently the Sum of all the $x\sqrt{2rx-xx}$, that is, the Flowing Quantity of the given Fluxion is equal to the Semi-segment AMP.

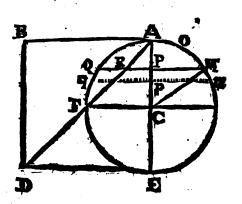
Example II.

Let it be required to find the Flowing Quantity of $\frac{r \times x}{2\sqrt{2r \times - x}}$. . Draw the Lines AM, Am, infinitely near each other, MP, mp, perpendicular to the Diameter AB, and MR perpendicular to Am; then by the Property of the Circle AM = Varx, and Rm the Fluxion thereof is Varz Now because the Triangles APM, MRm, are (the Angles AMP and MmR standing on equal Arches of the Circle) fimilar, it is PM ($\sqrt{2rx-xx}$): AP(x):: Rm $\sqrt{2rx} \times \sqrt{2rx - xx}$ and consequently the infinitely little Sector MAR $= \frac{1}{2}AR \times MR \text{ is} = \frac{r \times x}{2\sqrt{2r \times - x \times x}}$ given Fluxion: Whence it is evident that the Segment

Segment AOMA is the flowing Quantity of the given Fluxion.

Example III.

Let it be required to find the flowing Quantity of this Fluxion xx X 2 \sqrt{2rx-



the Center C, with the Radius CA = r, describe the Circle $\triangle FEM$; and suppose = x, PP = x, PE = 2r - x, the Circumference $\triangle FEM = c$; then, I say, that the Sum of all the xx $\times 2\sqrt{2rx-xx}$ is $=\frac{crr}{2}$.

Demonstration.

Let the Circle AFEM be the Base of an upright Cylinder, and the Parallelogram ABDE the Section of the Cylinder thro' its Axis, AB the Height of the Cylinder is equal to AE the Diameter of the Base. Draw the Diagonal AD, then a Plane passing through AD, and perpendicular than AD, and perpendicular than AD, and perpendicular than AD. lar to the Plane BE, will divide the Cylinder in two equal Parts, and cut off the Semi-quadrantal Ungula ADE. Now the Fluxion of this Ungula is equal to the Parallelogram Qm, multiplied into its Height PR or AP (because the Angle RAP is equal to 45° .) = xx x 2 \sqrt{2 rx --- xx; and consequently the Sum of all the $x \times x \times 2 \sqrt{2rx - xx}$ is (when AP becomes equal to AE, or $x \Rightarrow 2r$) equal to the Semi-quadrantal Ungula $ADE = \frac{rrc}{2}$. Q. E. I.

And thus innumerable Instances might be assign'd, to affift its in finding the flowing Quantity of any Muxion, without baving immediate Recourse to an Infusite Series.

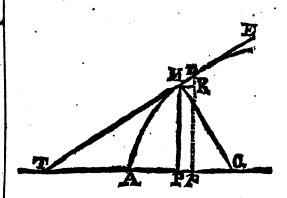
INVERSE Method of Tangents, is the Method of finding an Equation to express the Nature of a Curve in an Equation, express'd in the namest Terms. This depends on the Problem of find ing the fluent or flowing Quantity, by having the Rluxion given (of which fee the Inverse Method of Fluxions above given.) And the Art, of doing it Mr. Hayes (in Fluxions, p. 48.) shews after this manner.

At Page 33. he had shewn how to deduce Universal Rules for drawing Tangents to all forts of Geometrical Curves, when the given Equation expresses the Relation between the Ordinate and the intercepted Diameter. And therefore he states his 16th Proposition thus:

An Equation expressing the Value of the Subtangent of any Curve, in the nearest Terms being given: Tis requir'd to find the Equation expressing the Nature of the Curve.

t. What I mean by the nearest Terms will be

best explain'd by an Example. Suppose PT = s, AP = x, PM = y, MT = s, and let the Equation expressing the Nature of



the Curve be $y^2 + ayy = x^2 + bxx$; Then the Sub-tangent TP will be z = (Hayes, Sect. 10.

Art. 61.) $\frac{3y^3 + 2ayy}{3xx + 2bx}$. Now I call these Terms,

expressing the Value of the Sub-tangent, the nearest, because they immediately flow from the Equation of the Curve: But if this Value of the Sub-tangent be changed, by applying the Equation of the Curve; v.g. If we put $3y^2 = 3x^2 + 3bxx$

- 3a yy; and confequently:
$$=\frac{3x^2+3bxx-ayy}{3xx+2bx}$$
, fuch I call Remote Terms.

Now if the Value of the Sub-tangent be express'd in the nearest Terms, the Equation of the

Curve may be investigated in this manner.

Let the Curve (Hayes, Fig. Art. 77.) AMme
be described, and draw MT to touch the Curve in M; then suppose the Abscissa AP == x; the Ordinate PM = y, Pp = x, Rm = y; then because the Triangles mRM, MPT are similar;

therefore mR(y):RM(x)::PM(y):PT

 $=\frac{yx}{x}$. Put this Value of the Sub-tangent equal

to its Value given in the nearest Terms; clear the Equation of the Fractions, and find the flowing Quantity of each Term; so have you the Equation of the Curve.

Example I.

Let it be required to find the Equation of the Curve AMm, the Value of the Sub-tangent PT

being $=\frac{2ys}{3rr}$. The Sub-tangent PT is =

 $\frac{y \times}{y} = (e \times Hyp.) \frac{2y^3}{3rr}; \text{ therefore } 3rry \times = 2y \cdot y,$

and 3rrx = 2y'y: And substituting x for x,

and y for y: 3rrx Dzy3, and (dividing 3rrx by 1 the Exponent of x, and dividing 2 y2 by 3 the Exponent of y) $3rrx = \frac{1}{2}y^3$, and $9rrx = \frac{1}{2}y^3$, which divided by 2, we have $\frac{1}{2}rrx = y^3$, the Equation expressing the Nature of the Curve

Example II.

Let it be required to find the Property of the Curve AMm, the Sub-tangent PT being =

The Sub tangent P T is $=\frac{yx}{x}$ = (by Supposition) $\frac{2yy}{r}$; and therefore ryx = 2yyy, and rx= 2 yy, and (substituting x for x, and y for y) $r \times \square 2 y y$, and consequently (dividing $r \times$ by the Exponent of x, and 2 y y by 2 the Exponent of y) $r \times \square y y$, which shews that the Ourve of Mm is a Parabola.

Example III.

Let it be required to find the Property of the Curve AMm, the Value of the Sub-tangent PT being = $\frac{3y^3 + 2byy}{3xx + 2xx}$

The Sub-tangent PT is $=\frac{y \times x}{y} = \frac{3y^3 + 2byy}{5xx + 24x}$. Therefore $3 \times \times \times + 2 \times \times = 3 \cdot 3^2 y + 2 \cdot b \cdot y \cdot y$

But because this Method depends on that Problem, to find the Flowing Quantity of any Fluxions, with which the Reader is yet supposed to be unacquainted, I shall desist from prosecuting the same any further at present, and content my self to deduce the Solution of the present Proposition from the (Hages, Art. 61.) fixth preceding; this being nothing else but the Reverse of that.

That we may be able to proceed with the greater Certainty in this Enquiry, it will be neceffiry to observe from the forecited Place:

- 1º. The Sub-tangent s is always of one Dimension, and is express'd by a Fraction.
- 20. When the Value of the Sub tangent 16 expressed in the nearest Terms, then the Numerator of the Fraction confids only of those Terms wherein the Ordinate 9, (or the Tangent 5) is found.
- 3°. And if all the Terms of the Equation of the Curve be simple Terms, then the intercepted Diameter x never occurs in the Numerator; por the Ordinate y, Tangent s, or Curve z, in the Denominator.

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- . But if the Equation of the Curve contain mix'd Terms, then both-x, x, s and y may be found in both parts of the Fraction; but with this Condition, That the Fraction being reduced to an Equation, and all the Terms of the Equation being brought over to one fide, and every : changed into x, and every sinto z, every mix'd Term will be found as often as there are variable Quantities in the same. And the Coefficients, or prefixed Numbers, will be equal or proportional to the respective Exponents of the Powers of the variable Quantities.
- 5°. Whence it follows, that the Signs of the Terms, wherein the same variable Quantities occur, are the same, after a due Division by the prefix'd Numbers (or rather by the Exponents of the variable Quantities.)

Hence to resolve the Problem concerning the

Inverse Meshod of Tangents.

- 1°. Change every s into x, and every s into z (denoting the Curve) and transpose all the Terms to one fide of the Equation, and diligently observe whether all the Terms are Simple, or some Simple and others Mixt.
- 20. If all the Terms be Simp.e, divide every Term by the Exponent of the Intermediate or Flowing Quantity in the fame; so have you the Equation expressing the Nature of the Curve.
- 3°. And if there be any mixt Terms, then obferve (Hayes, Sect. 4, 5. Art. 78.) and let every Term containing the same variable Quantities be divided by the Exponent of the Power to which the respective Flowing Quantities are advanced, so that the same Term result from every such Division, and be as often found in the Equation as it has Flowing Quantities.
- 4º. Retain only one of those mixt Terms which occur more than once in the Equation, and mamage the other simple Terms according to Hages, Sect. 2. and there will arise an Equation expresfing the Nature of the Curve.

Example I.

Suppose: = $\frac{g_1 + ayg - bbg}{x + ax + bb}$; then (by Rule 1.) changing t into x, and transposing all the Terms to one fide of the Equation, we have $x^3 + a \times x + bb \times - y^2 - ayy + bby; and because all the Terms are simple Terms, there-$

fore (2.) $\frac{1}{7}x + \frac{1}{7}axx + bbx - \frac{1}{7}y^3 - \frac{1}{7}ayy + bby = 0$, which is an Equation expressing the Nature of the Curve, as was required.

Example II.

Let the Value of the Sub tangent be := $\frac{3y^3+2uyy-zxyy-xxy}{3xx+2xy+yy}$, then we have (by 1.) $3x^3 + 2yxx + yyx - 3y^3 - 2ayy + 2xyy + xxy$, and because we have the A a 2 mixt mixt Terms 2 y x x and yx x, also yyx, and 2 yyx each repeated twice, according to the Number of the flowing Quantities; therefore if one of them be divided by the Exponent of x, and the other by the Exponent of y, (3.) there will arise $y \times x$ $+ y y \times$ (by 4.) and dividing the simple Terms by the Exponents of the flowing Quantities in each respectively, the Equation expressing the Nature of the Curve will be x3 + yxx + yyx $-y_1 - ayy = 0.$

Example III.

And the Method is the same if the Curve z enter into the Value of the Sub-tangent, v.g. suppose 6ay122+4ay125+aay4 - yxx21-2yxx225 2 y x 23

change every s into x, and every s into z; and transpose all the Terms over to the same Side of the Equation, and then we have 2 yz3xx+yxxz1 + 3 yxxz1 - 6 ay1z2 - 4 ay1zz - a ay2. Wherein the Term yxxz1, containing three

flowing Quantities, is found thrice, and the Term ay: zz, containing two, is found twice: And because those mixt Terms being divided by the respective Exponents of the Powers of the flowing Quantities, the same Quotient always results; it is plain, that the Value of the Sub-tangent is given in the nearest Terms; and therefore the Equation expressing the Nature of the Curve will be $yz^3x^2 - 2ay^3zz - 2ay^4 = 0$: Or adding any determinate Quantity bb; $yz^3x^2 - 2ay^3zz$ $-1aay^4+bb=0.$

Hence it appears that a determinate Quantity may be added to the Equation of the Curve; which is plain from the direct Method of Tangents; because then when we investigate the Value of the Sub-tangent, all the Terms confishing of invariable Quantities are rejected and vanish: And this is sometimes absolutely necessary, v.g.

Suppose $s = \frac{-xy}{2x+y}$: then we have 2xx+yx + xy; and consequently xx+xy=0: And because this Equation has no true Root, therefore we must add a determinate Quantity, and then the Equation of the Curve may be xx +xy

COROLLARY.

Hence, if the Value of the Subnormal (Fig. Hayes, Art. 82.) P Q be given, the Property of the Curve may be found. For the Triangles QMP, MTP are fimilar; therefore QP: PM:: PM: PT;

and if PQ be = q, then $s = \frac{yy}{q}$. Whence the Equation of the Curve may easily be (Hayes, Art. 78, 79.) found.

The Property of the Curve may be investigated otherwise, thus: The Triangles mR M, QP M,

are fimilar; therefore MR (x): Rm (y):: PM $(y): PQ = \frac{yy}{x}$, and putting this equal to the

Value of the Subnormal given, the Property of the Curve may be (Hayes, Art. 77.) found.

Example,

Suppose $PQ = \frac{aax}{2yy}$; then is $\frac{yy}{x} = \frac{aax}{2yy}$, and

 $aaxx = 2y^3y$; and (substituting x for x, and y for y) $aaxx ext{ } ext{$

that the Curve AMm is a Parabola.

INVEST. To Invest, in the Law, fignifies to give Possession: And the Action of doing this, which is attended in different Places with different Ceremonies, Forms and Customs, is called

INVESTITURE.

INVOYCE, 12 Car. 2. c. 34. is a Particular of the Value, Custom and Charges of any Goods sent by a Merchant in another Man's Ship, and confign'd to a Factor or Correspondent in another Country

JOBENT Nails, are a smaller sort, commonly used to nail thin Plates of Iron to Wood.

JOINT-Tenants, are such as come to, and hold Lands or Tenements by one Title pro Indi-

viso, or without Partition.

These are distinguish'd from Sole, or Several Tenants; from Parceners, and from Tenants in Common: And anciently they were called Participes, and not Heredes: And these must jointly implead, and jointly be impleaded; which Property is common to them and to Coparceners. But Joint-Tenants have a fole Property of Survivorship, which Co-parceners have not: For if there be two or three Joint-Tenants, and one hath Issue and dies, then he, or those Joint-Tenants that survive, shall have the whole by Survivorship.

JOISTS, in Architecture, are such Pieces of Timber as are framed into the Girders and Summers, and on which the Boards of the Floor are

JOYNDER, in Law, is the coupling or joining of two Persons in one Action or Suit against another.

JOYSTS. See JOISTS. IRON. In the Forest of Dean in Gloucesterfoire, the best Iron Ore is of a bluish Colour, and is called Brush Ore: But this being melted alone produces a Metal very short and brittle: To remedy which Inconvenience they make use of Cynder, which is found in great Quantity where any old Works have been in that County: For in former Times, their Bellows being moved only by Hand, their Furnaces produced a Fire much less intense, than those they now employ: So that formerly they melted down only the principal Part of the Ore, rejecting the rest as useless. This Resule is the Cynder; which being mingled with the Ore in a due Quantity, gives it that excellent Temper of Toughness, for which this Iron is preferred before any brought from abroad.

The Ore is first calcined in Kilns, like ordinary Lime Kilns, which they fill up to the Top with Coal and Ore, S.S.S. Then putting Fire to the Bottom, they let it burn till the Coal be wasted. This is done without Fusion of the Metal, and serves to consume the more drossy Part of the Ore, and to make it friable. From hence they carry it to the Furnaces, which are built of Brick or Stone, about 24 Foot square on the Outside,

Outside, and near 30 Foot in Height. Within they are not above 8 or 10 Foot over in the middle, and the Top and Bottom have a yet narrower Compass; so they are almost of the Shape of an Egg. Behind the Furnace are placed two very large Pair of Bellows, whose Noses meet at a little Hole near the Bottom. These are compressed together by certain Buttons placed on the Axis

of a very large Oversbot Wheel.

The Furnaces are at first filled with Ore and Cynder, intermix'd with Fuel, which in these Works is always of Charcoal, laying them hollow at the Bottom, that they may the more easily take Fire. But after they are once kindled, the Materials run together into a hard Cake or Lump, which is sustain'd by the Fashion of the Furnace; and through this the Metal, as it melts, trickles down into the Receivers, where there is a Passage open, by which they clear away the Scum and Dross. Before this lies a great Bed of Sand, wherein they make Furrows of what Fashion they please, into which they let their Metal; which is made so very fluent by the Violence of the Fire, that it continues boiling for a good while. The Furnaces are kept at work Day and Night for many Months, still supplying the Waste of the Fuel and other Materials with fresh, pour'd in at the Top.

From these Furnaces they bring their Sows and Pigs of Irons (as they call them) to their Forges. These Forges are of two forts, tho' standing together under the same Roof: And one they call Finery, the other their Chafery. Both of them are on Hearths, on which they place great Heaps of Sea-Coal, and behind them Bellows, like the former, but not near so large. Into their Finery they first put the Pigs of Iron, placing three or four of them together behind the Fire, with a little of one End thrust into it; where softning by Degrees, they stir and work them with long Bars of Iron, till the Metal runs together into a round Mass or Lump, which they call an Half Bloom: This they take out, and giving it a few Strokes with their Sledges, they carry it to a great weighty Hammer, raised by the Motion of a Water-Wheel; where applying it dextroufly to the Blows, they presently beat it out into a thick short Square: This they put into the Finery again; and heating it red hot, they work it out under the same Hammer, till it comes to be in the Shape of a Bar in the middle, but with two square Knobs on the Ends. Last of all, they give it other Heats in the Chafery, and more Workings under the Hammer, till they have brought their Iron into Bars of several Shapes and Sizes. If they omit any one Process, it will be sure to want something of its Toughness, which they esteem its Perfection.

For the Backs of Chimneys, Hearths of Ovens, or the like, they take the melted Metal out of the Receivers in great Ladles, and pour it into Moulds of fine Sand. Philos. Trans. No 137.

At Miliborpe in Lancasbire they have several Sorts of Iron-Stone, some of it making Coldsbire-Iron; that is, such as is brittle when it is cold. Another fort makes Redsbire, which is such as is apt to break if it be hammer'd when't is of a dark red Heat; and therefore they are never melted down but in Mixture, and so they yield an indifferent good sort of Iron. They have of late made it much better than before, by melting the Sow-Metal over again, as likewise by using Turf and Charcoal; whereas formerly the Fuel was only Charcoal.

They first burn the Iron-Stone, and then for every seventeen Baskets of this burnt Stone they put in one of Lime Stone, unburnt, to make it melt freely and cast the Cynder, which they always take off from the melted Iron, before they let it run.

The Bottom of the Furnace is about two Yards square, and so rises perpendicularly for a Yard or more, which is also lined within with a Wall of the best Fire-stone, to keep off the Force of the Fire from the Walls of the Furnace. The Bellows, which are very large, and moved by Water, enter about the middle of the Focus: The rest of the Furnace is raised above this six or seven Yards square-wise, but tapering; so that the top Hole, where they throw in the Mine and Fuel, is but half a Yard square. When they find it to have subsided about a Yard and Quarter,

they fill the Furnace again.

Their Forge is much like that of a common Blacksmith's, about one Yard and half over, and of the same Height. The Hearth is all of Sow-Iron, much of the Shape of a Broad-brim'd Hat, with the Crown downwards. The hollow Place they fill and heap up with Charcoal, and lay the Oré (first broken into Pieces as big as a Pigeon's Egg) all round about the Charcoal on the flat Hearth, to bake it as it were, or neal it; thrusting it by little and little into the Hollow, and keep blowing for twelve Hours. Then they pull out a Stopple at the Bottom of the Wall, and out comes all the Glassy Cynder, being very liquid, leaving the Iron, which is never in a perfect Fufion, in a Lump at the Bottom: This they take out with great Tongs, and turn it under heavy. Hammers moved by Water, which at the same time beat off, or rather squeeze out the fluid Scorie or Dross, and after several Heats form it into Bars. They use no Lime-Stone, or any thing else, to promote the Flux. They get about 100 Pound Weight of Metal at one Melting, out of about three times as much Ore.

The Iron Mine in Suffex lies from four Foot deep to forty and upwards. There are several sorts of Mine, some hard, some gentle, some rich, some poor, some sine, some coarser. The Iron Masters mix different sorts of Mine together, otherwise it will not melt to so good an Advantage.

When the Mine is brought in, they take Small-coal, and lay a Row of that and a Row of Mine alternately, S. S. S. one above another; and fetting the Coals on Fire, therewith burn the Ore. This is done to mollify it, that so it may be broken in small Pieces, otherwise it would not melt in the Furnace, but come away whole: Normust it be over burnt; for then it will loop, as they call it, that is, run together in a Mass.

After 'tis burnt, 'tis beat into small Pieces with

After 'tis burnt, 'tis beat into small Pieces with an Iron Sledge, and then put into the Furnace, which is before charged with Coals, on the Top of which it is cast, where it melts and falls down into the Hearth in about twelve Hours more or less, and then 'tis run into a Sow.

This Hearth is made of Sand-Stone, as also its Sides round to the Height of about a Yard; and then the rest of the Furnace is lined up to the

Top with Brick.

When they begin upon a new Furnace, they put Fire for a Day or two before they begin to blow: Then they blow gently, and increase by Degrees, till they come to the Height in ten Weeks or more.

Every

Every fix Days they call a Founday, in which time they make 8 Ton of Iron; that is, if you divide the whole Sum of Iron they make by the Founday; or at first they make hels in a Founday, at laft more.

The Hearth, by the Force of the Fire cominarlly blown, grows wider and wider; so that if at first it contains so much as will make a Sow of 600 or 700 Pound Weight, at last it will contain so much as will make a Sow of 2000 Pound. The leffer Pieces of 1000 Pound, and under, they

Of twenty four Load of Coals, they expect eight Ton of Sows. To every Load of Coals, which confilts of eleven Quarters, they put a

Load of Mine, containing eighteen Bushels.

A Hearth, it made of good Stone, will ordinatily last forty Foundays or Weeks; during which time the Fire is never let go out. They never blow twice on one Hearth, tho' they go upon it but five or fix Foundays. The Cynder, like Stum, swims upon the melted Metal in the Hearth, and is let out once or twice before a Sow is caft.

The Manner of Working Iron at the Forge or Hammer.

In every Forge there are two Fires at least, which, as before is observed, are called, one the

Finery, and the other the Chafery.

At the Finery, by the Working of the Hammer, they bring it into Blooms and Anconies, thus: They roll the Sow at first into the Fire, and then melt off a Piece of about & of a hundred Pound Weight; which, as foon as 'tis broken off, they call a Loop. This Loop they take out with their Shingling Tongs, and beat it with Iron Sledges on an Iron Plate near the Fire, that so it may not fall in Pieces, but be in a Capacity to be carried under the Hammer; where it is beat very gently at first, only to draw Cynders and Dross out of the Matter: But afterwards they let out or draw more Water, and so by degrees beat it thicker and stronger, till they bring it to a Bloom; which is a four-square Mass, about two Foot long. This Operation they call Shingling the Loop. This done, they immediately return it to the Finery again; and after two or three Heats, and Working, they bring it to an Ancony, whose Figure is in the middle a Bar of about three Foot long, and of the Shape they intend the whole Bar shall be made of; but at both Ends is a square Piece left rough, to be wrought at the Chafery

Note, At the Finery three Load of the biggest Coals go to the making of one Tun of hom. At the Chafery they only draw out the two Ends suitable to what was drawn out at the Fi-

mery in the middle, and so finish the Bar. Note, One Load of smaller Coals draws out a

Tun of Iron at the Chafery.

At the Finery, they expect that one Man and a Boy should make two Tun of Iron in a Week; and at the Chafery, that two Men should take up, that is, make or work five or fix Tun in a Week.

One thing is remarkable here: They fay, That if into the Hearth where they work the Iron Sows (whether the Finery or the Chafery) you cast on the Iron a piece of Brass, it will hinder the Metal from Working, caufing it to spatter about

lo, that it cannot be wrought into a folid Piece.

Ray's Collect. of English Words, at the End. IRREGULARITY, in the Canon-Law, figmifies an Impediment, which will hinder a Per-son's going into Holy Orders, as being a Bestard, Maimed, Consensing to a Murder, &c.

IRREPLEVIABLE, in the Common-Law, fignifies what may not be Replevied, or let at

large, upon Sureties.

ISOCHRONAL LINE, is that in which a heavy Body is supposed to descend without any Acceleration. And the Excellent G.G. Leibnitz, in the AB. Erud. Lips. for Febr. 1689. hath a Discourse on this Subject; in which he shews, That an heavy Body, with a Degree of Velocity acquired by the Descent from any Height, may descend from the same Point, by an infinite Number of Isochronal-Curves, and which are all of the same Species, differing from one another only in the Magnitude of their Parameters; such as are all the Quadrato-Cubical Paraboloids, and consequently fimilar to one another.

He shews also there how to find a Line, in which a heavy Body descending shall recede uniformly from a given Point, or approach uni-

formly to it.
ISTHMUS, in Anatomy, is a Passage in that part of the Medulla Oblongata of the Brain, which lies between the Cerebrum and Cerebellum, and which reaches from the place called the Anus to the fourth Ventricle. The Upper Part or Cover of this Conduit or Passage, which is betwixt the Testes and the foremost Vermicular Process of. the Cerebellum, and to which two it is tied at its two Ends, and to the Processes that come from the Cerebellium to the Testes, at its Sides, is called Valenta Major: It is of a Medullary Substance; and its Use is to keep the Lympha from falling out above the Nerves in the Basis of the Skull.

ITALIAN Hours, are the 24 Hours of the Natural-Day, accounted on from the Sun-setting of one Day, to the same time again the next Day, as 'tis the Custom in Italy to do at this day,

and as the Jews did of old.

ITINERANT Judges or Justices, are such as were formerly fent with Commission into divers Countries, to hear chiefly such Causes as were called Pleas of the Crown, the same with Justices in

Eyre; which see.
JUBILEE, is a solemn Time of Festivity at Rome, in which the Pope pretends to give Pardons, Indulgencies, and Blessings, to such rich credulous Persons as have as much Money as Faith, and who have leifure enough to go thither The first Jubilee is said to have to fetch them. been Instituted by Pope Boniface VIII. A. D. 1300. to return every Hundred Years. But Pope Clement VI. thought fuch a Fair of Indulgencies should be kept oftner; and so he order'd that the Jubilee should return again every Fifty Years; which was decreed A. D. 1350.

In Imitation of this profitable Pardon-Market at Rome, the Monks of Christ's-Church in Canterbury set up a Jubilee of their own every Fiftieth Year also, to get a Concourse of Fools to the Shrine of that insolent Prelate Thomas Becket,

Our King Edward II. kept a kind of Givil In-bilee at his Court in the Fiftieth Year of his own Age, which was in 1362, granting Pardons, Privileges, and other Civil Indulgencies.

JUDI-

JUDICIUM Dei. Our Ancestors used to call those now prohibited Trials of guilty Persons by Ordeal, Judiciam Dei, the Judgment of God: See Ordeal in this Volume.

JUGUM Terre, is half an Arpent or fifty Perches, mention'd in Domestlay-Book, and interpreted there to contain half a Plough-land.

preted there to contain half a Plough-land.

JUPITER. The Calculation of the Ecliples of Jupiter's Satellites, being a thing of great Use for determining the Longitude of Places on the Earth, I judg'd it necessary to insert the Manner and Method of it here, from Mr. Whiston's Prelectiones Astronomica, p. 219.

He takes for an Example an Eclipse of the first Satellite; because, both those Excellent Astronomers, Cassini and Halley, have shewn how to calculate that by proper Tables; and that the same Method will serve to find the Eclipses of the other Satellites of this Planet.

And he observes that these Cassinian Tables are formed after a new and accurate Method, and will give the Moment of the Eclipses in as new

and accurate a Way.

It is supposed there, That the Periodick Time of this first Satellite is precisely one 2448th Part of the Periodick Time of Jupiter from one A-phelion to another. Whence the Equations of the Jovial Orbit being turn'd in Minutes of Time, and adapted to those particular Revolutions of the Satellites, will make good the principal Parts of the Equation of these Eclipses. 'Tis to be observed also, that these Tables suppose the Aphelion of Jupiter to be in the Beginning of the 9th Degree of Libra; and that the Orbit of the Satellite is so little distant from the Plane of the Orbit of Jupiter, or also of the Ecliptick, that the Differences thence arising may usually not be taken notice of. Note also, That in the accurate Calculation of these Eclipses, there is need of another Equation, according to the various Position of the Earth to Jupiter. Which Resti-Position of the Earth to Jupiter. tution of the Position, suppose the Opposition of the Sun and Jupiter, contains 2252 Periods of this Satellite.

The first Observer of this Equation, Mr. Romer, afferts, That 'tis in its greatest Quantity 22 Minutes of Time; but Cassini saith it don't exceed 14 Minutes and 10 Seconds. The Cause of this Equation is the successive Propagation or Motion of Light; which is by no means instantaneous. And from this Fountain the Equations of the 225 Revolutions of the second Satellite, being respectively adapted, do compleat the second Parts of these Eclipses. But a little Table may also be added, shewing the Half-Stay of the Satellite in the Shadow of Jupiter, accommodated to the former Periods of 2448. For as Jupiter accedes to the Sun, the Shadow increases; and as he recedes from the Sun, it decreases. But this Equation is so inconsiderable, that it may most safely be omitted. There is added also, as there ought, a Tablet, shewing the Half Duration of the Satellite in the Shadow of Jupiter, according to the different Position of the Satellite with respect to the Nodes and Limits: For tho, as was said above, the Angle of the Inclination of the Plane of the Satellite's Orbit be not great, 'tis yet something: And therefore about the Nodes of the Orbit, the Immersion will be more direct and deep in the Shidow, than about the Limits: And these Tables, together with the common

one of the Equation of Time, and no other, according to Mr. Halley's Judgment, are to be used in the Calculation of the Eclipses of this Satellite.

In order to Calculation then;

1. From the Table of the Epoche of the Revolutions of the first Satellite to the Shadow of Jupiter (which you will find amongst the Astronomical Tables, under those Words in this Vol. 2.) find first the Year in the left Hand Column, and then write down the Numbers that stand against it, expressing the Days, Hours, Minutes, and Seconds of the Revolution; and also those in the other two Columns, N° 1, N° 2. Under these Numbers place also in their proper Order (from the next Table) those which belong to the Month and Day affign'd, with those also in the little Columns, N° 1, N° 2. And then add them all severally, as they stand in order, into one Sum. Then will the first of those Sums shew the middle Moment of the middle of the Eclipse: The second serves for the first Equation: The third finds the second Equation; that is, if you write down also in every Leap-Year, and in the Months of January and February, the Day next after the given one, instead of the given Day, with its Equations: For the Table accommodated, as it should be, to the greater Part of the Leap-Year; can't serve without Correction for the former Part of the Mar, before the interposed Leap-Year Day.

2. If the Number placed in the former Column, and appointed for the former Equation, be less than 1224 (the half of the greatest 2448) that greatest Number itself also, if it be needful, being, as the entire Circle, first omitted, go to the next following Table agreeing to that Equation, and add the Equation there placed to the middle Time of the Eclipse before found. If the Sum exceed the half of the greatest Number, subtract the Equation corresponding to it from the middle Time of the Eclipse: Then will the Sum in the former Case, and the Difference in the latter, give you the Time of the middle of

the Eclipse equated the first Time.

3. If the Number placed in the latter Column, and either increased by the eleventh Part of the former Equation, where the first Equation was found by Subtraction; or lessen'd by it, where it was gain'd by Addition; be less than 113, the half of the greatest Number 225.4 (that greatest also itself, where 'tis necessary, being quite rejected); Then take that very Number, or if it be greater than the same half, its Compliment to the greatest Number, and apply it to find the second Equation; and add the proper corresponding Numbers, taken out of the Table, to the first Equated Time of the middle of the Eclipse. So shall the Sum of both be the true Moment of the middle of the Eclipse. From which Moment of Time, if you subtract the Half Duration of the same Eclipse (taken easily out of the next following Table) you will have the Moment of the Immersion; if you add it to that Time, you will have the Moment of the Emersion, and both duly accommodated to the mean Time of the Eclipse.

And these sew Rules and Operations are sully sufficient for the Calculation of these Eclipses; only I shall add an Example to make all plain

and clear.

T.	D.	H.			Numb. 1.	Numb. 2.
The Year 1702.	I	14	50	36	2192	78.9
	23	10	11	00	0185	184.0
November	25	OI	OI	36	2477	262.9
Equation 1 +	00		03	06		.3
Time first Equated	25	OI	04	42	29	262.6
Equation (2)+	00	00	03	29		225.4
		OI	04	39	_	37.2
The equal Time of ?	25	02	12	50	11) 3,1 (.3	
The Equation of 7)				⊙ in ‡ ì4	
The apparent Time of the Emersion	-25	02	21	15	p. m.	

But fince this Eclipse happens in the Daytime, viz. Nov. 25. at 2 Hours, 25 Minutes, and 15 Seconds past Noon; 2 Period or two must be added, to find when one will happen in the Night time.

D. H., "
The Radix is --- 25 02 21 15 p. m.
Add one Revolution 1 18 28 36

The Sum will be 26 20 49 51 p.m. for the Time of the next Emersion.

Which Eclipse being also invisible, add to the last Sum another Revolution.

D. H. 26 20 49 51 1 18 28 36

28 15 18 27 p. m. which will be the Time of the next visible Emersion of the Satellite in the Meridian of London.

And thus may the Times of the Eclipses of the Satellites of Supiter be calculated with great Exactness for the Meridian of any particular Place, and Tables made of them for any Time to come. And wherever, under any other Meridian, the exact Moment of the Eclipse of a Satellite can, by a good Telescope, be observed; the Time of its happening sooner or later than the Tables shew it will do, at London (suppose, or for any other Meridian) will shew how much the Meridian of the Observer is distant either East or West from the Meridian of London: That is, the Difference of the Longitude between these two Places will be known.

JURIDICAL Days, the same with Cours-Days.

JURISDICTION, is a Dignity which a Man has conferr'd on him to do Justice in Cases of Complaint made before him. Of this there are two Kinds; one, which a Man hath by reason of his Fee, of doing Right in all Plaints relating to his Fee, by Vertue thereof. The other is collated by a Prince to a Bailiff; which in a large Sense may fignify all such as have Commission from the Prince to give Judgment in any Case.

JUS Honorarium, or the Edists of the Pressors, was a Part of the written Roman Laws, and was what the Pressors, and such kind of Magistrates,

did propose by the Consent of the People.

JUS Retralles five Retrovendendi, in the Civil Law, is an Agreement between Buyer and Seller, that the latter and his Heirs may buy back the Goods or Wares again before any other.

JUSTICE. The Virtue of Justice is either Universal or Particular. General or Universal Justice is a constant giving to every one his Due; and this hath for its Object all Laws, both Di-Particular Justice, is a convine and Humane. flant Will and Defire of giving every one his Due, according to particular Agreement, or the Laws of Civil Society. Particular Justice, as 'tis exercised in Commerce, is usually called Commutative, and sometimes Expletory Justice, being directed without any Regard to the different Conditions of Men, but observes the simple Proportion, and is wholly bent on the Value or Price of Things, or what is really and justly due. But if you consider Particular Justice, as it is exercised in Governing, or in Beneficence, it is called Distributive or Attributive Justice; and is concern'd in the appointing of Rewards and Punishments, according to the several Conditions, Stations and Qualities of Men, according as they are more or less good or bad, useful or prejudicial, worthy or unworthy. And when there are many Claimers for Rewards, it observes a Comparative Proportion.

JUSTICE of the Hundred, was formerly the same with the Dominus Hundredi; called also Centurio, Centenarius, and Aldermannus.

JUSTICES of Labourers, were Justices heretofore appointed to redress the Frowardness of Labourers, that would either be Idle, or have unreasonable Wages.

reasonable Wages.

JUSTICES of the Pavillion, are certain Judges of a Pie-Powder Court, of a most transcendent Jurisdiction; anciently authorized by the Bishop of Winchester, at a Fair held on St. Giles's Hill, near that City, by Virtue of Letters Patents granted from King Edw. IV. See the Patents at large in Prynn's Animadv. on 4 Instit. fol. 191.

JUSTICES of the Peace, are they that are appointed by the King's Commission to preserve the Peace of the Country where they dwell. Of these some are made of the Quorum; because some Business of Importance cannot be dispatch'd (see Quorum) without the Presence or Assent of them, or one of them.

The Office and Power of the Justices of the Peace is very large and various, being founded on several Statutes; of which, see Fitzberbert, Lambert, Crompton, and in Smith de Repub. Aulor. lib. 2. cap. 9. They were called

Guard ans of the Peace till the 36 Edw. 3. cap. 12. where they are stilled Justices. Those that live in, and are Members of Towns, Corporations,

JUSTICE SEAT, is the highest Court that is held in a Forest, and before the Lord Chief Juflice in Eyre of the Forest, upon Warning given forty Days before; and then the Judgments are always given, and the Fines fet for Offences, that were presented at the Courts of Attachments, and the Offenders indicted at the Swain-Motes: See Manuood's Forest Law, C. 24.

Justices appointed by Edward the first, on great Disorders arising in the Kingdom, while he was absent in the Scotch and French Wars. Their Office was to make inquisition throughout the Realm, by the Verdict of substantial Juries, upon all Officers, as Mayors, Sheriffs, Bailiffs, &c. for their Breach or Neglect of Duty, in not punishing Bribery, Extortion, &c. 'Tis most likely they received their Name from a Bafton, or Stuff, that was the Badge of their Office, as it is of a Mareschal of France: And whoever was brought before them was Traile à Baston, traditus ad Bucu-JUSTICES of Traile Baston, were a kind of lum, brought to the Staff of Justice.

KAL

ALENDÆ, were formerly Rural Chapters, or Conventions of the Rural Dean and Parochial Clergy; so called, because they were held on the Kalends, or first Days of every Month; as at first every three Weeks: At last these Conventions came to be held only once a Quarter; and by Degrees have been wholly intermitted, to the great Decay of good Discipline. Parochial Antiquities, p. 640.

KALENDAR Month, is mentioned in 16 Car. a. cap. 7. and confifts of 30, or 31 Days (except February, which never hath more than 28 Days, excepting Leap-Year, and then has 29) twelve of which being those mentioned in the Kalendar, make a Year; which hence is vulgarly express'd in the Singular Number, and called a Twelve Month; But when in the Plural Number we say Twelve Months, then it shall be accounted a Month

of Weeks, which is but 28 Days.
KALENDAR. There is in Use still in Staffordsbire, among the common People, a very peculiar Kind of perpetual Kalendar or Almanack, Dr. Plott, in his Natural History of that County, describes very accurately, and proves to be of Danish Invention, and no doubt brought in when the Danes had the Government of this Kingdom.

It is called there the Cloce, I suppose from its Form and Matter, being usually made of a Piece of Wood, squared into sour plane Sides, and with a Ring on the upper End of it, to hang it on a

Nail somewhere in the House.

There is some Diversity in the Form of them, some being more persect than others. The sollowing Figure, which I borrow from D. Plott, represents the Common or Family Clogg, where each Angle of the Square Stick, with one half of each of the flat Sides belonging to it, is express'd; and this is the most clear and intelligible Form

it can well appear in, upon a Flat.

On each of the four Sides are three Months, the Number of the Days being represented by the Notches; That which begins every Month having a patulous Stroke turn'd up from it: Every seventh Notch, being also of a larger Size, stands for Sunday, which seems to shew that the Cycle of the Sun or Dominical Letters, are here committed to Memory; the Sundays and other Days here being fix'd.

Over against many of the Notches, whether great or small, there are placed on the left Hand Vol. II.

KAL

several Marks or Symbols, denoting the Golden Number, or Cycle of the Moon; which Number, if under 5, is represented by so many Points; but if it be 5, then a Line is drawn from the Norch, or Day to which it belongs, with a Hook returned back against the Course of the Line; which feems to be design'd to represent V the Roman Letter for 5.
If the Golden Number be above 5 and under 10,

then 'tis mark'd out by the former hooked Line for j; and with the Addition of as many Points as make up the Number design'd, As if it be 8, there

when the Colden Number is 10, there is a Cross on the Notch to represent X; And if it be above, and under 15, 'tis express'd by Points as before; And if above 15, by the cross Stroke, Points, and a hook Line for V: When 'tis 19, the Line issuing from the Notch for the Day, hath two resulting Crosses, or Strokes, as is plain from the patulous Crosses, or Strokes, as is plain from the

following Figure.

And these Numbers are not set so wildly and confusedly against the Days of the Month, as at first Sight may appear, but in a Method and Order; whether you consider them as they immediately precede and follow one another, or the Distance interceding each Figure, or the Value, or Denomination; for every following Number is made by adding 8 to the preceding; and every preceding one, by adding 11 to the following one; still casting away 19, the whole Cycle, when the Addition shall exceed it. Thus to 3, which stands against January 1, add 8, it makes 11; which stands against the third Day of the Month; to which add 8 again, and it makes 19; whence 8 itself comes to be the following Figure, and 16 the next: On the contrary , if to 16 you add 11, it makes 27; whence deducting 19, there remains 8, the Number above it; and

And for the Distances of the Numbers of the same Denomination, 'eis to be noted that they stand asunder either 30 or 29 Days, inter-changeably. Thus after 3, which stands overagainst the 1st of January, at 30 Days Distance you will find 3 again at the 30th of the same Month; and from thence, at 20 Days Distance, you will have 3 again fet to the tst of Narch; and at the last of March, at 30 Days Distance, 3

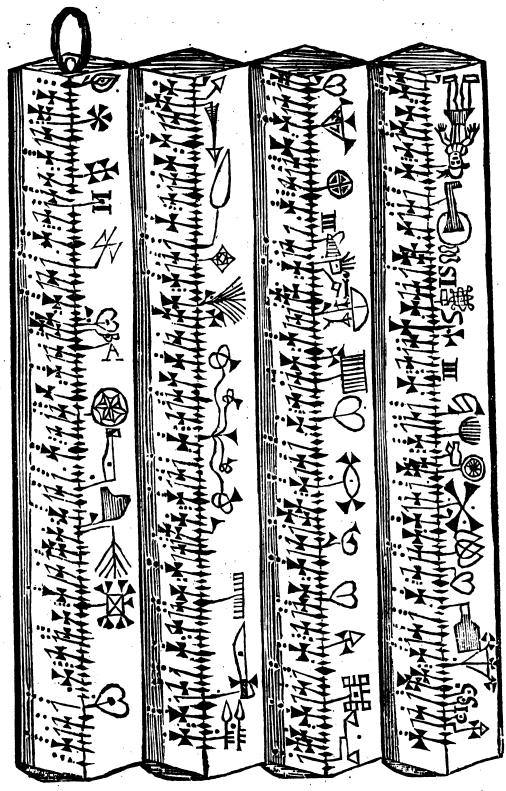
again, &s.

Note, 3 stands against the 1st of January, be- ! cause 3 was the Golden Number, when the Fathers of the Nicens Council settled the Time for the Observation of Easter. See Plot, in Loc. cit.

On the Right Hand, and issuing from the Notches, are several Inscriptions and Figures, Hieroglyphically representing the Festival Days, by some Actions, Offices, or Endowments of the Saints; or else the Work or Sport in fashion at the Time of the Year.

Thus from the Notch of January 13. being St. Hillary's Day, issues a Cross, the Badge of a

Bishop. From the 1st of March an Harp for St. David. Against June 29. St. Peter's Dry, you have his Keys: And against St. Crispin's Day a Pair of Shoes. Against Jan. 25. St. Paul's Day there is an Ax: And against June 24. a Sword for St. John Baptist. On Aug. 10th a Gridiron for St. Lawrence. So a Wheel for St. Katherine, a Star for Epiphany, a True-Lover's-Knot for St. Valentine's Day, &c. And against Christmas-Day is the old Wassbailling, or Carousing-Horn, that the Danes used to make merry withal at that



The Use of this Clogg is chiefly to find by Moons, and the Moveable Feasts; and the Immove the Prime or Golden Number the Ecclesiastical New able Feasts by the Symbols on the Right Hand. KANT-

KANT-Rref, was used anciently in Wales for the Government of an Hundred Towns; under which were so many Commots, which the Welch call Cummwd, and signifies Provinces or Regio, and confisted of twelve Manors or Circuits, and two Townships.

KARITE, or Carite, was the Word used formerly by the Religious for their best Conventual Drink, or Strong Beer; because in this they drank their Poculum Caritatis, or Grace Cup: Which Grace-Cup itself was sometimes called by

the Name of Karite or Carite.

KEELS or Keyles, were a kind of Long-Boats, of great Antiquity, and mentioned 23 H. 8. 18. Spelman faith they were those in which the Saxons invaded England.

KELP, what it is, and how made, see under

Allum Works in this Vol.

KERF, is the Notch or Slit that is made by the Saw between two Pieces of Wood, when they are sawing asunder.
KERNELLATUS, anciently fignified Embat-

zelled or Crenelled, i. e. Fortified : And

KERNELLARE Domum, was to build a House with such Walls and Towers; which to be allow'd to do, was a Favour commonly granted by our Kings after the Demolishments of the Caftles.

KEYSTONE in an Arch, is placed at the Top or Vertex of Elliptical or fuch-like flat Arches, to

bind the Sweeps of the Arch together.
KIDNEYS. The Kidneys in Man are always two in Number, one on each Side, being nearly of the Figure of the French or Kidney Beans; which latter Name they take from being like the Kidneys.

The Length of the human Kidney is between four and five Fingers Breadth. They are about two Fingers Breadth in Thickness, and three over. The Right Kidney is fituated under the Liver; the left under the Spleen.

In a Fætus their external Subfrance is divided in a formula laboration of the specific of

into several Lobes join'd together, which in adult Persons become more close; wherefore in such their Surface is equal and smooth. They have two Membranes; one Common from the Perisoneum, the other Proper. Usually they are cover'd with a good deal of Fat; their Colour is of a dark Red.

There are several Lymphatic Vessels observed in the Kidneys, which discharge themselves into Pecquet's Repository: The Veins go into the Vena Const. The Arteries come from the Artes.

Cava: The Arteries come from the Aorta

Those Veins and Arteries are called Emulgents: They come out from the Kidneys in their hollow Sides (which lie nearest to the Cava and Aorta) included in one common Capfula, and are divided into several Branches, which surround the Pelvis. These Branches are again sub-divided into an Infinity of other leffer ones, which go to the external Parts of the Kidneys, where they inosculate, and form a kind of Net; from which their Extremities coming, terminate al-fo in Infinity of Glands, which are all very Imall.

These Glands are in Figure roundish, and they compose the outer Substance of the Kidneys, which is half a Finger thick. From each of them there goes a long small Tube; and the Collection of these Tubes compose the innermost Substance of the Kidneys.

As these Tubules approach the Pelvis, they gather together in little Bundles; whose Extremities piercing the Membrane of the Pelvis, form those little Protuberances on the Inside of the Pelvis, or Cavity in the middle of the Kidney, which are called the Papille.

This Cavity, or Pelvis, is form'd by the Dilatation of the Ureters: It sends out several Ramifications, which divide the Urinary Tubes into Bundles, and which make a fort of Capiula to

the Blood Vessels.

I'he Use of the Kidneys is to separate the Urine from the Blood; which by the Motion of the Heart and Arteries is thrust into the Emulgent Branches, which carry it to the little Glands; by whose Means the Serosity being separated, is received by the Orifice of the little Tubes, which go from those Glands to the Pelvis; from whence it runs by the Ureters into the Bladder.

The Blood which was carried into the Glands, its Particles being too gross to enter into the small excretory Tubes, is brought back from the Kidneys by the Emulgent Veins, to be mingled with the other Venal Blood in the Cava.

The Description of the Ureters, Vesica Urinaria, Glandule Renales, &c. you will find in their pro-

per Places.

Dr. Keil, in his Animal Secretion, pag. 33-judges that the Kidneys are placed so near the Heart as they are, because Salts are Corpuscles, which are strongly attracted, and have a most close Union with the Fluid of Water: For tho' the Lungs may divide the Particles of Salt one from another, yet still they firmly adhere to the aqueous Humour in which they swim; and therefore they may likewise at first be drawn off: And he thinks that the Kidneys could not well have been placed at a greater Distance, to have separated such a Quantity of Urine as they now do; and that not only on the account of the great Quantities of Blood they receive where they are; but likewise, if they had a more distant Situation, other Particles must have united with the Salts and aqueous Particles (as even in their present Station some terrestrial Particles do) and consequently the Urine could not have been distilled luch as it is now, or at least but in

a small Quantity.
KING-PIECE in any Building, is a Piece of Timber standing upright in the middle between two principal Rafters, and having Strutts or Braces going from it to the middle of each Rafter-KINGS at Arms: See Heralds in this Vol.

KING-SILVER, is properly that Money due to the King or Queen in the Court of Common-Pleas pro Licentia concordandi, in respect of a Licence then granted to any Man for passing a Fine.
KINTAL, is a Weight in Merchandile, usual-

ly of about an hundred Pounds, but something more or less, according to the different Customs

of different Nations.

KNAVE, is an old faxon Word for a Man-Servant, and is so used in 14 E. 3. Sat. 1. c. 3. and Verstegan thinks it comes from the Duch Cnaps, which fignifies the same Thing. Cnaps in Same also is a Male-Child or Boy; and in this Sense a Knave-Child hath been frequently used formerly in Contradistinction to a Girl; and in this Sense Wickliff uses the Word in his Translation of Enod. 1.16. and other Places of the Bible. KNEVELS, B B b 2

KNEVELS, the same with Kevels.

KNIGHT, Miles, from the Saxon Cnite, fignifies with us a Person that beareth Arms, and who for Valour and Martial Conduct is by the Sovereign, or his Authority, fingled from the ordinary fort of Gentlemen, and raised to a higher Step or Dignity. This among almost all Nations takes his Name from the Horse, because they used to serve in War on Horseback. Thus the Komans called them Equites; the Italian Word is Cavallieri; the French, Chevaliers; the Germans, Reyters; the Spaniards, Gavallares, &c. It appears by the Stat. I E. 2. c. 1. That formerly a Gentleman having a full Knights-Fee, and holding his Land by Knight-Service, might be urged by Distress to procure himself to be made Knight when he came to full Age: But by 17 Car. 1. 20. no Man can be compelled to take that Order on him. The Manner of making Knights, Cambden, in his Brisannia, shortly expresses in these Words: Nostri vero Temporibus qui Equestrem Dignitatem suscipit, flexis genibus edusto Gladio leviter in humero percu-titur; Princeps hu Verbu Gallicè effatur: Son Chevalier au nom de Dieu.

KNIGHTS Bannerets: See Bannerets in this

Vol.

KNIGHTS of the Bath, are an Order of Knights made within the Lists of the Bath, and girded with a Sword in the Ceremony of their Creation. They are spoken of in 8 Edw. 4. c. 2. For their Antiquity and Manner of Creation, see Dugdale's Description of Worcestersbire. They take Place of Knights Batchelors, and come after Ba-

KNIGHTS-FEE, is so much Inheritance as is fufficient yearly to maintain a Knight with convenient Revenue; which in H. IIId's Time was 15 Pounds, Cambd. Brit. p. 111. But Sir Tho. Smith, in his Repub. Anglor. lib. 1. c. 18. rateth it at 40 Pounds. And in 1 E. 2. c. 1. it appears that such as had 20 Pound in Fee, or for Term of Life, might be compelled to be Knights; but this is now repealed by 17 Car. 1. Stow in his Annals saith, "There were in England at the Time of the Conquest 60211 (others say 60215) "Knights-Fees; whereof the Religious Houses, before their Suppression, were posses'd of 28015." Some say a Knight's-Fee contained 8,

others 12 Plough-lands, or 600 Acres.

KNIGHTS of the Garter, are an Order first created by King Edw. III. after the Acquisition

of many great and glorious Victories. He fought out of his own Kingdom, and all over Christendom, for a Number of most excellent and noble Persons, to each of which he gave a blue Garter deck'd with Gold, Pearls, and precious Stones, with 2 Buckle of Gold, to be worn only on the left Leg; a Kirtle, Crown, Cloak, Chaperon, a Collar, and other stately and magnificent. Apparel. The Number was 26, of which the King and his Successors were ordain'd Sovereigns, and the others Companions, or Brethren of the most Noble Order of the Garter.

This most Honourable Society is now a College or Corporation; having a Common Seal belonging to it; having, besides the Sovereign, which is Guardian of the Order, and who governs it by himself, or Deputy; and besides the 25 Companions, or Knights of the Garter, 14 Secular Canons, that are Priests, or must be within a Year after their Admission; 13 Vicars, which must also be Pricits; and 26 poor Knights, that have no other Subsistence or Means of Living but the Allowance of this Order. The Bishop of Winton, for the Time being, is called Prelate of the Garter; the Bishop of Sarum, Chancellor of the Garter; the Dean of Windsor, Register of the Garter. The Principal King at Arms is called Garter, who is to manage and marshal their Solemnities at all Installations and annual Feasts. The User of the Garter is also User of the Black-Rod. By Order of King Charles I. all the Companions of the Garter are to wear on the left Side of their upper Garment the Cross of England, encircled with the Garter and Mosto, and with Rays of Silver issaing from thence every way like a Star; whence 'tis usually called the Star and

KNIGHT-Marshal, is an Officer in the King's House, having Jurisdiction and Cognizance of any Transgression within the King's House and Verge; as also of Contracts made there, where-

of one of the House is Party.

KNIGHTEN Gyld, was anciently a Guild in London, confisting of nineteen Knights, founded by King Edgar; who gave then a Portion of waste Ground, lying without the Walls of the City, which is now called Port-Soken-Ward. S.ow's

KNOCKING Mill, is the same with a Stamping Mill, which see, and also the Word Tin.

LAB

LABEL, in the Law, is a narrow Slip of Paper or Parchment affixed to a Deed or Writing, in order to hold the appending Seal: So also any Paper, annex'd by way of Addition or Explication to any Will or Testament, is called a Label or Codicil.

LACERTA, is a Word used in Doomsday-Book,

and fignifies a Fathom.

LACHES, in the Law sense, seems to signify Slackness or Negligence, as appears from Littleton, Fel. 403 and 726, where Laches of Entry is nothing else but a Negle& of the Heir to enter; and so perhaps comes from our English Word to Lack; unless from the French Lascher or Lasche.

LACHRYMATORIES, were small Earthen Vessels, wherein the Tears of the weeping Friends that survived, were reposited and buried with the Ashes and Urns of the Dead.

LADA, is a Lade or Lath, from the Saxon Lathian, signifies an Assembly or Court of Justice; and from hence the annual Court at Dym-Church, by Romney-Marsh in Kent, for the Election of a Bailiff and other Officers, is call'd Dym-Church-Lath to this Day.

LADA, from the Saxon Ladian, also signifies a Purgation by Trial; and in the Laws of King Ethelred there is frequent Mention of the Lada

Simplex, Triplex, and Plena.

LAFORDSWICK, in the old Saxon, is the betraying of, or Infidelity to a Lord and Master. Tis mentioned in the Liws of Canutus, c. 61. and those of Henry I. c. 13.

LAGA, is a Word used for Law in Magna Charta: And hence comes Dane Lage, Saxon Lage,

Mercen Lage, &c. as also LAGEDAYUM or Lagb-day, that is, a Lawday, or Day of open Court : Hence also a Lages-Man is Home Legalis; and this Word Lage-Man is frequently used in Doomsday-Book, and in the Laws of Edward the Confessor.

LAGEN, Lagena, in ancient Times was a Measure containing six Sextarii. Vid. Fleta, 1. 2. c.

8, 9. and Charta Ed. 3. m. 25. n. 82.

LAGON or Lagan, is a parcel of Goods thrown out of a Ship in a Storm, &c. and because they would else sink, they are fastened to a Buoy or Cork, in order to be found again. If the Ship be wreck'd, the Goods are called Lagan or Ligan, quafi d Ligando: and so long as they continue in she Sea they belong to the Admiral; but when cast ashore they become a Wreck, and belong to him

that hath the Wreck, as appears in Co. l. 5. fo. 106.
LAHSLITE, Las slite, Lagbslite, is used in the
Laws of Hen. I. c. 13. for a Transgression of the Law; and sometimes for the Punishment there-

unto belonging

LAMMAS-DAY, quafi Lamb-mas, is our first of August; and on this Day the Tenants which formerly held Lands of the Cathedral Church in York, were bound by their Tenure to bring a Lamb afive into the Church at High-mass.

LAND-BOC, was anciently a Charter or Deed, whereby Lands or Tenements were given or held.

LAND-CHEAP, was an old customary Fine quid either in Cattle or Money at every Alienation of Land, lying in some peculiar Manor, or Liberty of some Burgh. This Custom yet remains in Malden in Effex.

LAND GABLE or Gavel, was anciently a Tax or Rent issuing out of Land: 'Tis called in Doomsday Census Pradialis; and Spelman faith, it was a Penny for every House, being, as we now speak,

a kind of Quit-Rent or Ground-Rent.

LANDIRECTA, in the Saxons Time, were fuch Services and Duties as were laid on those that held Land. These were three Obligations, which from their Number were called Trineda Necessit.u, and were Expedition, Burgh-bote, and Brig-bote. These were not called Servitia, because not Feodal Services arising from the Condition of the Owners; but by this Name Landiresta, Rights that charged the very Land, whether possess by Churchman or Layman.

LAND-TENANT, in the Law, is he that actually possesses the Land, and who hath it in his manual Occupation. The same with Terre-

Tenant.

LANO-NIGER, was a kind of base Coin in

Use about the Time of Edw. I.

LAPSE, is the Omission of a Patron to prefent to a Church within fix Months after voidable; on which Neglect, Title is given to the Ordinary to Collute to the faid Church.

LASHITE, was a common Forfeiture in the time of the Danes; it was 12 Ores, each Ore was about 6 d. Sterling. Vid. Selden Hist. Tythes. Tho' some say, the Ore was in Value about 16 Pence, and that 15 of them made the Libra or Pound.

LAST, in general fignifies a Burden, and particularly a certain Weight or Measure: As a Last of Pitch, Tar, or Ashes, is 14 Barrels; a Last of Hides or Skins is 12 Dozen; a Last of Codfish is 12 Barrels; a Last of Herrings is 20 Cades, or ten Thousand; a Last of Corn is 10 Quarters; a Last of Wool is 12 Sacks; a Last of Leather is 20 Dickers, and every Dicker is 10 Skins; a Last of unpack'd Herrings is 18 Barrels.

LAST, in the Marshes of the East of Kent; also is a Court held by 24 Jurats, and summoned by the two Bailiffs thereof, wherein they make Orders, lay and levy Taxes, &c. for the Preser-

vation of the Marshes.

LASTAGE or Lestage, is a Custom exacted in some Fairs and Markets, to carry Things where one will, saith Rastall; but sometimes 'tis taken also for the Balast of a Ship; and, as some say; its properly a Custom paid for Wares sold by the Last.

LAST-HEYRE, is he to whom the Land comes by Escheat, for want of lawful Heirs; which is sometimes the Lord of whom the Land is held;

and sometimes the King

LATCHES, in a Ship, are the same with

Laskets.

LATHE (Lastium) is a great part of a County or Shire, containing three or four Hundreds, as in Kent and Suffex. Whence the

LATHE REEVE, or Leid grede, or Tything-Reeve, was an Officer in the Saxon Government, who had Authority over the third Part of the Country, Country, or over three or more Hundreds or Wapentakes; whose Territory was called a Tithing, or a Leid or Leithen. Perhaps the Ridings in York sbire are so called corruptly from Tithings or Tridings, as 'tis sometimes written. Matters that could not be determined in the Hundred Court, were brought to the Trithing, where the principal Men of three or more Hundreds, being affembled by the Authority of the Lath Reeve or Trithing Reeve, did decide and determine it; but if they did not, it went further to the County Court.

LATITUDE of a Place, is found at Sea by having the Sun's or any Star's Declination (by the Tables) and his Meridian Altitude; and that is found by a Quadrant or Aftrolabe. Now from the Horizon to the Zenith being 90°; if from 90° you take the Sun's Meridian Altitude, the Remainder will be the Sun's Distance from the Zenith. When therefore by Observation the Sun's Meridian Altitude is found, you are to consider whether the Sun hath any Declination or not: If he hath none, but moves in the Equinoctial that Day, then the Elevation of the Equator will be equal to his Meridian Altitude; and confequently his Meridian Altitude is the Co-Latitude: Subduct therefore that from 90, the Re-mainder is the Latitude of the Place, which will be North, if the Sun be on the South Part of the Meridian, and South when the Sun comes to the North of the Meridian. 'Tis the same thing with any Star in the Equator. When the Sun or Star hath any Declination, the Zenith Di-stance with that will give the Latitude; for if the Meridian Altitude and Declination be both the same way, i.e. both North or both South, the Difference between them will be the Latitude of the Place, or the Pole's Height: Only observe, that if the Zenith Distance exceed the Declination, the contrary Pole will be elevated. V. gr. If the Declination be 23°. 30'. N. and the Zenith Distance 8°. 30'. N. the Latitude will be 15°. N. But if the Zenith Distance be 71°. 30'. S. and the Declination 20°. S. the Difference will be 30' = to the Latitude, as before; only it will be North, because the Zenith Distance exceeds the Declination. If the Declination be North, and the Meridian Altitude South, or vice versa, i. e. one contrary to the other, then the Sum of the Declination and the Zenith Distance is the Latitude of the Place. Indeed sometimes the Sun or Star may have two Meridian Altitudes; as when the Altitude and Declination being the same way, the latter exceeds the former; and then the Sum of the Co-declination and the Meridian Altitude is the Height of the Pole towards which the Declination is. And you must observe, that whether the Meridian Altitude be North or South, if that and the Co-declination together be less than 180°. the Sun or Star will have two Meridian Altitudes in 24 Hours.

LATROCINIUM, in fome old Charters, is used for the Liberty of Infang-thief, or the Privilege of adjudging and executing Thieves.

LATTA, is a Lathe or Tithing. LAUDIMIUM, in the Civil Law, is the 50th Part of the Value of Land or Houses paid by the Proprietor to the new Temant, by way of Emphyteuse, as an Acknowledgment upon Investitures, or for being put into Possession.

LAUDUM, was formerly used for an Arbitration or decifive Sentence of any chosen Judge

or Arbitrator.

LAUNDER, is a Trench cut in the Floor 8 Foot long and 10 Foot over, with a Turf for a Stopper at one End, to let the Water (which comes along with the bruifed Ore from the Coffer of a stamping Mill in the Tin-works) run away while the Ore finks to the bottom. See Tin.

LAURETS, were pieces of Gold coined in the Year 1619, with the King's Head laureated on them. There was a 20s. Piece marked with xx; one of 10s. marked x, and one of 5 s. marked v.

LAW. In England our Laws have been variable. (1.) We had the Laws of Molmutius, which were translated out of British into English by Gildu; of which there some remain in our present Laws. Vid. Mag. Chart. c. i. and 14.
(2.) There was the Merchen Lage, mentioned

in Cambden's Bris. and Polyd. Hift. Anglia, lib. 5.

(3.) West-Saxon-Lage.
(4.) Dane-Lage; all which were reduced into one Body by Edward the Confessor.

At present the Law of England is divided into ' three Parts.

(1.) The Common Law, which is the most ancient and general

(2.) Statutes, or Alls of Parliament.

(3.) Particular Customs. C. on L. fol. 15. LAW hath also a special Signification, sometimes implying that which is Lawful with us, and not elsewhere, as Tenant by Courtefy of England, 13 E. I. 3.

To Wage Law (Vadiare Legem) is to put in Security: To make Law (facere Legem) at a Day affigned: And to make Law, is to make Oath that he owes not the Debt challenged at his Hands; as also to bring with him so many Men as the Court shall affign, to avow upon their Oath, that they believe in their Consciences he hath sworn truly.

And this Law is used in Actions of Debt without Specialty; as also, where a Man coming to the Court after such a Time, that his Tenements have been seized for Default, shall deny himself to have been summoned.

LAW of Arms, Jus Militare, is the allowed Rules and Precepts concerning War; to make and observe Leagues and Truces, to punish Of-

fenders in Camps, &r.

LAW of Merchants, Lex Mercatoria, is a Privilege or special Law, differing from the Common Law of England, proper to Merchants, and summary in Proceedings. Vid. 27 E. 3. Stat. 8, 9, 19, 20. 13 E. 1. Stat 3. Cook on Littleton, fol. 182.

LAW Spiritual, is the Ecclesiastical Law, allowed by the Laws of this Realm, so far as it is not contrary to the Common-Law, nor the Statutes and Customs of the Realm. According to this the Ordinary or other Ecclefiastic Judges do proceed in Caufes within their Cognizance. Cook on Littleton, fol. 344

This was called the Law Christian, and the Court the Court Christian; and the Rural Dean, who was Judge or President of the Court within his own Diffeict, was called hence Decanus Christianitatis; and in Contradistinction to this, the Common-Law was by some called Lex Mundana, Terrena, &c.

LAW of the Staple, is the same with the Law

of Merchants,

LAW of Marque, (see Reprisals.) This Word is used 27 E. 3. Stat. 2. c. 22. and comes from the German Word March, which is a Bound or Limit and those who are driven to Reprisals, are forced to take the Ship and Goods of the Injurer, fince they cannot meet him at Home to have ordi-

nary Justice: LAW-day, is otherwise called the View of Frank Pledge or Court-Leet; and is used for the County Court, I E. 4. c. 2. and indeed the Lage-day or Law Day, formerly was any Day of open Court; and was commonly used for the more solemn

Courts of a County or Hundred.

LAW-less Court. On King's Hill at Rochford in

Essex on Wednesday Morning next after Michaelmusday, at Cock-crowing, is held a Court so called, because 'tis held at a lawless or unlawful Hour: They whisper, and have no Candle, nor any Pen and Ink, but only a Coal: And he that owes Suit or Service and appears not, forfeits double every Hour he is missing. This Court belongs to the Honor of Raleigh, and to the Earl of Warwick.

LAWES, are round Heaps of Stone, being a kind of rude Monument for the Dead. They are so called on the Borders between England and

Scotland.

LAYMAN, among the Painters, is a Statue of Wood, whose Joints are so made, that it may be put into any Posture; and its chiefest Use is for the casting and adjusting of Draperies for the cloathing of Figures.

LEA of Yarn. By Stat. 22, 23 Car. 2, c. — a Lea of Yarn at Kidderminster is appointed to contain 200 Threads, on a Reel which is four Yards about. LEAD. The Lead Mines in Somersetsbire are

at Mendip, which is a Place all mountainous, but the Hills are of unequal Heights; 'tis barren and cold, and in some Places rocky: the Ridges of the Hills run confusedly, but most East and West, and not many parallel one with another. Surface is heathy, ferny and furzy; it feeds Sheep all the Year, and young Beafts, Horses and Colts at Spring and Fall. The Soil is red and stony, but no way Clairy, Marley or Chalkey. The Stones are either of the Nature of Firestones or Lime-stones. The Trees have their Tops burnt, and their Leaves and their Outsides discoloured and scorched with the Wind; and they grow to no confiderable Bigness. Stones which are wash'd out by the Brooks and Springs are reddish and ponderous. The Country is more troubled with Thunder and Lightning, Storms, nocturnal Lights and fiery Meteors, than other Parts of the County

When they have gotten the Ore, they bear it small, then wash it clean in a running Stream, and then fift it in Iron Rudders, after which they make an Hearth or Furnace either of Clay or Fire-stone, which they fet in the Ground, and upon it build their Fire which is lighted with Charcoal, and conrinued with young oaken Gadds: Tis blown with Bellows by Men's treading upon them, and after the Fire is lighted, and the Fire-place hot, they throw their Lead Ore upon the Wood which melts down into the Furnace; and then with an Iron Ladle, they take it out, and on Sand cast it into what Form they please. Phil. Trans. N° 28.

In Phil. Trans. N° 39, you have this further

The Veins of Lead have been found to run up into the Roots of Trees without apparently altering them. White, yellow, and mix'd Earth, are Leaders to the Country or Place where the Ore lies; and changeable Colours do always encourage their Hopes. Sometimes they dig 12 Fathom deep before they meet with any Stones; other while when

a flony Reak is at top, they meet Ore just under the Swerd or Surface of the Grass: which Ore hath gone down 40 Fathom. A black Stone is an ill Sign, and leads to Jam, as they call it, that is, a thick Bed of Stone that hinders their Work; a grey, clear, and dry one they account the best, They seldom meet with any Damps. If in finking they come to wet moorish Earth, they expect a Jam, and to be closed up with Rocks. Their Nearness to the Ore they guess by short brittle Clay; for they don't think or find a tough Clay to be leading, as they call it; that is, directing towards Ore.

Sometimes the Ore lies Shale or shallow, and then it is 14 or 20 Fathom, more or less, before they hit it. They follow a Vein inclining to some

Depth, when it runs away in little flat Binns.
When the Stones part it, then they find a Vein again. Their Draughts are 14 or 16 Fathom, till they come to a Stone, where they cast a Side-Draught, called a Cut. Then they fink plumb again 4 or 5 Cuts one under another; They find Ore at 50 Fathom. Their best Reaks are North and South; East and West are good, the not so deep. The Groove is 4 Foot long and 2; Foot broad, till they meet with Stone, and then they carry it as The Groove is supported by Timber; they can. a Piece as big as one's Arm will support 10 Tun of Earth. The Timber there lasts long; they have known it lie 200 Years, and after that it will serve in new Works; it is tough and black, and being exposed a few Days to the Sun and Wind grows so hard that an Ax will scarce cut it.

For the supply of Air, they have Boxes of Elm, exactly closed, of about 6 Inches in the Clear, by which they carry it down 20 Fathom and more; but when they come at Ore, and need an Air-shaft, they fink it 4 or 5 Fathom distant, of the same Fashion with a Groove, to draw as well Ore as Air.

They make use of leathern Bags, holding 8 or 9 Gallons a piece, to free them from Water, which are drawn up with Ropes. If they find a Swallet, they drive an Adit upon a level till it is dry. If they cannot cut the Rock, they use Fire to anneal it, laying on Wood and Coal, and contriving the Fire so that they can leave the Mine before Operation begins; and they find it dangerous to enter again before it be quite cleared of the Smoak, which hath killed fome.

Their Beetles, Axes, and Wedges, &c, unless so hardened as to make a deep Impression on the Head of an Anvil, are not fit for their Use; and yet they sometimes break them in an Hour; others last three or sour Days, as it happens. They work in Frocks and Wastcoats, by Candle-light (of Tallow) 14 or 15 to the Pound, each of which lasts three Hours, if they have Air enough. Vein being lost, they drive two or three Fathom in the Breast, as the Nature of the Earth directs They hand out their Materials in Elm Buckets drawn by Ropes; the Buckets hold about a Gallon. Their Ladders are of Ropes,

The Ore sometimes runs in a Vein, and sometimes is dispersed in Banks; it lies often between Rocks: Some of it is hard, some milder. Many times they have branched Ore in the Spar, the Ore there is a Spar and Chalk, and another Substance which they call Crootes, which is a meally white Stone matted with Ore, and foft. The Spar is white, transparent and brittle like Glass, The Chalk white, and heavier than any Glass,

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The Vein lies between the Coats and is of d fferent Breadths; it breaks off sometimes abruptly in the Earth, which they call a deading Bed; and after a Fathom or two may come again to keep the same Point. It terminates sometimes in a Rock called a Fire-flone, and sometimes in a dead Earth, Clayie without either Croote or Spar. The clearest and hardest Ore is the best, of which 36 hundred Weight makes about a Tun of Lead.

The Hearth for melting the Ore is about 5 Foot high, set on Timber, to be turned about as a Wind-mill, to avoid the Smoak on a shifting Wind; it holds half a Bushel of Ore and Coal: There is a Sink on the side of the Hearth into which the Lead runs, and it holds about 11 Hundred. They have a Bar to stir the Fire, a Shovel to throw it up, and a Ladle heated red hot to cast out the melted Metal. Once melting is enough, and the best, which is the heaviest, melts first. There is a Flight (as they call it) or Steam in the Smoak, which falliing on the Grass, poisons those Cattle that eat of it. The Workmen find the Taste of it (when the Smoak flies in their Faces) to be sweet upon their Lips; brought home and laid in their Houses it kills Kats and Mice. What of this Flight falls upon the Sand, they gather up to melt on a Flag-Hearth, and make Shot and Sheet Lead of it.

LEAD, at Sea, fignifies a Plummet of that Metal of about a Foot long, and fix or seven pound Weight, which is hung at the End of a long String to found the Depth of the Sea withal: Therefore their Word is, Heave the Lead, that is, found the Depth of the Water, to know whether it be

fafe for the Ship to venture in any further or not. LEAD-NAILS, are such as are commonly used to nail down Lead, Leather, or Canvas to hard $\mathbf{Wood}.$

LEDGERS, are long Pieces of Timber fasten-ed horizontally to the Poles in the Scaffolds belonging to any Wall or Building, on which the

outermost Ends of the Putlogs do rest.

LEE WAY, of a Ship at Sea, is the Angle made by the Line on which the Ship should run, according to her Course or the Point of the Comas steered upon, and the real Line of the Ship's Way; for all Ships are apt to fall a little to Lee-ward or to make some Lee-way. Wherefore in casting up the Log board, something must always be allowed for Lee-way; and they give such Rules as these, s. If the Ship be upon a Wind you must allow one Point for Lee-way. 2. If the Wind blow hard, so that you are forced to take in one Top-sail, allow two Points for the Lee-way. 3. If it blow so hard that both Top-sails must be taken in, and the Sea runs high, then allow three Points for the Lee-way. 4. If her Fore-fail being furled, she Try under a Main-sail and Mizzen, she will make her Way four Points before the 5. If she Try with a Main-sail only, she will make her Way near three Points before the Beam. But, 6. If under a Mizzen only, she will make her Way about two Points before the Beam.

LEGACY, Legatum, is usually any particular Thing given in a last Will and Testament; for if the whole Estate be so given, 'tis Hereditas. But in the Ecclesiastical Sense it was formerly a Soul-Seat, or a Legacy given to the Church, or ac-customed Mortuary.

LEGION. In the time of the Romans first War in Sicily, Polybius, lib. 1. faith, that the Roman Le-

terward L. Æmylius and C. Ailius Coff. their Legion (in the great Preparations they made against the Gauls) confisted of 5200 Foot and 300 Horse.

After this, some Time before the Battel at Can na, the Roman Legion had in it 5000 Foot and 300 Horse, to which was added an equal Number of Latin Auxiliary Foot, and for the most part thrice the Number of Horse. Polyb. lib. 3.

LEVANT, in Geography, is properly the Eastern Side of any Continent or Country, or that on which the Sun rifes. But now with our Seamen it signifies the Mediterranean Sea, and especially the Eistern Part of it; and our Trade thi-ther is called the Levant Trade; and a Wind that blows from thence out of the Streights Mouth is

called a Levant Wind. LEVEL: In Phil. Transaff. No 141. there is an Account of a new Level by Mr. Butterfield, which he saith is done by a Tube with Glasses, and a Thread hanging between four Points, with a Weight in a Box; so contrived, that as soon as the Instrument is set down, you have the Point of Horizon with a great deal of Exactness; and he said he was then making another which plaid on the Point of a Diamond. But I have never heard any thing of this fince, and Mr. Butterfield, Instrument-Maker to the French King is now dead.

In Phil. Trans. N° 74. p. 2217, is an Account of a Book, then publishing, about the Art of Levelling by Mr. Mariette; but whether it was ever actually published, I know not. Capt. Halley, Geometry Professor at Oxford, from his Observations of the Height of the Mercury in the Barometer, at the Top and Bottom of Snowden Hill in Wales (where at the Top it funk three Inches eight Tenths lower than its Height at the Foot of the Hill) concludes, that one of our new portable Barometers, would be accurate enough to take the Levels for bringing Water from distant Places, and would be much less subject to Error than the common Levels, there being 11 of an Inch for every 30 Yards; which may be divided into many Parts evidently. See Phil. Transall. No 229. And Mr. Derham, by Observations of this nature made at the Foot and Top of the Monument, allows - of an Inch to 82 Foot of perpendicular Ascent, when the Mercury standeth at 30 Inches.

There is a Book written on the Subject of Levelling by Mr. De la Hire, but I have not seen it. And there is a Description of a new levelling Instrument, by Mr. Couplet, in the French Memoirs for 1699

LEVELLING, is the Art of finding a true horizontal Line, or the Difference of Alcent or Descent between any two Places, in order to drain Moors, Marshes, and Morasses, &c. or to convey Water from Place to Place. The Instruments made Use of you will find under the Word Level in Vol. I. and Pendulous Level in Vol II

The Method of proceeding in the Art of Levelling is, or may be much the same, let the Instrument be the common Water Level, that of Spiris of Wine, or the new Pendulous one. The most commodious and expeditious Way is to provide two Station Staves of square Deal, like Rulers, about 8 or 10 Foot in Length. Let every Foot be divided into 10 Parts, and each of those into 10 more; so each small Division will be the 100th part of a Foot. On each of these Staves there must be a Vane to slide up and down, and with a Screw gion consisted of 4000 Foot and 300 Horse; af- in the back Part to fasten it to any Height on the

Staff. The fore-fide of the Vane or Sight should be painted white, or covered with white Paper, with a black Line drawn across it lengthways. Having then two Affistants to hold these Staves upright, and to slide the Sights up and down, supposing you were to find the Difference of the Heights of any two Places, as of A and B: If one Station will do, place the Level in the middle between the Places, and having by the Bubble or otherwise set it truly Horizontal, look back to the first place, till your Assistant sliding the Vane up and down for you there on the Staff, you can fee the black Line thereon cut or covered by the cross Hair in the Telescope; and then ler him mark the Height of that black Line above the Ground on the Divisions on the Staff. Then turn the Telescope about and look towards your other Affistant at B, till you can see the Black Line on the Vane or Sight on his Staff coinciding with the cross Hair in the Telescope; and let himalso note how high his Black Line is above the Ground: If his Number be the same with the former, the Places are on a level, or of the same Height; otherwise that where the greatest Number is, is the highest; and the Difference between the Numbers shews how much

But if the Places are so far asunder, or have Obstacles interposing, that you can't do it at one Station, as is usually the Case; then you must do it at as few more than one as you can; and you must keep an Account of the Numbers on the Staves at all your Stations, putting the Back Station in one Column, and the Fore Station in another, with a Column for the Number of their Stations in the middle; in this, or such like Form.

1	Back ^{d.}	Sr.	Forwd.
I	029	1	132
I	178	2	201
١	199	3	295
1	221	4	256
	6.27		8.8 ₄ 627
١			
		ļ	2.57

Where all the Back Stations make together 6.27. or fix Foot and .27 of a Foot, and all the Fore Stations make 8.84. or 8 Feet and .84 of a Foot; and the Difference between those two Numbers being 2.77 . or 2 Feet .77 of a Foot, is the Excess in height of the last place above the first.

N. B. In levelling of Rivers, you must set the Black Line of the Sight in the first Backward, and in their last

Fore Station, just to the Edge of the Water: And then you may take the Intermediate Stations, any where, a Mile off from the River, &c. in the Meadow adjoining, for it will all come

LEVITATION, is a Word I've met with no where but in Dr. Hook's Opera Posthuma; and he means by it a Property directly contrary to that of Gravitation towards the Sun: And in his Discourse of Comers, p. 168, he faith he hath by many Obfervations discovered, that tho' there be a Descent of the Steams from the Nucleus of the Comet towards the Sun, yet they also quickly returned and went contrary and opposite to the Sun, and that fometimes to a prodigious Extent. And, perhaps where the Power or Force of Gravitation ceases, some such contrary Force may begin: Of which there feem to be many Instances in the Gravitations or Attractions of the Particles of Matter toward one another. (See Attraction.) This Force in Vol. II.

fuch Cases Sir If. Newton calls Vis Repellens; and it appears plainly to be one of the Laws of Nature, or a Branch of the Will of our Creator in the Material World; and without it I think there can be no possible Account of Rarefaction, and some other Phanomena of Nature. Dr. Hook, p. 170. takes notice also, that there is as vast an Acceleration in the Motion of Levitating Bodies, as there is in Gravitating ones.

LIBERA, anciently fignified a Livery or Delivery of so much Grass or Corn to a Customary Tenant, who cuts down or prepares the faid Grass or Corn, and receives some Part or small Portion

of it as a Reward or Gratuity.
LIBERTAS Ecclesiastica, was the usual Phrase in our old Writings to express Church Liberty and Ecclesiastical Immunities. At first this was only the Right of Investiture; but afterwards it grew very great, extending so far under some weak Governments as to a Pretence of Exemption of the Persons and Possessions of the Clergy

from the Civil Power and Jurisdiction.
LIBERTINE, in the Civil Law, is a Person who is manumifed, and made free from Bondage,

to which he was born. LIBRA. See Pound.

LIBRA, a Mechanick Power. See Balance in Vol. 1

LIBRATA Terra, was anciently a Quantity of Land containing 4 Ox-gangs, and every Ox-

gang 15 Acres.
LIGENTIA Transfretandi, is a Writ or Warrant directed to the Keepers of the Ports, willing them to let some pass quietly beyond Sea, who have formerly obtained the King's Licence there-

LIGHT. In the French Memoirs of the Academy of Sciences, A. D. 1699, there are some Reflections about the Nature of Light and Colours; and of the Generation of Fire, by Mr. Malebranche; in which he endeavours to support his Notion before communicated in his Recherches de la Verite, and in his Metaphysicks, viz. That Light and Colours do confist only in the various Pulses or Vibrations of the Ethereal or Subtile Matter.

Dr. Hook, in his Op. Posthuma, p. 54. considering the exceeding Hardness of a Diamond, and its wonderful Property of emitting Light or shining in the Dark, upon being rubbed or struck, thinks that there is this one Effential Property necessiry only to the Existence of Light, viz. a very quick vibrative Motion; for in this Experiment there is neither Combustion nor Flame, as in Fire; nor Moisture and Putrefaction, as in Fish, Plesh of Veal, rotten Wood, &c. nor a Motion of the Animal Spirits, (which some think to be the Cause of the Light in Glo-worms, the Eyes of Cats, &c.) effentially necessary to the Production of this Quality.

The same Author thinks that Aristotle's Definition of Light, pas esir n erseyeia Te Diapares, That it is the inworking of the Diaphanous Body, or of the Medium, or the Internal Action of the Pellucid or Transparent Body, is the Light of which we are fenfible, or which moves our Eye: So that he makes Light in the Luminous Body to be a peculiar Motion of it, which the Lucid Body can communicate to the Transparent Medium, or to such a Body as is fit to propagate it. And Light in the Eye is this Motion impressed on it; by which the Soul becomes sensible of it.

Ccc

P. 114. The Doctor afferts, That the Power or Force of Light decreases in a quadruplicate Ratio of the Distances reciprocally taken, or as the squared Squares of the Distances reciprocally; and con-fequently the Effect of Light, or the Motion it causes in other Bodies, will be in subduplicate Proportion of the Powers; and therefore only in duplicate Proportion of the Distances reciprocally taken.

118. The Length of the Strokes of the Pulles of Light are in duplicate Proportion of the Distances reciprocally. P. 121. Suppose then that the Length of the Pulse from the Centre outwards at the Body of the Sun should be one Inch, the Length of the Pulse of Light here with us would not be the 1000000th part of the thickness of a Hair: and yet is that amazing Organ, the Eye, fo wisely contrived, as that the Strength of the Pulse, which was destroyed by so vast a Distance, is reflored again to a good part of its first Power; for as in diverging Rays, the Length of the Pulse decreases in a duplicate Ratio of the Distance; so in converging Rays, it increases in that Ratio,

and in a contrary Order.

I had before, in Vol. I. shewn from Sir If. Newton, that Light is propagated in Time; and he then supposed about 10 Minutes were taken up in its Passage from the Sun to us: But in his Opticks he determines this Matter more accurately. Romer first, and after him others, had observed that the Eclipfes of Jupiter's Satellites happen about 7 or 8 Minutes sooner than they ought to do by the Tables, when the Earth is interpoled between the Sun and that Planet; but as much later, when the Earth is beyond the Sun in respect of Jupiter: the Reason of which is, that the Light of the Satellites hath farther to go in the latter Case, than in the former, by the Diameter of the Earth's Orbit. Some Inequalities of Time indeed may arise from the Eccentricities of the Orbits of the Satellites; but these can't answer in all the Satellites, and at all times, to the Position and Distance of the Earth from the Sun. The mean Motion of Jupiter's Sarellites is also swifter in his Descent from his Aphelium to his Peribelium, than in his Ascent in the other half of his Orb. But this Inequality hath no respect to the Position of the Earth, and in the three Interior Satellites is insensible; as he found by Computation from the Theory of their Gravity.

After this Sir Isaac advances this Proposition, which is the 12th of Part 3. of the 2d Book of

his Opticks, viz.

Every Ray of Light in its Passage thro' any refracting Substance is put into a certain Transferst Constitution or State, which in the Progress of the Ray returns at equal Intervals, and disposes the Ray at every Return to be easily transmitted thro' the next refracting Surface, and between the Returns to be easily reflected by it. This is manifest from his 5, 9, 12 and 15th Observations. Whence it appears, that one and the same fort of Rays, at equal Angles of Incidence on any thin transparent Plate, is alternately reflected and transmitted for many Successions, according as the Thickness of the Plate increases in Arithmetical Progression of the Numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, &c. (See Colours.) And this alternate Reflection and Transmission, he found by his 24th Observation, continues for above 100 Viciflitudes; nay, as he proves afterwards, to many thousands; being propagated from one Surface of a Glass Plate to another, tho' the Thickness of the Plate be ! of an Inch and more. So that this

Alternation seems to be propagated from every refracting Surface to all Distances without End or Limitation. He shews also, that this alternate Reflection and Refraction depends on both the Surfaces of every thin Plate, because it depends on their Distance; but that it is performed at the second Surface. It is also influenced by some Action or Disposition propagated from the first to the second; because otherwise at the second it would not depend on the first: And this Action or Disposition, in its Propagation, intermits and returns by equal Intervals. What kind of Action or Disposition this is; whether it confist in a vibrating or a circulating Motion of the Ray, or of the Medium, or something else, the Author does not inquire: But he allows those, that are averse to all new Discoveries which they can't explain by Hypotheles, at present to suppose, That as Stones by falling upon Water put it into an undulating Motion, and all Bodies by Percussion excite Vibrations in the Air; so the Rays of Light, by impinging on any refracting or reflecting Surface, excite Vibrations in the refracting or reflecting Medium; and by so doing do agitate the folid Parts of the refracting or reflecting Body, and by that Agitation cause the Body to grow warm or hot: That the Vibrations thus excited are propagated in the refracting or reflecting Medism or Substance, much after the manner that Vibrations are propagated in the Air for caufing Sound; and that they move faster than the Rays, fo as to overtake them; and that when any Ray is in that part of the Vibration which conspires with its Motion, it easily breaks thro' a refracting Substance; but when it is in a contrary part of the Vibration, which impedes its Motion, it is eafily reflected; and consequently, that every Ray is successively disposed to be easily reflected or transmitted by every Vibration which overtakes it. Whether this Hypothesis be true or false he doth not consider at present, contenting himself with the Certainty of the Fact, That he hath discovered the Rays of Light by some Cause or other to be thus alternately disposed to be reflected or refrac-ted for many Vicissitudes. The Returns of this Disposition of any Ray to be reflected, he calls Fits of easy Reflection; and those of its Disposition to be transmitted, he calls Fits of easy Transmission; and the Space it puts between every Return and the next Return, he calls the Intervals of its Fits. Then at Prop. 13. he shews, that the Reason why the Surface of all thick transparent Bodies reflect part of the Light incident on them, and refract the rest, is that some Rays at their Incidence are in Fits of easy Reflection, and others in Fits of easy Transmission. This appears from his 24th Observation; where the Light reflected by thin Plates of Glass and Air, which to the naked Eye appeared evenly white all over, did thro' a Prism appear waved with many Successions of Light and Darkness, made by alternate Fits of easy Reflection and easy Transmission; the Prism se-vering and distinguishing the Waves of which the white Light was composed.

And hence 'tis plain, Light is in its Fits of easy Reflection and easy Transmission before its Incidence on any transparent Body: And probably it is put into such Fits at its first Emission from Luminous Bodies, and continues in them during all its Progress. For these Fits are of a lasting Nature; as appears by what he proves elsewhere.

. He supposes here the Transparent Bodies to be thick; because if the Thickness of the Body be much less than the Interval of the Fits of easy Reslection and easy Transmission of the Rays, the Body loseth its reslecting Power. For if the Rays, which at their entring into the Body are put into Fits of easy Transmission, arrive at the farthest Surface of the Body, before they be out of those Fits, they must be transmitted. And this is the Reason why Bubbles of Water lose their reslecting Power when they grow very thin, and why all Opake Bodies, when reduced into very small Parts, become Transparent.

He shews also, that those Surfaces of Transparent Bodies, which, if the Rays be in a Fit of Refraction, do refractit most strongly, if the Ray be in a Fit of Resection, do reslect it most easily.

After this he gives several other curious Propofitions; from whence he shews, that 'tis easy to collect the Intervals of the Fits of easy Reflection and easy Transmission of any forts of Rays refracted in any Angle into any Medium, and thence to know, whether the Rays shall be reflected or transmitted at their subsequent Incidence

on any Pellucid Medium.

By the Experiments and Observation about the Inflection of the Rays of Light (See Inflection) he makes it plain, that Bodies act on Lighe at a diffance, and by that Action bend the Rays of it; and that this Action is strongest at the least distance. He shews also, that Rays which differ in Refrangibility differ also in Flexibility; and by their different Inflections it is that they are separated one from another, so far as after Separation to make the three Fringes of Colours mentioned in those Experiments: And'tisprobable the Rays of Light, in passing by the Edges and Sides of Bodies, are bent several times backwards and forwards with a Motion like that of an Eel; and that the faid Ecoloured Fringes of Light arise from three such Bendings. 'Tis probable also that the Rays of Light which fall upon Bodies, and by that means are reflected or refracted, begin to bend before they arrive at the Bodies; and that Light is reflected, refracted and inflected, by one and the same Principle acting variously in various Circumstances.

Tis probable also, that Bodies and Light act mutually on one another: Bodies upon Light, in emitting, reflecting, refracting and instecting it; and Light on Bodies, by hearing them, and putting their Parts into a vibrating Motion, wherein

Heat confifts.

All fix'd Bodies, when heared beyond a certain degree, do emit Light and foine; and this Shining and Emission of Light is probably caused by the vibrating Motions of the Parts; and all Bodies abounding with Earthy Particles, and especially when they are sulphureous, when their Parts are sufficiently agitated, do emit Light; whether this Agitation be caused by Attrition, by Percussion, by Putrefaction, or a vital Motion in an Animal Body, &c. or any other way. Thus the Seawater shines in a Storm; Quickssor when shaken in Vacuo; a Cat's Back, or a Horse's Neok, rubb'd by the Hand in the dark; Wood, Flesh and Fish, when putrissed.

The same admirable Author, in the new Queries annexed to the Lasin Edition of his Opticks, thinks it probable, that there are yet some other congenite Properties of the Rays of Light besides those above described; one of which the Refraction of that

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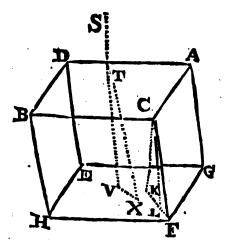
strange Body Island Chrystal acquaints us with. This was first taken notice of by Erasmus Bartholinus, but afterwards more accurately described by Huzens in his Book of Light, written in French. This Chrystal is a pellucid and field Stone, equalling Rock Chrystal or clear Water in Transparence; 'twill bear being white hot in the Fire, and after that will lose its Transparence: By a very violent Heat it's reduced to a Calx, but will not melt nor run: Being macerated for a Day or two in Water, it also loses its natural Politure on rubbing, it discovers an Electrick Quality, and with Aqua foreis makes an Ebullition. It seems to be a kind of Talk. If a piece of this Chrystal be laid on the Leaf of a Book, each Letter seen thro' the Chrystal, by a kind of double Reflection, appears double: And if any Ray of Light fall on any of its Surfaces, either perpendicularly or obliquely, it is always divided by a double Refraction into two Rays; each of which is of the same Colour with the Incident Ray, and they appear equal to one another as to the Quality of Light. One of these two Refractions is conformable to the known Laws of Opticks; viz. That the Sine of the Incidence out of Air into the Chrystal is to the Sine of Refraction: as 5 is to 3. But the other, which may be called the Unusual Refraction, is made thus: Let ADBC be the Surface of the Refracting Chrystal, C the greatest solid Angle belonging to that Surface: Let GEHF be the oppolite Surface, to which the Line CK is perpendicular: This Perpendicular with the Line CF representing the extream Edge of the Chrystal contain an Angle of 198. 3'. Join KF; in which take KL so, that the Angle KCL may be of 60. 40'. but the Angle LCF of 120. 23'. This being done, let the Line ST represent any Incident Ray of Light in the Point T; let TV be the refracted Ray; and what that is may be found by the given Ratio of the Sines of 5 to 3, according to the common Laws of Opticks. Then draw VX parallel and equal to KL, and so possed that it may lie the same way towards V, as L doth in respect of K. Join TX; and that Line TX shall be the unusual Refracted Ray, being carried by the new Refraction from T to X. If then the Incident Ray ST fall also perpendicularly on the Refracting Surface, those two Rays TV, and TX, into which by Refraction it is divided, will become parallel to the two Lines CK and CL: and the other Ray will be transinitted perpendicularly, according to the common Laws of Opticks; and the other (wz. TX) diverging by this unusual Refraction from the Perpendicular, will make with it the Angle VTX of about 6 degr. as is found by Experience.

And hence the Plane T' V X, and fuch like simi-

And hence the Plane T V X, and such like similar Planes, which are parallel to the Plane CFK, may be called the Planes of Perpendicular Refraction; and that Part, Side or Place towards which the Lines K L and V X tend, and which are drawn from the Points K. and V. may be called the Part, Place, or Side of Unusual Refraction.

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In like manner Rock Chrystal hath a double Refraction; but the Difference between the two Refractions is less and less conspicuous, than in

the Island Chrystal.

When the Ray ST, which falling on the first Surface of the Island Chrystal, is divided into the two Rays TV, and TX; and those two Rays come to the latter Surface of the faid Chrystal; then the Ray T X, which in the first Superficies is refracted in the unusual Ratio, will be again refracted entire with the same unusual Ratio, so that these two Rays will emerge out of the second Surface in Lines parallel to the first incident Ray ST. For the same will happen also as to the Ray TV, which being refracted in the first Surface with the usual Ratio, will also be again refracted at the second with the usual Ratio

And if of two pieces of Island Chrystal, one be so placed after another, that all the Surfaces of the latter be respectively parallel to those of the former: Now also those Rays, which in the first Surface of the first Chrystal were refracted with the usual Ratio, shall in all the latter Surfaces be refracted with the same ufual Ratio; and those Rays, which in the first Surface of the former Chrystal were refracted with the unufual Ratio, shall in all the latter Surfaces be refracted with the unusual Ratio: And the same thing will come to pass when the Surface of the two Chrystals are inclined one to another, so their Planes of Perpendicular Refrac-

tion be but parallel.

There is therefore some congenite Difference in the Rays of Light, that occasions, as in this Experiment, some of them to be refracted in the usual Ratio always, and others always in the unusual Ratio; for if it were not congenite, but did arise from some new Modifications impressed on the Rays in the first Refraction, then that would be changed by the same kind of new Mod fications in the three following Refractions. But no such thing happens: But the Property continues always the same, and hath the very same Effect in the Rays in all those Refractions: Wherefore this unusual Refraction must depend on some congenite Property in the Rays of Light. And 'tis very well worth while to enquire, whether there may not be other such, as yet unobserved and unknown.

For one would suspect that there are divers Sides of the Rays of Light, and those endued with divers congenite Properties: For if the Planes of Perpendicular Refraction of the second piece of Chrystal be placed at Right Angles with the Planes of

Perpendicular Refraction of the first Chrystal; then will the Rays, which in their Projection thro' the first Chrystal were refracted with the ufual Ratio, in passing thro' the second be refracted with the unusual Rasio; and those Rays, which in passing thro' the first Chrystal were refracted with the unufual Ratio, shall in passing thro' the second be refracted with the ufual Ratio. Wherefore there are not two divers kinds of Rays in their own Nature different ; of which one sortare always and in all Positions refracted with the nsual, and others with the unusual Ratio: But these two kinds of Rays, as mentioned in the last Experiment, did only differ in this, that the Rays, according to their different Position, did with their different Sides respect the Place, Region or Side of unusual Refraction in the Chrystal: For in the present Experiment, one and the same Ray is re-fracted one way with the usual, the other way with the unufual Ratio, according to the Position of its Sides to those of the Chrystal. If the same Sides of any Ray look towards the same Parts of each Chrystal, then will that Ray be refracted with one and the Same Ratio in each Chrystal; but if that Side of the Ray, which is turned towards the Place of unusual Refraction in the former Chry-flal, be distant 90°. from that Side of the same Ray which looks towards the Place of unusual Refraction of the second Chrystal (which may be done, by so turning the second Chrystal, that it shall look towards the former Chrystal, and consequently the Rays of Light themselves in different Polition) that Ray will now be refracted in different Ratio's in the different Chrystals. So that you may determine, whether the Rays, which fall on the second Chrystal, will be refracted in the usual or unusual Ratio. And for this there is nothing more required, than that the second Chrystal be so turned about, that its Place or Region of muusual Refraction be accordingly posited on this or that Side of the Ray

Wherefore every Ray may be confidered as having four Sides; two of which being directly opposite to one another, cause that the Ray be always refracted in the unusual Ratio, whenever either of those Sides is turned towards the Side or Piace of unusual Refraction in the Chrystal: But the other two Sides, as often as either of them is turned towards the Side of unusual Refraction in the Chrystal, do yet cause the Ray to be refracted with the usual Ratio. The two former Sides of the Ray therefore may be called the Sides of unusual, the two latter of usual Refraction. And because these Dis-positions were in the Rays before they fell on the 2d, 3d, and 4th Surface of the 2 Chrystals, nor were they at all changed by the Refraction of the Rays in their Passage thro' those Surfaces, but the Rays were refracted by one and the same Law in every one of the four Surfaces, it seems that these Dispositions are properly congenite to the Rays of Light, and were not at all changed by the first Refraction; but that it is on the account of these Disposetions in the Rays, that they were refracted in their Incidence on the first Surface of the first Chrystal, some in the usual, and some in the unusual Katio, according as their Sides of usual or unusual Refraction at that time respected the Sides or Place of unusual Refraction in that Chrystal.

All the Rays of Light therefore have two opposite Sides, in which the Property is congenite, on which the unusual Refraction depends; and the

other two Sides are without any fuch Property. And it requires yet further to be considered, whether there be not even other Properties of Light, by which the Sides of the Rays differ, and are distinguished from one another.

After this he shews, that in an Oblique Incidence of the Rays upon the first Chrystal, the same Difference between them appears, as when they fall

perpendicularly to the former Properties. From the whole therefore may be very justly concluded, That all those Hypotheses are falle and

precarious which have been yet advanced, in order to explain the Phanomena of Light by new Modifications of the Rays; for they do not depend on any such Modifications, but on congenite and immable Properties, effentially inherent in the Rays.

And equally erroneous also are those Hypotheses, which attempt to explain the Phenomena of Light by any Pressure or Pulse impressed upon the fluid Medium by Motion; for these at long run depend upon the new and different Modifications of the Rays, and so fall in with the other.

But further, if Light confisted only in a Pressure upon the Medison, it must be either without any local Mosion; and then 'tis impossible to account for the Agitation and Heat produced in Bodies by the Refraction and Reflection of the Rays: Or if it be supposed to consist in Motion propagated to all Distances in an Instant, to that must be required an infinite Force acting every Moment, and in each lucid Particle. But did Light consist in a Pressure or a Motion propagated thro' a fluid Medium, whether it propagated instantaneously, or in time, it could not be done in Right Lines, but must inflect back upon itself in a Shadow; for Pressure or Mesion in a fluid Mediam, whenever it meets with any Obstacle which may impede Part of its Motion, cannot be propagated in Right Lines, but must be inflected back towards itself, and disused every way throughout the quiescent Mediam which lies beyond the Obstacle.

The Force of Gravity tends downwards; and yet the Preffure of the Parts of Water, which arises only from the Force of Gravity, tends with an equable Force every way, and is propagated with equal Ease by crooked Lines as by strair. Waves, on the Surface of Water, where they fall on the Surface of any large Obstacle, inflect back upon themselves, and are dilated and diffused gradually in the quiescent Water lying beyond that Obstacle. The Waves, Vibrations, or Pulses of Air, in which Sounds confist, are manifestly inflected, tho' not so much as those of Water; for the Sound of a Bell, or of a great Gun, can be heard over a Hill, interposed between the Ear and Eye, and founding Body: And we find that Sound is propagated as easily by crooked as strait Tubes; whereas Light is never observed to move in curve Lines, nor to be inflected back so as to shadow itself. Indeed there is a kind of Inflection of the Rays of Light, as hath been before mentioned; but that is not ad Umbram, but a contrary way, and is only found in a Ray's passing by and very near the extream Edge of some Body; and then as soon as it is past the Body, it

goes on frait again.

The Rays of Light are therefore certainly little Particles, actually emitted from the Lucent Body, and refratted by some Attrattion, by which Light, and the Podies on which it falls, do mutually act by their Attrastion, or some other Force, do excite upon one another; for such Particles or Cor- certain Vibrations in the Bodies on which they

puscles thro' uniform Mediums will be transmitted in right Lines without any Inflection in Umbram, as we find the Rays of Light are: They may have also divers Properties, and which they may preserve immutable in their own Passages thro' divers Mediums; which agrees with the Nature of the Rays of Light. Pellucid Bodies ass upon the Rays of Light at some Distance, when they refract, reflect and inflect them; and the Rays of Light reciprocally act upon them, at some little Distance also, by agitating and heating their Particles. And this Alion and Re allion, which is performed at some Distance, is mighty like what we call the Force of Attraction, or Gravity, in other Bodies. And if the Cause of Refraction be the Attraction of the Rays, he shews in his admirable Principia, that the Sines of Incidence must be so the Sines of Refraction in a given Ratio; as in Fact we find the thing to be. The Rays of Light, in passing out of Glass into a Vacuum, are inflected towards the Glass, and, if they fall too obliquely, will revert back again to the Glass, and be totally refletted. Now the Cause of this Reflection cannot be attributed to any Resillance of the Void or Vacuum, but entirely to some Force or Power in the Glass, which attracts or draws back again the Rays as they are passing into the Vacuum. And this appears from hence, That if you wet the posterior Surface of the Glass with Water, Oil, or liquid and clear Honey, or with a Solution of Quickfilver; then the Rays, which would otherwise have been reflected, will pass into and thro' that Liquor. Which plainly shews, that the Rays are not reflected till they come to that posterior Surface of the Glass, nor till they begin to go out of it too. But if at their going out they full into any of the aforesaid Liquors, they will then not be refletted, but go on in their former Course; the Reason of which is, that the Attraction of the Glass is counter-balanced by the Attraction of the Parts of the Liquor which adhere to its Surface. And this appears yet plainer in the Experiment of two Glass Prisms, or the Object Glasses of two long Telescopes, one of which shall be plane (on one side), the other a little convex, and then compressing them so that they do neither quite touch one another throughout, and yet have their Surfaces very near; for then that Light which falls on the hinder Surface of the first Glass, and in that Place where the Glasses are not distant one from another above of an Inch, will be totally transmitted thro' that Surface and the interjected Air or Vacuity, and will enter into the second Glass (as he shews in his 1st, 4th, and 8th Observations of the first Part of his 2d Book of his Opticks). But if the second Glass be moved a little farther off, then the Light, coming out of the hinder Surface of the first Glass into that Air or Vacuum, will be turned back again towards the Glass, and reflected. Wherefore 'tis plain, that the Rays are drawn back by some Force that is inherent in the first Glass, since there is nothing else that can occasion it.

To account also for that odd Phanemenon of the Rays of Light, which he calls their Fits of easy Transmission and Restettion, he judges that there is nothing more required, than that the Rays should be very small Corpuscles of Matter, which either act; which Vibrations, being faifter than the Motion of the Rays, do successively outstrip or get before them, and so agitate them as alternately to increase or diminish their Velocity; and there-fore produce those Eits in the Rays of Light.

And he thinks it very likely, that the Unafual Refrattion, discovered to be in the Island Chrystal above mentioned, is caused by some Attracting Force, which is inherent in certain Sides of the Rays and of the Particles of the Chrystal. For if there were not some such Force or Virtue in some Part of the Chrystal, and not in the others, in order to differt and bend the Rays towards the Sides or Parts of Unusual Refraction, it could not be, that the Rays, which fall perpendicularly upon the Chrystal, should both in their Ingress and Egress be so refracted one way rather than another, as that they should also perpendicularly emerge by a now contrary Polition of the Place or Region of Unusual Refraction in the Surface of the second Chrystal; the Chrystal plainly acting upon the Rays after they have passed thro' it, and are got into the Air, or into a Vacuum.

And because the Chrystal, by that Force, doth not act on the Rays, but when the proper corre-founding Sides of the Rays of Light are turned towards the Places or Parts of Unnjual Refraction in the Chrystal, it appears that there is also some Force or Virtue in the Sides of the Rays themfelves, corresponding to that Force inherent in those Parts of the Chrystal, almost after the same manner as the two Poles of the Magnet answer to Which Virtue in the Magnet, as one another. it is capable of being increased and diminished, and is hot any where to be found but in the Magnet and in Iron; so this Virtue of the refracting Rays which fall perpendicularly upon it, is greater in the Island than in the Rock Chrystal, and is as

yet found no where else.

Not that he thinks this Virtue to be Magnetical; for it seems to be of a different Nature. But let it be what it will, it can scarce be conceived that the Rays of Light, unless they be allowed to be really Corpuscles or Particles of Matter, can have any fuch permanent Force in two of their Sides, and not have any fuch thing, at the fame time, in their two other; and this without any regard to the Position with which they respect the

Space or Medium thro' which they pais.

And yet tho' Light be certainly a Body, it is almost impossible to conceive the Smallness of its Corpuscles. But however, that they are exceeding minute, may be gathered from thele Confiderations: (1.) That they freely pervade all transparent Bodies, such as Chrystal, Glass, several Pebbles and Gems; and almost all Fluids, but Mercury; and pals where no other Fluid, how thin foever, can enter; and yet no Eye hath ever been able to discover the constituent Particles of the grossell Fluid. (2.) It may be propagated from innumerable different Luminous Bodies, without any confiderable Opposition to one another, as Dr. theyne shows by this Experiment: Suppose a Plate of Metal, having at the top the smallest Hole that can be made, were erected perpendicularly on an Horizontal Plane, and that about it were set innumerable Luminous Objects of about the same Height with the Plate, at an ordinary Diffance from it; then will the Light, proceeding from every one of these Objects, be propagated thro' this small Hole, without interfering. This will appear by applying a dark Object, in

a strait Line, against the luminous Body; for the Light of this Body will thro' the Hole be received upon the dark Body. Now it is impossible that so many different Streams of Light could be transmitted thro' so small a Hole, were not the Particles of Light extreamly little. To which may be added, (3.) That if they were not very minute Corpuscles, their amazing Velocity is such, that they would pierce thro all Kinds of solid Bodies almost as easily as they do Vacuities; whereas we see the Rays of Light to be regularly reflected from some Bodies. (4.) We find also that innumerable different Spheres of Light may be propagated from their several luminous Centres within our Horizon, without interfering. How many Millions of Candles and Flambeaus, sending all out their Tides of Light, is it possible for the Eye to see together, without their being confounded one with another? Which shews both the exceeding Smallness of the Particles of Light, and also the Largeness of the Vacuities between the Particles of Air and other Bodier.

How extreamly swift the Particles of Light move, may be gathered from the Experiment of Mr. Romer; wherein he finds that the Rays of Light pass from the Sun to us in about 10 Minutes of Time : And Mr. Hugens hath proved in his Cosmotheores, that a Bullet discharged from the Mouth of a Cannon, and not abating of its first Velocity, would be 25 Years before it reach the Sun. Now the Via percurfa being the fame in both, the Velocities will be reciprocally as the Times; that is, the Velocity of Light to that of a Cannon-Bullet, will be to that of a Cannon-Bullet, perfifting in its greatest Swiftness, as 25 Years to 10 Minutes; or as 1314700 is to one, nearly: So that the Motion of Light is above a Million of times swifter

than that of a Cannon Ball.

Moreover, the Distance between the Sun and Earth is at least 12000 Diameters of the Earth; but suppose it but 10000, then will Light run 1000 Diameters in a Minute, or 16; Diameters in a Second; that is, at least 130000 Miles in one Second; which is Motion almost incredibly and really amazingly swift. But the extraordinary Effects of Light and Heat feem to require all this; and we see how powerfully it acts (being congregated) on the most compact solid Bodies; and we never find any Abatement of its Force arising from a Diminution of its Velocity.

See Mr. Hanksbee's Experiments about the Production of Light in Vacuo by the Attrition of Bodies, in Phil. Trans. No 304, and in No 307; and by the Effluvia of one Glass falling on another in

Motion, Phil. Trans. No 309, 310.

LIGHTS. Ships of War are in the Night-time very well distinguished by the Lights that they hang out; for in a Fleet the Admiral carries three Lights on the Poop, and one on the Main-Top; the Vice-Admiral hath two on his Poop, and one on his Main-Top; the Rear-Admiral hath but one on his Poop, and one on his Main-Top; the Vice-Admiral of each particular Squadron bath only two on his Poop, but none on his Main-Top; the Rear-Admiral of each Squadron hath only one on his Poop. But when the whole Fleet carry their Lights, then the Rear-Admiral is distinguished by carrying two Lights, the one hoisted a Yard above the other, on the Ensign-Staff; and in case of foul Weather and a dark Night, every Ship must carry a Light.

LIGULA,

LIGULA, in our Latin Law fignifies a Copy, Exemplification, or Transcript of any Court Roll or Deed.

LIMBERS, in Gunnery, are a kind of Train joined to the Carriage of a Cannon upon a March. It is composed of two Shafts wide enough to receive a Horse between them (which Horse is called the Filles Horse.) These Shafts are joined by two Bars of Wood and a Bolt of Iron at the end, and have a pair of small Wheels: On the Axletree rifes a firong Iron Spike, on which the Train of the Carriage is put upon a March: But when a Gun is on Action, these Limbers are run out behind her.

LINE of the True Place of a Planet, is a right

Apparent of a Planet, is a right

Line drawn from Exe of the Spectator thro' the

Planet, and continued as far as the fixed Stars.

LINE of Measures, in the Stereographick Projection of the Sphere in Plano, is that Line in which the Plane of a great Circle, perpendicular to the Plane of the Projection and that oblique Circle which is to be projected, interfects the Plane of the Projection. Or it is the common Section of a Plane passing thro' the Eye Point, and thro' the Centre of the Primitive, and at right Angles, to any oblique Circle which is to be projected, and in which the Centre and Pole of such Circle will be found.

Line of Direction, of the Earth's Axis in the Pythagorean System of Astronomy, is the Line connecting the two Poles of the Ecliptick, and of the Equator, when they are projected on the Plane of the former.

LINE of the Section, in Perspective, is the Intersection or Contact of the Plane to be projected

with the Glass or Diaphanous Plane.

LINE of Lines, on the Sector, is a Scale of equal Parts on each Leg, and running from the Centre. This is divided actually into 100 equal Parts, and sometimes into more, when the Instrument is large. There are only the Figures 1, 2, 3 4, 5, 6, 7, 8, 9, 10, placed on the Lines; and therefore they sometimes stand for themselves alone, and sometimes fignify ten times, or an hundred, or a thousand times themselves, according as the Matter shall require.

The Uses of the Line of Lines. I. To increase or diminish a Line of any given Length, according to any Ratio required.

Suppose the Line were of Inches in length; apply it into the Sector by way of parallel Entrance, so that each Foot of the Compasses stand in 6 1 in Line of Lines, and then let the Sector be kept at that Angle. Then if you wou'd have it increased in the Proportion of 9 to 6; 5 or diminished in the Proportion of 2; to 6; 8c. let the Sector lie, and take with the Compas the parallel Distances between those Points of 9! and 91; or of 2? and 2?, in the Line of Lines of each Leg, and that will give you the Length required.

2. To divide a given Line into any Number of Parts; as suppose into 9.

Apply the Line over from g to g in the Line of Lines; and keeping the Sector of that Angle, take the Distance between 1 and 1, and that will be 4 Part of the Line.

3. To find what Proportion two or more Lines bear to one another.

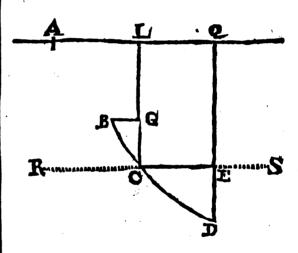
Apply the greater of greatest over from 10 to 10 at the ends of Lines; and then taking any of the other, and applying it over parallel to the former, it will mark out such Numbers as shall express its Proportion to the greatest Line: as suppose the Compasses pointed to 30 and 30; then will the greatest Line be to it as 100 i is to 30. &c.

4. To work Proportions with the Sector, proceed just as you do in finding a 3d or 4th Proportional to 2 or 3 Lines given Geometrically. See Proportion, Vol. I.

LINEA Celerrimi Descensus, is that Curve which a Body would describe in its Descent, if it moved the swiftest possible: The Investigation of which was first, I think, proposed as a Problem by Mr. John Bernoulli, and hath been solved by his Brother James, and several others; and very easily thus, by Mr. John Craig, in Phil. Trans. N. 268.

Suppose BC, CD, two infinitely small Parts of the Curve fought: Then, fince the Nature of the Curve is to be such, that the Descent of the Bo-

dy from B to D,



after its Fall from the Horizontal Line AQ, is to be in the least time possible; we must find in the Line RS (drawn parallel to AQ so, that the Differences between any two Ordinates to the Curve, as of GC, DE, may be equal) a Point

in which this must happen.

Now the Velocity of the Body in the Point C is = V: LC; and its Velocity in the Point D, as BC

:QD. Wherefore (V:LC) is=to the Time of the Descent thro' BC, as $\frac{1}{\sqrt{1000}} = 100$ to the Time of the Descent thro' CD. by Prop. 54. Newson, Princ. Wherefore the Point C must be such, as BC CD

that $\frac{BC}{\sqrt{:LC}} + \frac{CD}{\sqrt{:QD}}$ must be a Minimum, or the least possible. Suppose then the Points B and D to be fix'd; let GC (=DE) = m : LC = b, and QD = p; all invariable Quantities: and let the flowing Quantities BG = n : and CE = a.

Wherefore
$$\frac{\sqrt{:m^2 + n^2}}{\sqrt{:b}} + \frac{\sqrt{:m^2 + n^2}}{\sqrt{:p}} = \text{to a}$$

Mini-

Minimum. And consequently $+\frac{zz}{p_{\overline{z}}\sqrt{m^2+z^2}}=0. \quad \text{But } \dot{n}=-\dot{z} \text{ (because)}$ u + z = to an invariable Quantity.) Wherefore $\frac{u}{b \frac{1}{2} \sqrt{m^2 + u^2}} = \frac{z}{p \frac{1}{2} \sqrt{m^2 + z^2}}$: Wherefore 'tis plain that $\frac{u}{b \frac{1}{2} \sqrt{m^2 + u^2}} = \text{to an invariable}$ Quantity. Let then the Abscissa A L = x; the Ordinate LC = y: And therefore BG = x. GC = y. $BC = \sqrt{xx}$ and let a be any invariable Line. Then will $\frac{x}{y! \cancel{V}: xx + yy} = \frac{1}{\sqrt{a}}$ Wherefore $x\sqrt{a} = y \times V \dot{x} \dot{x} + \dot{y}\dot{y}$. But in

every Curve x is to Vxx + yy, as the Subtangent to the Tangent: Wherefore the Nature of this Curve is such, that the Subtangent is to the Tangent as \sqrt{a} , is to the \sqrt{y} , which is known to be the Property of the Cycloid; where the Tangent is parallel to the Chord of a Conterminous Ark in the generating Circle, whose Diameter is a, and its Vertex downward.

LINES of Solids. See Solids.
LINES of Superficies or Surfaces. See Surfaces.
LINES of Chords. See Chords.

LINES of Tangents. See Tangents. LINES of Secants. See Secants.

LINSTOCK, is a short Staff of Wood about 3 Foot long, having at one End a piece of Iron divided into 2 Branches, each of which hath a Notch to hold a piece of Match, and a Screw to fasten it there. The other End of the Staff is shod also with Iron, and pointed to stick into the Ground. Tis used by the Gunners in string Cannon.

LIQUID, is a Word used by the Civilians in this Sense, for a Thing's being apparently proved, as they say: A Creditor would be injur'd, should a Debr which is clearly due be stop'd, on the Pretence of another Debt that is not Liquid, or

apparently proved.

LIQUIDUM Nervorum, is that Juice or Fluid which Nerves carry in their Canals, and is

- usually called the Nervous Juice. LIVER. See Hepar.

LOAD, is the Miners Word, especially in the

Tin Mines, for a Vein of Ore.

LOCAL Colours, in Painting, are such as are natural and proper for each particular Object in a Picture; and they are so called to distinguish them from the Claro-Obscuro: Which see.

LOCATIO-Conductio, in the Civil Law, is a Contract of the Law of Nations, whereby the Use of a Thing, or the Service and Labour of a Person, is gained for some Time for a certain Reward.

LOCUS Resolutus, according to Pappus's Account of it in Libr. 700 Mathem. Coll. is, That it is a proper peculiar Matter, after the common Constitution of the Elements of Geometry, contrived for such Persons as would obtain a ready and easy Method of solving such Problems as shall be proposed to them. (See Resolution in Vol. I.) On this Subject Euclide, Apollonius Pegaus, Erasof-

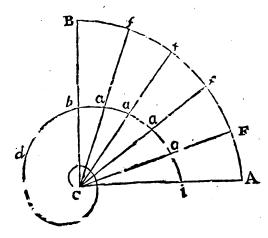
sbenes and Aristaus Senior, are the only Writers among the ancient Geometers. Euclide's Tracts are Datorum Liber Unus; Locorum ad Superficiem Duo; Porismatum Tres. Apollonius, de Settione Rationis (lately put out at Oxon by Mr. Halley) Libri Duo: De Sestione Spatii Libri Duo; Tastionum Libri Duo: Inclinationum Duo; Planorum Locorum Duo: Conicorum Offo. Of Aristaus, there were Locorum Solidorum Libri Quinque. And of Eratosthenes, Duo Libri de Medietatibus

There are two Kinds, faith Pappus, of this Refolution; one, where bare Truth in Theory only is pursued; which therefore he calls the Contemplative Method or Theoretic: and the other, where we investigate something which we propose to have done; and this is called the Problematic Method. What this Resolution or Analysis of the Ancients was, you may see in the Learned Mr. Halley's Edition of Apollonius de Settione Rationis abovementioned; and a good Attempt towards its Restitution in a Modern Spanish Author, Hugo de Omerique, his Analysis Geometrica, printed at Cales 1698.

LODEMANAGE, was anciently the Term for the Hire of a Pilot, when he conducted a Ship from Place to Place.

LODE-SHIP, was formerly the Name of a

fmall fishing Vessel. Vid. 31 E. 3. Stat. 3. c. 2. LOGARITHMICK-spiral, is a Curve generated by the equable Motion of the Radius of a Circle thro' equal Arks of the Circumference; while at the same time a Point in that Radius is supposed to move from the Ark towards the Centre, with a Retardation of Motion in a Geometric Proportion. As suppose there be a Quadrant of a Circle, as BCA, and any equal Divisions in the Ark, as AF = Ff = ff, &c. with 5 corresponding Radii, suppose as CA, CF, Cf, &c.



whole Parts or Portions 61, Ca, Ca, &c. are Geometrically proportional; then if a Line, as I, a, a, b, d, C, be drawn thro' those Points, it will be the Logarithmick-Spiral. Vid. Guido Grand. Theo-

rem. Hugen. Cap. 1.

LOGARITHMS. The Learned and Ingenious Mr. Halley, Savilian Professor of Geometry in Oxon. and F. R.S. hath in Phil. Transact. N' 216. and fince that, in Sherwin's Mathematical Tables, published a most compendious and easy Method of constructing the Logarithms; and this exemplified and demonstrated from the Nature of Numbers, without any regard to the Hyperbola, or any other Curves: Together with a speedy Method of finding the Number answering to any given Logarithm. See the Preface to Sherwin's Math. Tables, p. 14, &c.

A

TABLE

O F

LOGARITHMS

For Numbers increasing orderly from I to 10000, with their Differences.

Wherehy the Logarithm of any Number under 10000 may be readily taken.

NT	. T	1 37	1 T	2 27			37	Tan
Nu.	Log.	Nu.	Log.	Nu.	Log.	,	Nu.	Log.
. 1	0.0000000	26	1.4149733	5 I	1.7075702		76	1.8808136
2	0.3010300	27	1.4313637	52	1.7160033		77	1.8864907
- 3	0.4771212	28	1.4471580	53	1.7242759	,	78.	1.8910946
- 4	0.6020600	29	1.4623980	54	1.7323937		79	1.8976271
~ 5	0.6989700	30	1.4771212	.55	1.7403627		80	1,9030900
6	0.7781 512	31	1.4913617	56	1.7481880		81	1.9084850
7	0.8450980	32	1.5051500	57	1.7558748		82	1.9138138
8	0.9030900	33	1.5185139	58	1.7634280		83	1.9190781
و ٠	0.9542425	34	1.5314789	59.	1,7708520		84	1.9242793
10	1.0000000	35	1.5440680	60	1.7781512		85	1.9294189
111	1.0413927	36	1.5563025	61	1.7853298		86	1.9344984
12	1.0791812	37	1.5682017	62	1.7923917	,	87	1,9395192
13	1.1139433	38	1.5797836	63	1,7993495		88	1.9444827
14	1.1461280	39	1.5910646	64	1.8061800		8 9	1.9493900
15	1.1760912	40	1.6020600	65	1,8129133	\	90-	1.9542425
6	1.2041200	4I	1.6127838	66	1.8195439	٠.	91	1.9590414
7	1.2304489	42	1.6232493	67	1.8260748	1	92	1,9637878
18	1.2552725	43	1.6334684	68	1.8325089	, ,	93	1.9684829
19	1.2787936	44	1.6434527	69	1.8388491	;	94	1.9731278
20	1.3010300	45	1.6532125	70	1.8450980	, ,	95	1.9777236
21	1.3222193	46	1.6627578	71	1.8512583	;	96	1.9822712
22	1.3424227	47	1.6720978	72	1.8573325		97	1.9867717
23	1.3617278	48	1.6812412		1.8633229	· ·	98	1.9912261
24	1.3802112	49	1.6901961	73 74	1.8692317		99	1.9956352
25	1.3979400	50	1.6989790	75	1.8750613	· .	100	2.0000000
-,	12.77/74001	· , , ~	12.5909/90	1 /)	12.0/)0013	1		,

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į.	Num.	0	I 1	2	3	4
1		0000000	0004341	0008677	0613009	0017337
1	100	0043214	0047511	0051805	0056095	c060379
- }	101 102	0086002	0090257	0094509	0098756	0102999
ı	103	0128372	0132587	0136794	0141003 .	0145205
ı	104	0170333	0174507	0178677	0182843	0187005
- 1	105	0211893	0216027	0220157	02.24284	0128406
1	106	0253059	0257154	0261245	0265333	0269416
1	107	0293838	0297895	0301948	0305997	0310043
ı	108	0334237	0338257	0342273	0346284	0350293
- 1	109	0374265	0378247	0382226	0386202	0390173
ł	011	0413927	0417873	0421816- 0461048	0425755 0464952	0429691 0468852
1	. 111	0453230	0457140			
- 1	112	0492180	0496056	0499928 05384 6 4	0503767 0542299	0507663
	113	0530784	0534626	0576661	0580462	0584260
	114	0569048	. 0610753	0614525	0618293	0622058
	115 116	0644580	0648322	0652061	0655797	0659530
	117_	0681859	0685569	0689276	0692980	0696681
1	118	0718820	0722499	0726175	0729847	0733517
1	115	0755479	0759118	0762762	0766404	3870043
1	Y20	0791812	0795430	0799045	0802656	0806265
	121	0827854	0831441	0835026	0838608	0842187
	I22	0863598	0867157	0870712	0874264	0877814
	,_123_	0899051.	0902580	0906107	0909631	0913151
1	124	0934217	093771.8	0941216	0944711	0948204
	125	0969100	0972573	0976043 1010593	0979511	0982975 1017471
	126	1003705	100.7151	1044871	1048284	1051694
	127	1072100	1075491	1078880	1082266	1085650
	129	1105897	1109262	1112625	1115985	1119343
	130	1139433	1142773	1146110	1149444	1152776
	131	1172713	1176027	1179338	1182647	1185954
	132	1205739	1209028	1212314	1215598	1218880
	133	12385 F6	1241780	1245042	1248301	1251558
	134	1271048	1 274288	1277525	1280760	1283993
	135	1303338	1306553	1309767	1312978	1316177
	136	1335389	1338581	1341771	1344958	1348144
_	137	1367206	1370374	1373541 -1405080	1376705	1379867
٤.	138	1398791	- 14 0 193 7 -	1436392	1439511	1442628
	139 140 d	1430140	1464381	1467480	1370577	1473671
· Q.	141	1492191	7495270	1498847	1501422	1504494
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	1 497	1731863	1734776	1737688	1747598	1743906
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	133	1846914	: 01849752	1852588	1855421	1858253
٠.	154	1875207	1878026	1880844	1883659	1886473
;. ′	° 1,55	1903317	7966118	1908917	1911714	1914510
	156	1931246	1954029	1936810	1939590	1942567
٠.	7 57	1 1958996	1981762 +		1967287	1970047
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. :	161	2068259	2070955	2073650	2076344	2079035.
ì	163	2095150 2121876	2124540	2127201	2129862	2132521
	164	2148438	2151086	2153732	2156376	1159018
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١	0107239	0111473	0115704	0119931	0124154		4240
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ı	0881361	0884905		0891984	0895519	•	3547
	0916669	0920185	0923696	0927206	0930712		3518
1	0951693	0955180	0958664	0962146	0965624	1	3489
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1	102090 5 105510 2	1024337 1058506	1061909	1055308	103461 6 1068705]	3434 3408
1	1189031	1092410	1095785	1099159	1102529	l	3381
1	.1122698	1126050	1129400	1132746	1136091	l	3355
ı	1156105	1159432	1162756	1166077	1169396		3329
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ı	1414498	1417632	1420765	1423895	1427022		3137
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	1538149	1541195	1544240	1547282	1550322		3049
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ı	177536 5 1804126	1778250 1806992	1781132 1809856	1784013	1780892		2867 2867
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1	2135178	2137833	2140487	2143139	2145789	•	2657
I	2161659	2164298	2166936	2169572	2172206	· .	2641
ł	2187990	2190602	2193325	2195845	2198464	<u> </u>	2625
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١	166	1	2201031	220,696	2206310	2208922	2211533
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- 1	182		2600714	2603099	2605484	2607867	2610248
- 1	183		2624511	2626883	2 6 2925 5	2631625	2633993
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- 1	185		2671717	2674064	2676410	2678754	2681097
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			2764618	278982 I		2771506	2773800
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	222	1	3463530	3465486	3467441	3469395	3471348
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	243		3873898	• 3875678	3877457	3879235	3881012
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	245 246		3909351	3911116	3912880	3914644	3916407
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	262		4183013	4184670	4186327	4187983	4189638
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J	288 289		459392 5 4608978	4595433 4610481	4596940 4611983	4598446 4513484	4599953 4614985.
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3811151	3812956	3814761		3818368		1806
			3816565			
3829171	3850969	3832766	3834563	38363.59		1798
3 ⁸ 47117	384890 8	3850698	3852487	3854275		1791
3864990	3866773	3868555	3870337	3872118		1784
388:789	3884565	3886340	5888114	3889888		
			5000114			1774
3900515	3902284	3904052	3905819	3907585		1769
3918169	3919931	3921691	3923452	3925211	:	1762
3935752	3937506	39392 6 0	3941013	3942765		1755
3953264	3955011	3936758	3958504	3960249	:	1748
3970705	3972446	3974185	3975924	3977662		1741
					l '	
3988077	3989811	3991543	3993275	3991007	1 '	1734
4005380	4007106	4008832	4010557	4012282		1727
4022614	4024333	4026052	402777I	4029488	Ī	1721
4039780	4041492	4043205	4044916	4046627		1714
4056878	4058584	4060289	4261994	4063698	!	1797
4073909	4075608	4077307	4079005	4080703	l :	1700
4030874	4092567	4094259	4095950	4097641		1694
4107772	4109459	4111144	4112829	4114513	٠ ا	1687
4124605	4126285	4127964	4129643	4131320	1	1680
4141374	(4144719	4146391	4148963		1674
41413/4	4143047					
4158077	4159744	4161410	. 4163076	4164741	· .	1667
4:74717	4176377	4178037	4179696	4181355	1	1661
4191293	4192947	4194601	4196254	4197906		1655
4207806	4209454	421,1101	4212748	4214394] ;	1648
		4227539	4229180	4230820		1643
4224257	4225898			4247183		
4:40645	4242281	4243915	4245550			1,636
4256y72 :	4258601	4260230	4261858	4263486	ļ	1630
4273238	4274861	4276484 .	4278106	4279727	Ì	1624
4289443	4291060	4292677	4294293	4295908	i	1618
4305588		4308809	4310419	4312029	l	1612
4305500	4307199	4300009	4310419			
4321673	4323278	4324883	4326487	4328090	ł	1606
4337698	4339298	4340896	4332494	4344092		1600
4353665	4355258	4336851	4358444	4360035	,	1594
4369573	4371161	4372748	4374334	4375920		1588
		4388587	4390167	-	ı	
4385423	4387005	4500507	1	4391747	l '	1,582
4401216	4402792	4404368	4405943	4407517	l	1577
4416951	4418522	4420092	4421661	4423229	i	_I57I
4432630	4434195	4435759	4437322	4438885	l	,1565
4448252	4449811	4451370	4452928	4454485	1	1560
4463818	4465372	4466925	4468477	4470029	I	I554
					l	
4479329	4480877	4482424	4483971	4485517	l	1549
4494784	4496326	4497868	4499420	45009.51	I	1543
4510184	4511721	4513258	4514794	4516329	1	¥ #37
4525531	4527062	4528593	4530124	4531654	l	1533
4540823	4542349	4543875	4545400	4546924		2527
4556061	4557582	4559102	4560622	4562142	1	1921
					1	
4571246	4572762	4574277	4575791	4577305		23 51 5 i
4586378	4587889	4589399	4590908	4592417	j.	£\$10
4601458	4602963	4604468	4605972	4607475	1	1505
4616486	4617986	4619485	4620984	4622482	I	1501
4631461		4634450	4635944	4637437	ł	1495
	4632956		445)944		į	
4646386	4647875	4649364	4650853	,4652341	l	7491
4661259	4662743	4664227	:4665711	4667194	:	1485
4676081	4677560	4679039	4680518	4681996	ł	1486
4590853		4693801	4695275	4696748	ľ	(1475
	4692327		-4709982		I	
4705575	4707044	4708513	4/09902	4711450	1	11470
4720247	4721711	4723175	4724639	4726102	Ī	- 3465
4734870	4736329	4737788	4739347	4.740705	1	1460
						

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1	Mon		0	I .	2	3	4
1	Num.	l			4745076	4746533	4747988
١	298	i	4742163	4743620	4749016		4762518
1	299	i	4756712	4758164	4759616	4761067	
1	300	1	4771212	4772663	4774107	4775553	4776999
ł	30r	1	4785665	4787108	4788550	4789991	4791432
ı	302		4800069	4801 507	4802945	4804381	4805818
- 1	303		4814426	481 5859	4817292	4818724	4820156
- [1	4828736	4830164	4831592	4833019	4834446
1	304		4842998	4844422	4845845	4847268	4848690
- 1	305			4858633	4860052	4861470	4862888
	306		4857214	4872798	4874212	4875626	4877039
	307	1	4871384		4888326	4889735	4891144
	308	1	4885507	4886917			4905203
	30 9	1	4899585	4900990	4902395	4903799	
	310	1 1	4913617	4915018	4916418	4917818	4919217
	311	1 1	4927604	4929000	4930396	4931791	4933186
	312	1 1	4941546	4942638	4944329	4945720	4947110
	313	1	4955443	4956831	4958218	4959604	4960990
	314	1	4969296	4970679	4972062	4973444	4974825
	315	1	4983106	4984484	4985862	4987240	4988617
		1 1		4998245	4999619	5000992	5002365
	316	1	4996871		5013332	5014701	5016069
	317	1 1	5010593	5011962	5027002	5028366	5029731
	318	1 1	502427I	5025637		5028389	
	319		5037907	5039268	5040629		5043349
	320	1	5051500	5052857	5054213	5055569	5056925
	32 I	1	5065050	5066403	5067755	5069107	5070459
	322	1	5078559	5079907	5081255	5082603	5083950
	323		5092025	5093372	5094713	5096057	5097400
	324		5105450	5106790	5108130	5109469	5110808
	325	1	5118834	5120170	5121505	5122841	5124175
	326	1	5132176	5133508	5134840	5136171	5137501
•			5145478	5146805	5148133	5149460	5150787
	327				5161386		5164031
	328		5158738	5160062	5101300	5162709	3104031
	329		5171959	5173279	5174598	5175917	5177236
	330		5185139	5186455	5187771	5189086	5190400
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	332	1 1	5211381	5212689	5213996	5215303	5216610
	333	1	5224442	5225746	5227050	5228353	5229656
	334		5237465	5238765	\$240064	5241364	5242663
	335	1	5250448	5251744	5253040	5254335	5255631
	336	1	5263393	5264685	5265977 .	5267269	5268560
	337	1 .	5276299	5277588	5278876	5280163	5281451
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				5303278	5304558	5305839	5307118
	339		5301997				5319895
	340	· [5314789	5316066	5317343	5318619	5319095
	34 I	i	5327544	5328817	5330090	5331363	5332635
	342		5340261	5341531	5342800	5344069	5345338
	343		535294I	5354207	5355473 5368109	5356738	5358003
	344	1	5365584	5366847	5368109	5369370	5370631
	345	1	5378191	5379450	5380708	5381966	5383223
	346	I	5390761	5392016	5393271	5394525	5395779
	347		5403295	5404546	5405797	5407048	5408298 ;
	348	1.	5415792	5417040	5418288	5419535	5420781
	340	1	5428254	5429498	5430742	5431986	5433229
	349	1	5440680	5441921	5443161	5444401	5445641
	350	1 .	5440000	5454308	5455545	5456781	5458017
	391		5493071				
	352		5465427	5466660	5467894	5469126	5470359
	3 5 3	,	5477747	5478977	5480207	5481436	5482665
	354	}	5490033	5491259	5492486	5493712	5494937
	355	1	5502283	5 503 507	5504730	5505952	5507174
	356		5514500	5515720	5516939	5518158	5519377
	357	1	5526682	5527898	5529114	5530330	5531545
	358	- (5538830	5540043	5541256	5542468	5543680
	3,0	\$	5550944	5552154	5553362	5554572	5555781
	359		5563025	5564131		5556643	5567848
	360			5576275	5577477	5578680	5579881
	361		5575072	5588285	5589484	5590683	- 5591882
	362	1 3	5587086	5600262	5601458	5602654	5603849
	363	• · ·	5599066	, ,000202	1 ,00-4,0	3002034	70~3°49

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	6	. 7	8		1	1 Diff.	
5		7		9	ł		١
4749413	4750898	4752352	4753806	4755259	Ī	1455	ı
4763968	4765418	4766867	4768316	4769765 '	l	1450.	ı
4778445	4777890	4781334	4782778	4784222	l	1446	i
4792873	4794313	4795754	4797192	4798631	1	1441	ı
4807254	4808689	4810124	4811559	4812993		1436	ı
4821587	4823018	4824448	4825878	4827307	İ	1431	ı
							ı
4835873	4837-99	4838725	4840150	4841 574	Ì	1427	Į
4850112	4851533	4852954	4854375	4855795		1422	ı
. 4864305	4865721	4867138	4868554	4869969	٠.	1417	I
4878451	4879863	4881275	4882686	4884097	i	1412	l
4892552	4893959	4895366	4896773	4898179		1408	I
4906607	4908009	4909412	4910814	4912216		1404	l
4920616	4922014	4923413	4924810	4926207		1399	ı
4934580	4935974	4937368	4938761	4940154		1394	١
4948500	4949890	4951279	4952667	4954056		1390	l
4962375	4963761	4965145	4966529	4967913		1385	l
4976206	4977587	4978967	4980347	4981727	•	1381	ł
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4989994	4991370	4992746	4994121	4995496		1377	l
5003737	5005109 '	5006481	5007852	9009212		1372	ı
5017437	5018805	J020IJ2	502 1,539	5022905		1368	l
5031094	5032458	5033821	5035183	5036545		1363	I
5044709	5046068	5047426	5048785	5050142		1360	ı
5058280	5059635	5060990	5062344	3063697		1355	ı
5071810	5073160	5074511	5075860	5077210		1351	l
5085297	5086644	5087990	5089335	5090680		1347	I
5098743	5120085	5101427	5102768	5104109			ı
	5113485		5116160			1343	l
5112147		5114823		5117497		1339	l
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5138832	5140162	5141491	5142820	5144149		1331	l
5152113	5153439	5154764	5156089	5157414		1326	ĺ
5165354	5166676	5167997	5169318	5170639		1323	ı
5178554	5179872	5181189	5182506	5183823		1318	ŀ
5191715	5193028	5194342	5195655	5196968		1315	ı
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5230958	5232260	5233562	5234863	5236164		1302	ı
			5247854			1298	ĺ
5243961	5245259	5246557		5249151	1		ĺ
5256925	5258219	5259513	5260807	5262100		1294	l
5269851	5271141	527243I	5273721	5275010		1291	l
5282738	5284024	5285311	5286596	5287882		1287	ĺ
5295387	5296869	5298152	5299434	5300716		1284	ĺ
5308398	5309677	5310955	5312234	5313512		1280	l
5321171	5322446	5323721	5324996	5326270		1276	١.
5333907	5335179	5336450	5337721	5338991	•	1272	
5346606	5347874	5349141	5350408	5351675		1268	ı
5359267	5360532	5361795	5363059	5364322		1264	l
5371892	5373153	5374413	5375672	5376932		1261	
5384481	5385737	5386994	5388250	5389506	,	1258	
	5398286	5399538					l
5397032	5390200		5400791	5402043		1253	l
5409548		5412047	541 32 96	5414544		1250	
5422028	5423274	5424519	5425765	5427010		1247	
5434472	5435714	5436956	5438198	5439439		1243	
5446880	5448119	5449358	5450596	5451834		1239	l
5459253	5460489	5461724	5462958	5464193	}	1236	ĺ
5471591	5472823	5474055	5475286	5476517	i	1232	
5483894	5485123	5486351	5487578	5488806		1229	ĺ
5496162	5497387	5498612	5499836	5501060	1	1225	Ì
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5581083	5582284	5583485	5584686	5585886	i	1202	
5593080	5594278	5595476	5596673	5597870		1198	
5605044	5606239	5607433	5608627	5604820	<u> </u>	1195	
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i	Num.	1	1 0	1	2	3	1 4
	364		5611014	5612207	5613399	5614592	5615785
	365	1	5622929	5624118	5625308	5626497	5627685
	366	1	5634811	5635997	5637183	5638369	5639555
	367	· !	5646661	5647844	5649027 5660838	5650209	5651392
	368		5658478 5670264	5659658 5671440	5672617	5662017 5673793	566319 6 5674969
	369		5682017	5683191	5684364	5685537	5686710
	370 371		5693739	5694910	5696080	5697249	5698419
	372		5705429	5706597	5707764	5708930	5710097
	373		5717088	5718252	5719416	5720580	5721743
-	374		5728716	5729877	5731038	5732198	5733358
	375		5740313	5741471	5742628	5743786	5744943
	376		5751878	5753033	5754188	5755342	5756496
	377		5763413	5764565 5776067	5765717	5766868 5778363	5768019
	378 379		5774917 5786392	5787538	5777215 5788683	5789828	5779511 5790973
	380		5797836	5798979	5800121	5801263	5802405
	381	1	5809250	5810389	5811529	5812668	5813807
	382	1	5820634	5821770	5822907	5824043	5825179
	383	1	5831988	5833122	5734255	5835388	5836521
	384	1	5843312	5844443	5845574	5846704	5847834
	385		5854607	5855735	5856863	5857990	5859117
i	386 387	1	5865873 6877110	5866998 5878232	5868123 5879353	586924 7 5880475	5870371 5881596
	388		5888317	5889436	5890555	5891674	
	389	1	5899496	5900612	5901728	5902844	5892792 590395 9
	390		5910646	5911759	5912873	5913985	5915098
	391		5921768	5922878	5923988	5925098	5926208
	392		5932861	5933968	5935076	5936183	5937290
	393	1 .	5943925	5945030	5946135	5947239	5948344
	394		5954962	5956064	5957166	5958268	5959369
	395	•	5965971 5976952	5967070 5978048	59681 6 9	596926 8 59802 4 1	5970367
	.396 397	1	5987905	5988999	5979145 5990092	5991186	5981336 59922 7 9
	398		5998831	5999922	6001013	6002103	6003193
	399		6009729	6010817	6011905	6012993	6014081
	400		6020600	6021685	6022771	6023856	6024941
	401		6031444	6032527	6033609	6034692	6035774
	402		6042261	6043341	6044421	6045500	6046580
	403 404		6053050 6063814	6054128 6064888	6055205 6065963	6056282 6067037	6057359
	404 405		6074550	6075622	6076694	6077766	6078837
	406		6085260	6086330	6087399	6088468	6089537
	407		6095944	6097011	6098078	6099144	6100210
	408	l	6106602	6107666	6108730	6109794	6110857
j	409	1	6117233	6118295	6119356	6120417	6121478
	410]	6127839	6128898	6129957	6131015	6132073
	411	l	6138518	6139475	6140531	6141587	6142643
	412 413	ł	6148972 6159501	6150026 6160552	6151080 6161603	61 52 1 3 3 61 62 6 5 4	6153187 6163705
	414	İ	6170003	6171052	6172101	6173149	6174197
	415		6180481	6181527	6182573	6183619	6184665
	416	•	6190933	6191977	6193021	6194064	6195107
	417		6201360	6202402	6203443	6204484	6205524
	418		6211763	6212802	6213840	6214879	6215917
	419	1	6222140	6223177	6224213	6225249	6226284
	420 421		6232493 6242821	6233527 6243852	6234560 6244884	6235594 6245915	6236627 6246945
	422	,	5253124	6254153	9255182	6256211	6257239
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]	426		6294096	6295115	6296134	6297153	6298172
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	428 429	1	6314438 6324573	6315452 6325585	3316467 6326597	6317481 6327609	6318495
	467		♥ フ^♥フ/ ラ	♥プ アフ''ス	0720791	U 7 2 7 U U Y	0 7 2 0 0 2 0 .

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1 5	1 6	7 ,	. 8	9.		Diff.	_
5616975	5618167	5619358	5620548		1		-
5628874	5630062	5631250		5621739	i	191	
	5641925	5643109	56324 3 7 564429 3	5633.624		1189	1
5640740		5654936		5645477 5657298	į	1185	1
5652573	5653755	5666731	5656117		ł	181	1
5664375	5665553		5667909	5663087)	1179	
5676144	5677320	5678494	5679669	5680843	İ	1175	.
5687882	5689054	55902 26	5691397	5692568	1	1172	1
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5711263	5712428	5713594	5714759	5715924	l	1166	1
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5757650	57588c3	5759956	5761109	5762261	l	1154	1
5769169	5770320	5771470	5772620	5773769	ŀ	1150	1
5780659	5781806	5782953	5784100	5785246		1148	ł
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5826314	5827450	5828585	5829719	5830854			1
5837654	5838786	5839918	5841050	5842181		1135	ı
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5860244	5861370	5862496	5863622	5853479 5864748		1129	
5871495	5872618	5873742	5874865	5875987	'	1127	ł
5882717	5883838	5884958	5886078			1124	
				5887198	,	1121	ŀ
5893910	5895028	5896145	5897262	5898379		1118	ŀ
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5927318	5928427	5929536	5930644	5931753		1110	li
5938397	5939503	5940609	5941715	5942820		1107	Į.
<u>5949447</u>	5950551	5951654	5952757	5953860		1.103	li .
5960470	5961571	5962671	5963771	5964871		1101	li l
5971465	5972563	5973660	5974758	5975855	}	1098	11
5982432	5983527	. 5984622	5985717	5986811		1096	
599337I	5994464	5995556	5996648	5997739		1092	
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6015168	6016255	6017341	6018428	6019514		1087	
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6122539 6133132	6134189	6135247	6136304	6137361	<u>;</u>	1059	
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6206565	6207605	6208645	6209684	6210724	!	1041	1
6216955	6217992	6219030	6220067	6221104	i 1	1038	!
6227320	6228355	6229390	6230424	6231459	1	1036	
6237660	6238693	6239725	6240757	6241789	:	1033	}
6247976	6249006	6250036	6251066	6252095	:	1031	
6258267	6259295	6260322	6261350	6262377	į l	1028	
6268534	6269559	6270585	6271610	6272634		1025	ľ
6278777	6279800	6280823	6281845	6282867	; 1	1023	•
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6319508	6320522	6321535	6322548	6323560	.	1013	1
6320632	6330642	6221653-1	6222664	~ 6222674	În 2 - 1	1012	١
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	1			6336704		6338723
430		6334685	6335694	6530 /54	6337713	0330723
431		6344773	6345780	6346788	6347795	6348801
432		6354837	6355843	6356848	6;57852	6358957
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447		6503075	6504047	6505018	6575989	65.6960
448	1	6512780	6513749	6514719	6515687	6516656
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455	1	6580114	6581068	6582023	6582476	6583930
456	1	6589648	6590601	6591553	6592505	6593456
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458	1	6608655	66096031	6610551	6611499	6612446
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467	1	6693169	6604000	6695028	6695958	6696887
468	1	1	6694099			
400	1 .	6702459	6703386	9704314	6705242	6706169
469 .	1'	6711728	6712654	6713580	6714506	6715431
470	1	6720979	6721903	6722826	6723750	6724673
471	1	6730209	6731131	6732053	6732974	6733896
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474	}	6757783	6758700	6759615	6760531	6761447
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480	1	6812412	6813317	6814222	6815126	6816030
481	1	6821451	6822354	6823256	6824159	682506 I
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483	ŀ	6839471	6840370	6841269	6842168	6843066
484	1	6848454	20427	6850248		
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405	1	6857417	6858313	6859208	6860103	6860998
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494	1	6937269	6938148	6939027	6939906	6940785
H 495	1	6946052	6946929	6947806	6948682	6949560

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64: 9459	6440415	6441430	6442416	6443401		986
6449307		6451274				994
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6468936	6469915	647 2844	6471873	6472851		979
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6556186	6557145	6558105	6554064	6560023		960
6565773 .	6566730	6567688	6568645	6569602		958
6575339	6576294	6517250	6578205	65791 5 9		956
6584884	6 58 5 837	6586790	6587743	6588696		954
6594408	6595359	6596310	6597261	6598212	•	952
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6613393	6614340	6615287	6616234	6617181		947
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6734817	6735738	6736659	6737579	6738500		921
6744018	6744937	6745856	6746775	6747693		919
		0 /4)0)0		0 14 10 93 C= - 202 -		
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6762362	6763277	6764192	6765107	6766022		915
6771505	6772418	6773332	6774244	6775157		913
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6-80	6700610		6900460			910
6789734	6790643	6791552	6792461	6793370	1	
6798819	6799727	6800634	6801 541	6802448		908
6807886	6808792	6809697	6810602	6811507	1	906
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6816934	6817838	6818741	6819645	6820548	l	904
6825963	6826865	6827766	6828668	6829569	l	902
68:4973	6835873	6836773	6837637	6838572	I	900
6843965	6844863	684576I	6846659	6847556	l	899
		774777		3347773	ł	
6852938	6853834	6854730	6855626	6856522	l	897
6861892	6862787	68636 8 t	6854575	6865469	1	894
6870828	6871721	6872613	6873506	6874398	1	892
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6879746	6880637	6881528	6882418	6883308	i	891
6888646	6889535	6890423	6891312	6892200	Į.	889
6897527	6898414	689930£	6900188	6,01074	1	887
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6906390	6907275	1918069	6909046	6909930	ı	205
6915235	6916119	6917002	691 7885	8978768	l	883
6924062	6924944	6925826	6926707	6927588	l	882
		6004601			I	88 r
6932872	6933752	6934631	6935511	6936390	1	878
6941663	6942541	6943419	6944297	6945174	i	270
1 6950437	6051313	6952189	6953065	6953941	Ι.	877
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Num.		0	f t	1 2	3	1 4
	•	6954817	6955692	6256568	6957443	6958318
496 497		6963564	6964438	6965311	6966185	6957058
498		6972293	6973165	6974037	6974909	6975780
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510 511		7075702 7084209	7076553 7085059	7077405 7085908	7086758	7019107 7087607
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523 524		7185017	7185847	7186677	7187507	7188337
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534		7275413	7276226	7277039	7277852	7278664
535 536		7283538	7284349 7292458	7285161	7285972 7294078	7286784
537		7291648	7300551	72932 6 8 7301360	7302168	7294888 7302977
538		7307823	7308630		•	
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540		7323938	7324742	7325546	7326350	7319109
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546		7371926	7372722	7373517	7374312	7375207
547		7379873	7380667	7381461	7382254	7383048
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55I 552		7411516	7412304 7420177	7413092	7413880 7421750	7414668
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556		7450748	7451529	7452310	7453091	7453871
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559		7474118	7474895	7475672	7476448	7477225
560		7481880	7482656	7483431	7484206	7484981
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6959193	6960067	6960942	6961816	8962690		
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6985355	6986224	6987093	6987963	6988831	į.	870
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	7003575		7005307		1	
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7019995	7020857	7021719	7022582	7023444	1.	863
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7045794	7046652	7047509	7048366	7049223		857
7054360	7055216	7056072	7056927	7057782	ł	855
7062910	7063764	7064617		9066324	1	
			7065471		1 :	854
7071442	7072294	7073146	7073998	7074850	1 1	853
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7088456	7089305	7090154	7091003	7091851		849
7096939	7097786	7098633	7099480	7100327	`	848
				7108786		845
7105404	7106250	7107096	7107941			-04)
7113854	7114698	7115542	7116385	7117229	1	844
7122287	7123129	7123971	7124813	7125655		843
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		7140782		7142459		840
7139104	7139943	1140/02	7141620	/*444) y :		040
7147488	7148325	7149162	7150000	7150837		838
7155856	7156691	7157527	7158363	7159198		837
7164207	7165042	7165876	7166710	7167544) 1	834
	7173376	7174208	7175041	7175873		422
7172543				72/30/3		433
. 7180863	7181694	7182525	7183356	7184186	1 1	831
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- 7197455	7198283	7199111	7199938	7200766	i i	828
7205727	7206554	7207380	7208206	7209032		826
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7255033	7255850	7256667	7217483		·	
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7279477	7280290	7281101	7281914	7282726		813
	7200290			7290838		811
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7295697	7296506	7297316	7298125	7298934	l 1	809
7303785	7304593	7305400	7306208	7307015	1	808
7311857	7312663	7313470	7314276	7315082		806
					!	80 j
7319914	7320719	7321524	7322329	7323133		007
7327957	7328760	7329564	7330367	7331170		804
7335985	7336787	7337588	7338390	7339191		803
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7351995	7352794	7353593	7354392	7355191	1	799
					1	798
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7485756	7486531	7487306	7488080	7488854		775
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-	564	ł	7512791	75135 61	7514331	7515100	7515870
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	575	;]	7596678 7604225	7597434 7604979	7605733	7606486	7607240
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	616		7895807	7896512	7897217		
	617		7902852	7903555	7904259	7897922	7898626
	618		7909885	79°53333 7910587	7904239	7904963 79119 9 2	790566 6 791269 5
:	619		7916906	7917608	7918309	791992	7912095
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-	7501225	7501947	7502769	750354E	7504312	1	772
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628	-	7979596	7980288	7980979	7981671	7982362
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692		8401061	8401688	8402316	8402943	8403571
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991	l	9960737	9961175	9961613	9962051	9962189
992	l	9965117	9965554	9965992	9066430	9966868
993	ļ	99 69492	9969930	9970367	9970804	9971242
994	1	9973864	9974301	997473 ⁸	9975174	9975611
995		9978231	9978667	9979104	9979540	99799 76
996		9982593	9953029	9983465	99×3901	5984337
997		9986952	9987357	9987823	9988258	9988694
998		9991305	9991740	9992176	9992611	9993046
999	'	9995655	9995090	9995524	9596959	9997393

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9815921	9816374	9816827	9817280	9817733	1	453
9820450	9820902	9821355	9821807	9822260	1	453
9824974 ·	9825426	9825878	9826330	9826782	1.	452
9829493	9829945	9830396	9830848	9831299	1	452
9834007	9834459	9834910	9835361	9835812	ı	451
9838517	9838968	9839419	9839869	9840320	1	451
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9843022	9843473	9843923	19844373	9844823	i	450
9847523	9847973	9848422	-9848873	9849322	ľ	450
9852019	9852468	9852917	9853366	9853816	ł	450
9856510	9855959	9857407	9857856	9858305	1	449
9860996	9861445	9861893	9862341	9862790	1	448
9865478	9865926	9866374	9866822	9867270	1	448
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9869955	9870403	9870850	9871298	9871745	1	447
9874428	9874875	9875322	9875769	9876216	1	447
9878896	9879343	9879789	9880236	9880632	1	447
9883360	9883806	9884252	9884 6 98	9885144	I	446
9887818	9888264	9888710	9889155	988,601	, '	446
9892273	9892718	9893163	9893608	9894050	} .	445
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9896722	9897167	9897612	9898056	9898501	}	445
9901168	9901612	9902056	9902500	9902944		444
9905608	9906052	9906496	9906940	9907383		444
9910044	9910488	5910931	9911374	9911818		443
9914476	9914919	9915362	9915805	9916247		443
9918903	9919345	9919788	9920230	9920673		442
				3720073		742
9923326	9923768	9924210	9924651	9925093		442
9927744	9928185	9928627	9929068	9929510		442
9932157	5932598	9933039	9933480	9933921		441
9936586	993700 7	9937448	9937888	9938329		441
9940971	9941411	9941851	9942291	9942731	•	440
9945371	9945811	9946251	9946690	9947130		440
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9949767	9950206	9950645	9951085	9951524		440
9954158	9954597	9955036	9955474	9955913		439
9958545	9958983	9959422	9959860	9960298		439
9962927	9963365	996383	9964241	9964679	•	438
9967305	9967743	9968180	9968618	9969055		438
9971679	9972116	9972553	9972990	9973427		437
		771-113		27/344/		
9976048	9976485	9976921	9977358	9977794	,	437
99804#3	9980849	9981285	9981721	9982157		437
9984773	9985209	9985645	9986080	9986516		436
9989129	9989564	9990000	9990435	9990870	1	435
y99348I	9993916	9994350	9994785	9995220	į	435
9997828	9998262	9998697	9999131	9999566	1	435
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64			13	19 20	26 26	32	38	45	51	98
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68		7 7 7 7 8	14	20	27 28	34	41	48	54	61
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72		7	15	22	30 30	30 37	43 44	50 52	58	67
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78		8	16	23	31	39	47	55	62	70
80			16	24	32	40	48			
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374 27 56 82 11Q 137 164 168 210	247 248
276 28 55 83 110 128 166 100 221	248
280 28 46 84 112 140 166 104 204	250
282 28 16 85 813 841 169 197 226	252 254
28	256
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296 39 59 89 118 148 178 207 237	
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240	270 272
304 30 61 91 121 152 188 212 242	272
306 : 34 61, 92 122 153 184 214 245	274 275
309 31 62 92 123 154 185 216 246 310 31 62 93 124 155 185 217 248	277
31 681 94 125 1150 187 218 250	270 281
314 31 631 94 126 157 188 220 251	283
316 32 68 95 126 158 190 221 253 318 32 64 95 127 159 101 223	284
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320 : 33 641 96 128 160 192 224 256	288
32 2 2 32 24 97 129 161 193 225 258	290
324 326 33 651 98 130 162 194 227 259 326 33 651 98 130 163 196 228 261	292
320 328 33 661 98 134 164 197 230 262	293 295
330 1 33 661 99 132 165 198 221 264	297
332 33 661 100 133 166 199 232 266 334 1 33 67; 100 134 167 290 234 267	200
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338 34 68 ₁ 101 135 169 203 237 270	304
349 34 68 102 136 170 214 228 272 342 342 34 68 103 137 171 205 239 274	306
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344 34 69 103 138 172 206 241 275 246 36 69 104 138 173 208 242 277	,3 LP
348 36 70 104 139 174 209 844 278	377
350 1 36 39 195 140 175 210 245 280	313
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354 36 71 106 142 177 212 248 283 356 358 36 74 107 142 178 214 249 285 358 36 74 107 143 179 215 251 286	310
356 -86 71 157 142 178 214 249 285 358 36 74 197 143 179 215 251 286	.320
358 369 74 197 143 179 215 251 286 369 72 108 144 180 216 212 288	322
362 136 72 109 145 181 217 253 200	324 326
1 59 73 149 162 248 255 291	328
300 37 73 110 146 183 240 256 293	329
368 37 74 110 147 184 221 248 294	3 3.4
370 377 74 111 148 1185 222 249 296	333
974 37 74 112 150 187 224 262 200	335
38 75 143 150 188 225 262 201	337 338
378 38 76 113 151 189 227 265 303 380 38 76 114 152 190 228 266 304	339
350 48 76 114 152 100 928 966 904	342
382 38 76 115 153 191 229 257 306	344
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398	Ĭ. · ·	40	79	110	150	199	239	279	318	356 358
400		40	80	125	159	300	240	280	320	360
402	V 4	40	80	,121	101	201	241	281	322	362
404		40 (81	121	162	,202	242	283	323	363
406	· .	41	8:	122	162	203	244	284 286	. 325	365
408 410		41	82 82	122	163 164	204	245 246 :	287	326 328	367 369
412		41 !	82	124	165	206	247	283	330	371
À14		41	83	124	366	207	248	290	331	373
416		42	83.	125	166	208	250	291	333	374
418		42	84	125	167 168	209	251	293	334	276
420 422	- !	42 42	84 84	126 127	108 169	310	252 253	294 295	3 36 3 38	378
424		42	85	127	170	218	254	297	339	382
426	2 1	43	85	128	17Ò	213	256	298	341	3,83
438		43	86	128	171	214	!	300	342	385
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432	4.7	43	86 87	130	173	210	259 . 250 :	302 304	346 347	389
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442	\$70. \ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \	44	88	133	177 178	221	264 265	309	354	398
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734		73	147	220	294	367	440	514	587	65E	j
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738		74	148	221	2,5	369	443	517	590	664	1
740		74	148	222	296	370	444	518	592	666	
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818	1 1	82	164	245	327	409	491	572	654	734 736
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884		88	177	265	354	442	530	619	707	796
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888		89	178	266	355	444	533	622	710	795
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892		89	178	268 268	357	446	535	624	714	803
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912	,	91 91	183	274 274	365 366	456 457	547	€38 640	730	821 823
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921		92	184	276	368	460	553	645	737	ີ 82ບ
924		92	185	277	370	452	554	647	739	832
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954	1	95	191	286	3.82	477	572	668	763	850
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963	1	96 96	192 193	289	385	481	576 578	674	770	857
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97 8 981		98 98	19 6 196	293 294	391 392	489 490	587 589	687	785	880 883
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1021		102	204 205	306 307	410	512	613	717	820	919 923
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1073	•	107	215	322	429	536	611	751	858	966 966
1077		108	215	323	431	538	646	754	852	969
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1145	1	114	229	343	458	572	687	801	916	1031
1149		115	230	345	460	574	689	8⊃4	919	1934
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1165	1.	116	233	349	466	582	699	815	932	1049
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	1181	1	118	236	354 355	472	590 592	709	827	945 948	1063
	1189	1	f19	238	357	476	594	713	832	951	1070
l	1193		119	239	358	477	596	716	835	954	1074
1	1197	1	120	239	359	479	598	718	838	958	1077
- 1	1201	Ì	120	240	36⊕	480	600	721	841	961	1081
1	1205		120	241 242	361	482 484	602 604	723	843 846	964 967	1084
-	1209 1213		121	243	364	485	606	728	849	970	1092
1	1217	·	122	243	369	487	608	730	852	974	1095
1	1221	`	122	244	366	488	610	732	855	977	1099
1	1225		122	245	367	490	612	735	857	980	1102
1	1229	ł	123	246	369 370	492 493	614	737	860 863	983 986	11106
	1233 123 7	ł	124	247	371	495	613	742	866	990	1113
	1241		124	248	372	496	620	745	869	993	1117
1	1245	1	124	249	373	498	622	747	871	996	1120
1	1249	1	125	250	375	500	624	749	874	999	11724
	1253 125 7	1	125	251 251	376 377	501 503	626 628	752 75 4	877 880	1002	1128
ı	1257	ŀ	126	252	378	504	630	756	852	1008	1131
	1263	1	126	253	379	505	631	758	894	1010	1137
1.	1267	1	127	253	380	507	633	760	887	1014	1140
	1271		127	254	381	508	635	763	890	1017	1144
Ì	1235		127	255	382 384	510	637	765	892	1020	1147.
1	1279	1	128	256 257	385	512	639 641	767 770	895 898	1023 1026	1151
l	1287	1	129	257	386	515	6+3	772	901	1030	2158
-	1291	1	129	258	387	516	645	775	904	1033	1162
	1295	ŀ	129	259	388	518	647	775 777	906	1036	1165
	1299		130 130	260 261	391	520	649	779	909	1039	1169
	1303 1307		131	261 261	392	52I 523	651 653	784	912 915	1042 1046	1173
	1311	l	131	262	393	524	655	787	918	1049	1180
1	1315	1	131	263	394	526	657	789	920	1052	1183
	1319		132	264	396	528	65,9	791	923	1055	1187
1	1323		13 2 13 3	265 265	39 7 39 8	529	661 663	794 706	926	1058	1191
ŀ	13 27 1331		133	265	399	531 532	665	796 799	932 929	1062 1065	1194 1198
	1335		133	267	400	534	667	801	934	1068	1201
	1339		134	268	402	536	669	803	937	1071	1205
ı	1343		134	269	403	537	671	8 06 808	940	1074	1200
l	1347 1351		135	269 270	404 405	539 540	673 675	81 g	943 946	1078 1081	1212 1216
	1355		135	271	406	- 542	677	813	948	1084	1219
_	1359		136	272	408	544	679	815	951	1087	1213
	1363		136	273	409	545	681	818	954	1090	1227
ı	1367 1371		137 137	273 274	410 411	547 548	683 685	8 20 823	957 960	1094	1230 1234
	1375		137	275	412	550	687	825	962	1097	1237
l	1379		138	276	414	552	689	827	965	.1103	1241
1-	1383	l	138	277	415	553	69 r	830	968	1106	1245
	1387	. 1	139	277 278	416	555 556	693 695	832 835	971	1110	1248 1252
	1395	1	140	279	418	558	697	837	974 976	1113	1255
1	1399	1	140	280	420	559	699	839	979	1119	1259
	1403		140 141	281 281	421 422	561 563	701 703	842 844	98 2 985	1122 1126	1263 1266
-	1411	I	141	282	423	564		847	988		}
	1415	1	141	283	424	566	705 707	849	995	1129	1270 1273
	1420	1	142	284	426	568	710	852	994	1136	1278
	1425 1430	i	142	285 286	427	570	712	855 858	997	1140	1282
	1435		143	287	429 430	572 _574	715	861	1004	1144 1148	1287

Diff.		1	2	3	4	5	6	7. 1	8	9
1440		\ 	288	422	. 576	720	864	1008		1296
1440	3	144	289	432 433	578	722	857	1011	1152 1156	1300
1450		145	290	435	- 5 ઇ ૦	725	870	1015	1160	1305
1455		145	291	436	562	727.	873	1018	1164	1309
1460	,	146	292	436	584	7 30	876	1022	1168	1314
1455		146	293	439	586	732	879	1025	1172	1318
1470		147	294	441	588	735	882	1029	1176	1323
1475 1480		147 148	295	442	590	7 3 7	885	1032	1180	1327
1480		148	296	444	5.92	7+0	888	1036	1184	1332
1485 1490		148 149	297 298	445 447	594 596	742 745	891 894	1039 1043	1188 11 92	133 6 1341
1495		149	299	448	598	747	897	1046	1196	1345
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1500		150	300	450	600	750	, 900	1050	1200	1350
1505 1510		150 151	301 302	451 453	602 604	7 52 7 55	903	1053	1204 1208	1354 1359
1515		151	303	454	606	757	909	1060	1212	1363
1520		152	304	456	608	760	912	1064	1216	1368
1525		152	305	457	610	762	915.	1067	1220	1372
1530	'	153	306	459	612	765	918	1071	1224	1377
1535		153	307	460	614	767	931	1074	1228	1381
1540		154	308	462	616	770	924	1078	1232	1386
1545		154	309	463	618	772	927	1:81	1236	1390
1550		155	310	46 5 46 6	620 622	775 777	930 933	1085 1088	1240	1395
1555		155	311					1000	1244	1399
1560		156	312	468	624	780	936	1092	1248	1404
1565		156	313	469	626	782	939	1095	1252	1408
1570		157	314	471 472	628 630	785 787	942	1099	125 6 1260	1413
1575 1580		157 158	316 316	474	632	790	945 948	1102 1106	1264	1417 1422
1585		158	317	475	634	792	949	1109	1268	1426
				400						
1590		159	319	477 478	636 . 638	79 5 7 3 7	954 957	1113	1272 1276	1431
159 5 1600		159 16J	320	480	640	800	960	1116 1120	1280	1435 1440
1605		160	321	481	642	862	963	1123	1284	1444
1610		161	322	483	644	805	956	1127	1288	1449
1615		161	323	484	646	807	969	1130	1292	1453
1620		162	3 24	486	648	810	972	1134	1296	1458
1625		162	325	487	650	812	975	1137	1300	1462
1630		163	3 2 6	489	652	815	978	1141	1304	1467
1635 1 64 0		163 164	3 27 3 28	490 492	654 656	817 820	981 984	1144 1148	1308 1312	1471 1476
1645		164	329	493	658	822	987	1151	1316	1480
		165	330	495	660	825	990		1320	1485
1650 165 5		165	331	496	662	827	993	1155	1324	1489
1660		166	33 2	498	664	830	9 9 6	1162	1328	1494
1665		166	333	499	666	832	99 9	1165	1332	149 8
1670		167	334	502	668	835 83 7	1002	1169	1336	1503
1675	1	167	335		670			1172	1340	1507
1680		168	338	504	672	840 842	1008	1176	1344	1512
1685 1690		163 169	337 338	505 507	674 676	845	1011	1179 1183	1348 1352	1516 1521
1695		159	339	50s	678	847	1017	1186	1356	1525
1700	1	170	340	510	680	850	1020	1190	1360	1530
1705	ŀ	170	341	511	682	852	1023	1193	1364	1534
1710	•	171	342	513	684	855	1025	1197	1368	i539
1715	•	171	343	514	686	857	1029	1200	1372	1543
1720 1725	1	172 172	344 345	510 517	688 690	860 862	1032	1204	1376 1380	1548 1552
1730	1	173	346	519	692	865	1038	1211	1384	1557
1735	1	173	347	520	694	867	1041	1214	1388	1561
1740	1 :	174	348	522	696	870	1044	1218	1392	1566
1745		174	349	523	698	872	1047	1221	1396	1570
1750	1	175	350	525	700	875	1050	1225	1400	1575
1755	1	175	351	526	702	877 886	1063	1228	1404 1408	1579
1760 1765		176	352 353.	528 529	704	882	1056	1232	1412	1584
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-	Diff.		1 -	2	1 3	1 4	5	1 6	7	1 8	9
ŧ	1770		177	354	931	708	885	1062	1239	1416	1593
- 1	1775	}	177.	355 356	\$32	710	887	1065	1242		1597
	1780 1785	1	178	350	534	712	890 892		1246		1602
- [1790		179	357 358	3 55 3 37	716	895	1071	1249		1611
- 1	1795	1	179	359	548	718	897	1077	1256		1615
-		1	1 ===	360			•				
	1800 1805	1	180	361	540 541	720	900	1080	1260 1253		1620 1624
- 1	1810	l	181	362	143	724	905	1086		1448	1629
	1815		181	363	544	726	907	1089	1270	1472	1633
ŀ	1820		182 182	364	946	728	910				1638
- 1.	1825	.]	102	365	547	730	912	1095	1277	1460	1642
	1830		183	366	\$49	732	915	1098	1281	1464	1647
1	1835	1	183	367	\$50	734	917	1101	1284		1651
	1840 1845	1	184 184	368 369	\$52 \$53	736 738	920		1288	1472	1656
-	1850		185	370	555	740	922				1665
1	1855	1	185	371	\$56	742	927		1298		1669
1	1860		136	270	0					1488	
Ì	1865	1	186	372 373	558	744	930 932	1116	1302 1305	1488	1674 1678
ł	1870	1	187	374	561	748	935	1122	1309		1683
	1875		187	375	562	750	937	1125	1312	1500	1687
ı	1880 1885	į	188	376	564	752	940		1316		1692
1.		1	—		565	754	942	1131	1319		1696
	1890	1	189	378	367	756	945	1134	1323	1512	1701
ļ	1895 1900	1.	189	379	568	758 760	9+7	1137	1326	1516 1520	1705
1	1905	1	190	381	570	762	950 952	1140	1333	1524	1710
1	1910	l	191	382	573	764	955	1146	1337	1528	1719
1	1915		191	383	574	766	957	1149	1340	1532	1723
-	1920	1	192	384	576	768	. 960	1152	1344	1536	1728
1	1925	1	192	385	577	770	962	1155	1347	1540	1732
ı	1930	ì	193	386	579	772	965	1158	1351	1544	1737
1	1935 1940	ł	193 194	387	580 582	774 776	967 970	1161	1354	1548	1741
1	1945	l	194	389	583	778	972	1164	1361	1556	1746 1750
1.		1	I —	_	-						
1	1950	1	195	390	585 586	780 782	975	1170	1365 1368	1560	1755
1	1955	l	196	392	188	784	977 980	1173	1372	1568	1759 1764
1	1965	l	196	393	589	786	982	1179	1375	1572	1768
1	1970	1	197	394	591	788	985	1182	1379	1576	1773
]_	1975	l	197	395	592	790	987	1185	1382	1580	1777
1	1980	l	198	396	594	792	990	1188	1386	1584	1782
I	1985		199	397 398	595 597	794 796	992 995	1191	1389	1588 1592	1786
	1995		199	399	598	798	997	1197	1396	1596	1791 1795
1	2000		200	400	600	800	1000	1200	1400	1600	1800
1 -	2010		201	402	603	804	1005	1206	1407	1608	1809
1	2020		202	404	606	808	1010	1212	1414	1616	1818
1	2030 2040		203 204	406 408	609 612	812 816	1015 1020	1218	1421	1624 1632	1827
1	2050		205	410	615	820	1025	1224	1435	1640	1836 1845
	2060		206	412	618	824	1030	1236	1442	1648	1854
1_	2070		207	414	621	828	1035	1242	1449	1656	1863
1	2080		208	416	625	B32	1040	1248	1456	1664	1872
1	2090		209 210	418	627	836	1045	1254	1463	1672	1881
	2110		211	420	630 633	840 844	1050	1260 1266	1470 1477	1680 1688	18 9 0
1	2120		212	424	636	848	1060	1272	1484	1696	1908
Ŀ	2130		213	426	639	852	1065	1278	1491	1704	1917
	2140		214	428	642	856	1070	1284	1498	1712	1926
	2150	l	215	430	645	860	1075	1290	1505	1720	1935
	2160 2170		216	432 434	648	864 868	1080	1295	1512 1519	1728	1944
	2180	i	218	436	654	872	1090	1302 1308	1526	1736	1953 1962
	2190		219	438	657	876	1095	1314	1533	1752	1971

Diff.	1	I	2	3	4.	5.	6.	7: 1	8	91
	1 1		440	660						
2200	1 1	220	440	660 663	880 884	1100	1320	1540	1760	1980
2220	1 1	221 222	442 444	656	888	1105 1110	1326	1547	1768	1989
2230	1.1	223	446	669	893	1115	1332 1338	1554 1561	1776 1 7 84	1998
2240	1 1	224	448	672	\$96	1120	1344	1568	1792	2016
9250	1 1	225	450	679	900	1125	1350	1575	1800	2025
	1 1									
2260	l i	226	452	678	904	1130	1356	1582	1808	2034
2270	1	227	454	681	908	1135	1362	1589	1816	2043
2280	1 1	228	456	684 687	912	1140	1368	1596	1824	2052
2290 2300	1 i	229	458 460	690	916	1145	1374	1603 1610	1832	2061
2310	1 1	230 231	452	693	920 924	1150	1380 1380	1617	1840 1848	2070
	1 1				~~~		-,,,,,			2079
2320	i i	232	454	696	928	1160	1392	1621	1856	2088
2 330	l ·	233	466	699	933	1165	1398	.1531	1864	2097
2340	1 1	234	468	702	936	1179	1404	1638	1872	2106
2350	1 }	231	470	705	940	1175	1410	1645	1880	2115
2360	[]	236	472	708	944	1180	1416	1652	1888	2124
2370]	237	474	711	948	1185	1422	1659	1896	2133
2380	[1	238	476	714	952	1190	1428	1666	1904	2142
2390	1	239	47.8	717	956	1195	1434	1673	1912	2151
2400	j i	240	480	720	9 60	1200	1440	1680	1920	2160
2410] [241	482	723	664	1205	1446	1687	1928	2169
2430	j 1	242	484	726	968	1210	1452	1694	1936	2178
2430		243	486	729	972	1215	1458	1701	1944	2187
2410			488	732	976	1220	1464	1708	1952	2196
2450		244	490	735	980	1225	1470	1745	1960	2205
2460		246	492	738	984	1230	1476	1722	1968	2214
2470		247	494	741	988	1235	1476 1482	1729	1976	2223
2480		248	496	744	992	1240	1488	1736	1984	2732
2490		249	498	747	69 6	1245	1494	1743	1992	2241
2500		240	520	750	1000	1000	1500	1750	2000	2250
2510		250 251	502	753	1004	1250 1255	1506	¥757	2008	2259
2520		252	504	756	8001	1260	1512	1764	2016	2268
2530	1	253	506	759	1012	1265	1518	1771	2024	2277
2540	1 1	254	508	762	1016	1270	1524	1778	2032	2286
2550		255	510.	768	1020	1275	1530	17,85	2040	2295
2560		2.6		768	1024	1280	1536	1700	2048	2304
2570		256 257	512 514	771	1028	1285	1542	17 <u>9</u> 2 1799	2056	2313
2580		258	516	774	1032	1/290	1548	1806	2064	2322
2590		259	518	779	1036	1,295	1554	1813	2072	2331
2600		260	520	780 i	1040	1300	1565	1820	2080	2340
2610	. 1	261	522	783 →	1044	1305	1566	1827	2088	2349
2620		262	524	786	1048	1310	#572	1834	2096	2358
2630	1	263	526	789	1052	1315	1578	1841	2104	2367
2640		264	528	792	1056	1320	1584	1848	2112	2376
2650		265	530	795 1	1060	1325	1590	1855	2120	2385
2660		256	532	798	1064	1330	1596	1862	2128	2394
2670	1	267	534	801	1068	1335	1602	1869	2136	2403
2680	II ;	269	535	804	1072	1340	1608	1876	2144	2412
2690	()	269	.538	807	1076	1345	1614	1883	2152	2421
2700	11	270	540	810	1080	1350	1630	1890	2160 2168	2430
2710		271	512	813	1084	1355	1626	1897	2176	2439 2448
.2720		272	·544 546	819	1094	1360	1638	1904	2184	2457
:2730	{ }	273					,			
2740	!	274	548	822	1096	1370	1644	1928	2102	2466 2475
2750	!	275	550	828	1100	1375	1650 1656	1935	2208	24/5
2760 2770	1	276 277	.552 .554	831	1108	1385	1662	1949	2215	2493
2780	1	278	1555	834	1112	1390	1668	1955	2224	2502
2790	11 .	279	.558	837	1116	1395	1674	1963	2232	2511
	11 .		565	840		1400	1685	1970	2240	2520
2800 2810	. '	280	1562	843	1120	1405	1686	1977	2248	2529
2820	11 ,	282	1964	846	1128	1410	1692	1984	2256	2538
2830		283	566	849	1132	1415	1698	1991	2264	2547
12840	1	284	568	892	1136	14201	1704	1998	2272	2556
2850	11	285	570	1 845	1140	1425	17.10	2005	2280	2565

Diff.	1	1 1.	1 2	1 3	4	1 5	1 6	1 7	1 8	1 9
	- (1	}	1		2060	
2860 2870		286 · 287	572	858 108	1144	1435	1716	2012	2288 2296	2574
2880		288	576	864	1152	1440	1728	2026	2304	2583 2592
2890		289	578	867	1156	1445	1734	2033	2312	2601
2900		290	58e	870	1160	1450	1740	2040	2320	2610
2910		291	582	873	1164	1455	1746	2047	2328	2619
2920	- [-	292	584	876	1168	1460	. 1752	2054	2336	2628
2930		293	586	879	1172	1465	1758	2061	2344	2637
2940	1	294	588	882	1176	1470	1764	2068	2352	2646
2950		295	590	.885	1180	1475	1770	2075	2360	2655
2960		296	592 594	888	1184	1480	1776	2072	2368 2376	2664 2673
2970			 		·					20/3
2980		298	596	894	1192	1490	1788	2086	2384	2682
2990		299 '	598. 600	897	1196	1495	1794	2093	2392	259 1
3000	1	300	602	900	1200	1500	1306	2100	2400 2408	2700 2709
3020	. :	302	604	906	1208	1510	1812	2114	2416	2718
3030	1	303	606	909	1212	1515	1818	2121	2424	2727
2010	•	304	608	912	1216	1520	1824	2128	2432	0336
3040 3050		305	610	915	1220	1525	1830	2135	2440	2736 2745
3060	1	306	612	918	1224	1530	1836	2142	2448	2754
3070	ł	307.	:614	921	1228	1535	1842	2149	2456	2763
3080	1	308	616	924	1232	1540	1848 1854	2156 2163	2464	2772
3090	1	300	===	527	1236	1545		-103	2472	2781
3100		310 -	620	930	1240	1550	1 860	2170	2480	2790
3110		311	622	933	1244	1555	1866	2177	2488	2799
3120	}	312	624 62 6	936 939	1248	1560	1872 1878	2184	2496 2504	2808 2817
3130 3140	1	314	628	939	1252	1570	1884	2198	2512	2826
3150	1	315	630	945	1260	1575	1890	2205	2520	2835
2160	l	316	632	948	1264	1580	1896	2212	2538	
3160 3170	}	317	634	951	1268	1585	1902	2219	2528 2536	2844 2853
3180		318	636	954	1272	1590	1908	2226	2544	2862
3190	į	319	638	957	1276	1595	1914	2233	2552	2871
32.0	Ì	320 321	640	960	1280	1600	1920	2240	2560	2 ⁹ 80
3210	l	311	642	963	1284	1605	1926	2247	2568	2889
3220	į .	322	644	966	1288	1610	1932	2254	2576	2898
3230		323	646	969	1292	1615	1938	2261	2584	2907
3240		324 325	648 650	972	1295	1620 1625	1944	2268	2592	2916
3250 3260		326	652	97 5 978	1300 1304	1630	1956	2275 2282	2500 2608	2925
3270	•	327	654	981	1308	1635	1962	2289	2616	2934 2943
3280		320	656	984	1312	1640	1968	2296	2624	
3290	į į	329	658	987	1316	1645	1974	2303	2632	2952 2961
3300	1	330	660	990	1320	1650	1980	2310	2640	2970
3310		331 332	662 664	993	1324	1655 1660	1986	2316	2648	2979
3320 3330		333	666	996 9 9 9	1328 1332	1665	1992 1998	2324 2331	2656 2664	2988
			668			1670			~~-	2997
3340 3350		334 335	670	1002 1005	1336 1340	1675	2004 2010	2338 2345	2672 2680	3006
3350	!	336	672	1008	1344	1680	2016	2352	2688	3015 3024
3370		33 7	674	1111	1348	1685	2022	2359	2696	3033
3380	1.	338	676	1014	1352	1690	2028	2366	2704	3042
3390	1	339	678	1017	1356	1695	2034	2373	2712	3051
3400	1 1	340	680	1020	1360	1700	2040	2380	2720	3060
3410 3 42 0	, I	341 342	682 684	1023	1364 1368	1705 1710	2046 2052	2387 2394	2728	3069.
3430]	343	686	1029	1372	1715	2058	2394 2401	2736 2744	3078 3087
3440		344	688	1032	1376	1720	2064	2408	2752	3007
3450		345	650	1035	1380	1725	2070	2415	2760	3105
3460		346	692	1038	1384	1730	2076	2422	2768	3114
3470		347	694	1041	1388	1735	2082	2429	2776	3123
3480		348	696	1044	1392	1740	2088	2436	2784	3132
3490 35 0 0		349 350	698 7 00	1047	13 9 6	1745 1750	2094 2100	2443 2450	2792 2800	3141
3510		351	702	1053	1404	1755	2106	2457	2808	3150 3159
	<u> </u>						<u></u>			7-18

Diff.							<u> </u>			
<i>Di</i> II			2	3	1 4	1 5	8	7	8	9
3520		359	704	1056	1408	1760	2112	2464	2316	3168
3530		353	706	1059	1418	1769	2118	2471	2821	3177
3540		354	708	1068	1416	1770	2124	2478	2832	3186
3220		355	710	1065	1420	1775	5130	2485	2840	3195
3300		356	718	1068	1424	1780	2136	2492	2848	3204
3570		357	714	1071	1428	1785	2142	2499	2856	3213
3580		358	716	1074	1432	1790	2148	2006	2864	
3590		359	718	1077	1436	1795	2154	2506	2872	3222
3600		3 6 0	.729	1080	1440	1800	2160	2520	2880	3231 3240
3610		361	728	1083	1444	180€	2166	2527	2888	3219
3620		362	724	1086	1448	1810	2172	2534	2896	9258
3639		369	726	1089	1452	1814	2178	2541	2904	3267
		364			1456	1820		24.0		
3640 3610		365	728	1098	1460	1824	2184 2190	2548	2912	3276
3060		366	730 7 32	1098-	1464	1830	2196	2955 25 62	2920 2928	3285
3670		367	734	1101	1458	1835	2202	2569	2936	3 3 94. 3 3 03
3680		368	736	1104	1472	1840	2208	2570	2944	3312
3690		369	738	1107	1476	1845	2214	2583	2952	3321
I										
3700		370	740	1110	1480	1850	2220	2590	2960	3330
3710		371	742	1113	1484 1488	1855 1860	2226	2597	2968	3339
3 72 0 3 7 30		. 37 2 3 7 3	744 7 46	1116	1492	1865	2232 2238	2604 2611	2976 2984	3348
3740		374	748	1122	1496	1870	2244	2618	2992	33 5 7 3366
3750		375	750	1125	1500	1875	2250	2625	3000	3375
1		_								
3760		.376	752	1128	1504	1880	2256	2632	3008	3384
3770		377	754	1131	1508	1885 1890	2262 2268	2639	3016	3393
3780		378 379	756	1134	1512 1516	1895	2274	2646 2653	3024	3402
3790 3800		380	758 760	1137	1520	1900	2280	2660	3032 3040	3411 34 2 0
3810		381	762	1143	1524	1905	2286	2667	3048	3 429
3820		382	764	1146	1528	1910	2292	2674	3056	3438
3830		383	766	1149	1532	1915	2298	2681	3064	3447
3840 3850		384	768	1152	1536	1920	2304	2688	3072	3456
38 6 0		385 386	770	1155	1540 1544	1925 1930	2310 2316	2695 2702	3080 3080	3465
3870		387	772 774	1161	1548	1935	2322	2709	3008	3474 3483
1									3090	
3880		388	776	1164	1552	1940	2 3 28	2716	3104	3492
3890		389	778	1167	1556	1945	2334	2723	3112	350I
3900		390	780	1170	1500	1950	2340	27 30	3120	3510
3910		391	782 1 784	1173	15 6 4 1568	1955 1960	2346 23 52	27 37	3128	3519
3920 3930		39 2 393	786	1176	1572	1965	2358	2744 2751	3136 3144	3528
										3537
3940		394	788	1182	1576	1970	2364 2370	2758	3152	3546
3950		395	,790	1185	1580	1975 1980	2370 23 76	2765 2772	3168 3168	3555
3960 3970		396 397	792 794	1191	1588	1995	2382	2779	3176	3564 35 <u>7</u> 3
3980	1	398	796	1194	1592	1990	2388	2786	3184	3582
3990		399	798	1197	1596	1995	2394	2793	3192	3591
4000		400	800	1200	1600	2000	2400	2800	3200	3600
4010		401	800 802	1203	1604	2005	2406	2807	3208	3609
4020		402	8c4	1206	1608	2010	2412	2814	3216	3618
4030		403	806	1209	1612	2015	2418	2821	3224	3627
4040		404	808	1212	1616	2020	2424	2828	3232	3636
4050		405	810	1215	1620	2025	2430	2835	3240	3645
4060		406	812	1218	1624	2030	2436	2842	3248	3654
4070		407	814	1221	1628	2035	2442	2849	3256	3663
4080		408	816	1224	1632	2040	2448	2856	3264	3672
4090		409	818	1227	1636	2045	2454	2863	3272	3681
4100		410	820 822	1230	1640 1644	2050	2460 2466	2870 2877	3280 3288	3690 3699
4110		411		1233		2055				
4120		412	824	1236	1648	2060	2472	2884	3296	3708
4130		413	826 828	1239	1652 1656	2065	2478	2891 2898	3304	3717
4140		414 415	830	1242 1245	1660	2070 2075	2484 2490	2905	3312 3320	3 726 3735
4160		416	832	1248	1664	2080	2496	2912	3328	3744
4170		417	834	1251	1658	2085	2502	2919	3336	3753
1						******				

44 A TABLE of PROPORTIONAL PARTS.

						6 1	·	8	
Diff.	1 2 1	2	3	4	5	0	' 7	•	9
	1-1								
4180	418	836	1254	1672	2090	2508	2926	3344	3762
4190	419	838	1257	1676	2095	2514	2933	3352	3771
4200	420	840	1260	1680	2100	2520	2940	3360	3780
1 ' 1	421	842	1263	1684	2105	2526	2947	3368	3789
4210 4220	422	844	1266	1688	2110	2532	2954	3 3 76	3798
	423	846	1269	1692	2115	2538	2961	3384	3807
4230		-							
1	424	848	1272	1696	2120	2544	2968	3392	3816
4240		850	1275	1700	2125	2550	2975	3400	3825
4250	425		1278	1704	2130	2556	2982	3408	3834
4260	426	852	1281	1708	2135	2562	2989	3416	3843
4270	427	854			2140	2568		3424	3852
4280	428	856	1284	1712		-	2996		3861
4290	429	858	1287	1716	2145	2574	3003	343 2	3001
						- 0-			
4300	430	860	1290	1720	2150	2580	3010	3440	3870
4310	431	862	1293	1724	2155	2586	3017	3448	3879
4320	432	864	1296	1728	2160	2592	3024	3456	3888

The End of the Table of PROPORTIONAL PARTS.

AN

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OFTHE

Origine, Nature, Construction, Uses.

AND

Application of the preceeding TABLES

OF

IT R

HE Invention of the Logarithms is justly esteemed one of the most useful Discoveries in the Art of Numbers, and accordingly has had an universal Reception and Applause. And the great Geometricians of this Age have not been wanting to cultivate this Subject, with all the Accuracy and Subtilty as a Matter of that Consequence doth require; and they have demonstrated several very admirable Properties of these Artificial Numbers, which have render'd their Construction much more facile, than by those operose Methods, at fift used by their truly Noble Inventer, the Lord Neper; and our Worthy Country-Man Mr. Briggs.

But some Account however of the first Invention of these most useful Tables, 'tis proper to in-

troduce here.

Logarithms (saith Dr. Wallis in his Algebra) were first of all invented, without any Example be-fore him that I know of, by John Neper, Baron of Merchiston in Scotland, and by him published at Edinburgh, A. D. 1614. and soon after by him-felf (with the Assistance of Henry Briggs, Pro-fessor of Geometry, first at London in Gresham-College, and afterwards at Oxford) reduced to a better Form and perfected.

The Invention was greedily embraced (and defervedly) by Learned Men.

Mr. Briggs upon the first Publication of it, was fo pleased with it, that he presently repaired into Scotland, to consult the Author's Advice about it, and be assistant to him in the perfecting of it, and in calculating Tables for it; which was a Work of great Labour, as well as subtile Invention.

And it was embraced and promoted abroad by Benjamin Ursinus, John Kepler, Adrian Ulacq, Petrus Cragerus, and others.

And at home, by Henry Gellibrand, who perfected the Trigonometria Britannica, which Mr. Briggs

began, but died before he had finished it.

So that in a short time it became generally known, and greedily embraced in all Parts, as of unspeakable Advantage; especially for Ease and Expedition in Trigonometrical Calculations. Vol. II.

In the former Volume I have briefly shewn the Nature and Construction of Logarithms in general, which therefore I shall not repeat here; but go on with their History, and the several Improvements which have been made in this Science, some

of which are only barely hinted at there.

A. D. 1614. The Lord Neper published the first Tables of Canon, or Natural and Artificial Sines for each Degree and Minute of the Qua-

drant.

And whereas it was at his Choice to give to what Number he pleased the Logarithm o, and whether to proceed by Way of Increase or Decrease, he chose to make o the Logarithm of the whole Sine 10000000, that so the Multiplication or Division by the whole Sine (frequent in Trigonometrical Calculation) might be dispatched without Trouble, requiring here but the Addition or Subtraction of o

And because the Use of lesser Sines and Numbers less than the Radius or whole Sine, were likely to be of more frequent Use, than Tangents, Secants, and other Numbers greater than the Radius; he chose to give to those lesser Numbers Affirmative Logarithms (increasing the Logarithms from 0, as the Sines decrease) which he calls A-bundants: And consequently Negative Logarithms (which he calls Defectives) to greater Numbers. Designing those by +, these by

And by this means he directs how the Table of Sincs (with the Differences there inferted) may ferve also for a Table of Tangents, and of Secants; so that this Canon is a compleat Canon, of Natural Sines, and of Logarithmical Sines, Tan-

gents, and Secants.

He shews also how this Table may be applied to the Logarithms of Absolute Numbers; but becanse with some Trouble, he reserves the fuller Account hereof to a farther Treatife.

In the Year 1619, the Lord Neper being then dead, the same was again published by his Son Robert Neper; with some posthumous Treatises of his Father concerning the Construction of this Logarithmical Canon, and concerning his De-

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fign (after Communication had with Mr. Briggs) of changing the Form of his Logarithms, making e, to be the Logarithm of 1, (of which he had before given Notice in the Preface to his Rabdologia, published in the Year 1617;) and concerning some things pertaining to Trigonometry; with some Lucubrations of Mr. Briggs on the

same Subject.

But the Lord Neper being dead the whole Work was devolved on Mr. Briggs, who (according to their joint Advice) making the Logarithm of 1 to be 0; and of 10, 100, 1000, &c. to be 1, 2, 3, &c. which he calls Indices, or Characteristicks, and which we may repute as Integer Numbers, with fourteen Cyphers annexed, and esteem or value as so many Places, or Decimal Fractions, below the Place of Units, or of the Characteri-ftick: And between these he sets the intermediate Logarithm for the Intermediate Numbers.

And consequently the Logarithm of 1 being 0, the Logarithm of Fractions less than 1, or of Numbers intermediate, between 1 and 0, must be Negative Numbers, or Numbers less than o, which he calls Defective Logarithms, denoted by

(the Note of Negative) prefix'd.

Now these Desective Logarithms may be two ways expressed; either so as that the Note of Negation shall affect the whole Logarithm, or so as to affect only the Characteristick, (leaving the Rest of the Logarithm to be understood as Af-

firmative.)

As for Example; The Fraction 3, or (which is equivalent) 0.375. This Fraction supposeth the Numerator 3 to be divided by the Denominator 8, which in Logarithms, is to be performed by Subtracting the Logarithm of 8, from that of 3, and the Remainder will be the Logarithm of 3, which will be then the Negative Number, -0.4259687.

Or thus; For as much as the Logarithm of 375, (supposing it to be an Integer Number) is 2. 5740313, And the depressing this to the First, Second or Third, or farther Place of Decimal Fractions, doth (without altering the Figures) divide the Value by 10, 100, 1000, &c. which in Logarithms is done by subtracting 1, 2, 3, &c. from the Characteristick, or Place of Integers (1, 2, 3, &c. in that Place being the Logarithms of 10, 100, 1000, &c.) such Alteration of the Value (the Figures remaining) is done by altering the Characteristick of the Logarithm, without varying the other Figures, in this Manner:

> Log. 3750=3. 5740313 375 = 2.574031337|5=1.57403133|75 = 0.5740313Log. Log. $0_{1375} = 1.5740313$ Log. 0|0375=2. 5740313

Which two Forms, tho' they seem different, and fome may rather chuse the one, some the other; or in some Cases the one, and in some Cases the other; yet they are in Substance and Value the

For, by sudducting the lower Number same. from the upper.

$$\begin{array}{r}
-1. & 0000000 \\
+0. & 5740313
\end{array}$$
is = -0. 4259687

And every one is left to his Liberty whether of the two Ways (or what other Equivalent there-

unto) he shall please to use.

In this Method Mr. Briggs hath calculated a Table of Logarithms (publifiled in the Year 1624) for 20 Chiliads of Absolute Numbers (from 1 to 20,000;) and again for 10 more (from 90,000 to 100,000) and one Chiliad supernumerary (viz. the Hundred and First Chiliad) that is, 31 Chiliads in all.

Before which is prefix'd a large Account of the Nature and Construction of the Logarithmical Canon, and the Uses thereof; and directing how to supply the intermediate Chiliads, which are here wanting. The whole intituled Arithmetica Logarithmica.

The same was again published in 1628, by Adrian Ulacq (or Flack) with a Supplement (as Mr. Briggs directed) of the Chiliads before omitted; that is, in all of 100 Chiliads, with one

Supernumerary.

But in shorter Numbers extended but to 10 Places below that of the Integers, or Characteri-And he subjoins also a Logarithmical Canon of Sines, Tangents, and Secants (for Degrees and Minutes of the Quadrant) of as many Places.

Mr. Briggs proceeded to calculate a Trigonometrical Canon, Logarithmical, suited to that for Absolute Numbers to the Logarithms extending (as in that other) to 14 Places besides the Characteristick. And having before calculated a Table of Natural Sines, Tangents, and Secants (for Degrees and Centesms of Degrees) in Number extending to 15 Places, he fitted thereunto a Canon of Logarithmical Sines, and Tangents (because those of Secants might be spared;) and a Treatise prefixed concerning the Construction thereof, with other Things pertinent thereunto: intending a further Treatife concerning the Use of it.

But dying before this last was finished, or the rest published, Mr. Henry Gellibrand supplied this latter, and published the whole with the Title of Trigonometria Britannica, in the Year 1633. To which is subjoin'd another Canon of Logarithmical Sines, and Tangents, by Adrian Olacq, for Degrees, Minutes, and Tenth Seconds, extending (as his former did) to 10 Places besides the Characteristick; and Mr. Briggs 20 Chiliads for Logarithms of Absolute Numbers.

So that the whole Doctrine of Logarithms was by this time sufficiently perfected, with convenient Canons or Tables fitted thereunto in large Numbers: Of which also Petrus Cragerus gives an Account in the Preface to his Trigonometria Logarithmica, Printed in the Year 1634, with his Lo-

garithmical Tables, but in short Numbers.

And the Table of Logarithms above-mentioned, (for 100 Chiliads of Absolute Numbers, and of Sines and Tangents to Degrees and Centesms) were the same Year (1633) contracted, into a lesser Form and more manageable (but in shorter Numbers, the former not extending to above 7



Places, beside the Characterifick, but the latter to 10) by Nathanael Row; with Directions for the Use of them (in Trigonometry, Geometry, Astronomy, Geography, and Navigation) by Edmund Wingate.

In the mean time, Benjamin Ursinus, did also publish Tables of Logarithms in the Year 1618; and Claudius Batschius about the same Time, or soon after. And again Benjamin Ursinus in the Year 1625, in his Trigonometria; and Johannes Keplerus also in the Year 1624, in his Chilias Logarithmorum (which he applies also to his Rudolphine Tables, published in 1627;) and Claudius Batschius about the same Time, or soon after: And Georgius Ludovicus Frobenius in the Year 1634, (and perhaps some others.)

But all or most of them in short Numbers, and conformable to the Lord Neper's first Design; not to that Form which upon second Thoughts he and Mr. Briggs agreed upon as most Eligible, and which hath since been received in common Pra-

ctice.

Thus far Dr. Wallis: What follows is the easie and compendious Method of Mr. Edm. Halley, Savilian Professor of Geometry in Oxon, for constructing Logarithms; which was mentioned in the former Volume.

The Invention, saith that excellent Geometer, of the Logarithms, is justly esteemed one of the most useful Discoveries in the Art of Numbers, and accordingly has had an universal Reception and Applause: And the great Geometricians of this Age have not been wanting to cultivate this Subject, with all the Accuracy and Subtilty which a Matter of that Consequence doth require; and they have demonstrated several very admirable Properties of these artificial Numbers, which have rendred their Construction much more facile, than by those operose Methods, at first used by their truly noble Inventor, the Lord Neper, and our worthy Country-man Mr. Briggs.

But notwithstanding all their Endeavours, I find very sew of those, who make constant Use of Logarithms to have attained an Adequate Nothin of them; to know how to make or examine them, or to understand the Extent of the Use of them; contenting themselves with the Tables of them, as they find them, without daring to question them, or caring to know how to Rectify them, should they be found amis; being I suppose under the Apprehension of some great Difficulty

herein.

For the Sake of fuch, the following Tract is principally intended, but not without hopes however, to produce something that may be acceptable to the most knowing in these Matters.

But first, it may be requisite to premise a Desinition of Logarithms, in order to render the ensuing Discourse more clear; the rather because the Old one Numerorum proportionalium aqui-differentes comites, seems too scanty to define them fully.

They may much more properly be said to be Numeri Rationum exponentes: Wherein we consider Ratio as a Quantitas sui generis, beginning from the Ratio of Equality, or 1 to 1 = 0; being Affirmative when the Ratio is Increasing, as of Unity to a greater Number, but Negative when Decreasing: And these Ratios we suppose to be measured by the Number of Ratiunculæ contained instead of 1 — ed in each.

Now these Ratiunculæ, are so to be understood,

as in a continual Scale of Proportions, infinite in Number between the two Terms of the Ratio; which infinite Number of mean Proportionals is to that infinite Number of the like equal Ratiunculae, between any other two Terms: as the Logarithm of one Ratio, is to the Logarithm of the other: Thus, if there be supposed between 1 and 10, an infinite Scale of mean-Proportionals, whose Number is 100000, &c. in infinitum; between 1, and 2, there shall be 30102, &c. of such Proportionals, and between 1 and 3, there will be 47712, &c. of them; which Numbers therefore are the Logarithms of the Rationes of 1, to 10, 1, to 2, and 1, to 3; and not so properly to be call'd the Logarithms of 10, 2, and 3.

But if instead of supposing the Logarithms composed of a Number of equal Ratiuncule, proportional to each Ratio; we shall take the Ratio of Unity to any Number, to consist always of the same infinite Number of Rassuncula; their Magnitude in this Case, will be as their Number in the former. Wherefore, if between Unity and any Number proposed, there be taken an Infinity of mean Proportionals, the infinitely little Augment or Decrement of the first of those Means from Unity will be a Ratiunculæ; that is, the Momentum or Fluxion of the Ratio of Unity to the faid Number: And seeing that in these continual Proportionals all the Ratiunculæ are equal; their Summ, or the whole Ratio, will be as the faid Momentum is directly; that is, the Logarithm of each Ratio, will be as the Fluxion thereof. Wherefore if the Root of any infinite Power be extracted out of any Number, the Differentiala of the said Root from Unity, shall be as the Logarithm of that Number.

So that Logarithms thus produced may be of as many Forms as you please, to assume infinite Indices of the Power whose Root you seek: As if the Index be supposed 100000, So. infinitely; the Roots shall be the Logarithms invented by the Lord Neper; but if the said Index were 2302585, So. Mr. Briggs's Logarithms would immediately be produced. And if you please to stop at any Number of Figures, and not to continue them on, it will suffice to assume an Index of a Figure or two more, than your intended Logarithm is to have; as Mr. Briggs did, who, to have his Logarithms true to 14, places by continual Extraction of the Square Root, at last came to have the Root of the 140737488355328th Power; but how operose that Extraction was, will easily be judged by whoso shall undertake to examine his Calculus.

Now though the Notion of an infinite Power may seem very strange; and (to those that know the Difficulty of the Extraction of the Roots of high Powers) perhaps imprasticable; yet by the Help of that admirable Invention of Six Isaac Newton, whereby he determines the Uncia, or Numbers prefixed to the Members composing Powers (on which chiefly depends the Doctring of Series) the Infinity of the Index contributes to render the Expression much more easie: For if the infinite Power to be resolved be put (after Sir Isaac

Newton's Method)
$$\frac{1}{m}$$
 or $\frac{1}{m}$ or $\frac{1}{m}$ $\frac{1}{m}$ instead of 1 $+$ $\frac{1}{m}$ $+$

 $1-6m+11m^2-6m^3$ (which is the Root when m is Finite) becomes $-q - \frac{1}{2m}q^2 + \frac{1}{3m}q^3 + \frac{1}{4m}q^4 + \frac{1}{4m}$ -q5, &c. m2, being Infinite, and consequently whatever is divided thereby vanishing. Hence it follows that — Multiplied into $q - \frac{1}{3} q^4 - \frac{1}{3} q^3$ - 4 94 + 191, &c. is the Augment of the First of our mean Proportionals between Unity and 1+q, and is therefore the Logarithm of the Ratio of 1, to 1 + q; and whereas the Infinite Index m, may be taken at Pleasure; the several Scales of Logarithms to fuch Indices will be as -; or reciprocally as the Indices. And if the Index be taken 10000, &c. as in the Case of Neper's Logarithms;

Again, if the Logarithm of a Decreasing Ratio be fought, the Infinite Roos of 1-q, or is $1 - \frac{1}{q} - \frac{1}{q^2} - \frac{1}{q^3} - \frac{1}{q^4} \frac{1}{5m}q^5 - \frac{1}{6m}q^6$ &c. whence the Decrement of the First of our infinite Number of Proportionals will be — into $q + \frac{1}{2}q^2 + \frac{1}{3}q^3 + \frac{1}{4}q^4 + \frac{1}{4}q^5$ $+\frac{1}{2}q^6$, &c. which therefore will be as the Logarithm of the Ratio of Unity to 1-q.

they will be simple $q - \frac{1}{2}q + \frac{1}{3}q^3 - \frac{1}{4}q^4 + \frac{1}{4}$

1 gi - 1 g6, &c.

But if m, be put 10000, &c. then the said Logarithm will be $q + \frac{1}{2}q^2 + \frac{1}{3}q^3 + \frac{1}{4}q^4 + \frac{1}{5}q^5 + \frac{1}{6}q^6$, &c. Hence, the Terms of any Ratio be-—, or the Difference diviing and b, q becomes ded by the lesser Term, when it's an Increasing Ratio; - when 'tis Decreasing, or as b to a. Whence the Logarithm of the same Ratio may be doubly expressed; for putting x, for the Difference of the Terms a, and b, it will be either $-\frac{1}{m} \times \frac{1}{b}$

But if the Ratio of a to b, be supposed to be divided into two Parts, viz. into the Ratio of a, to the Arithmetical Mean between the Terms, and the Ratio of the said Arithmetical Mean to the other Term b; then will the Summ of the Logarithms of those two Rationes be the Logarithm of

the Ratio of a to b; and substituting -- in-

stead of ----, the said Arithmetical Mean,

the Logarithms of those Rationes will be by the foregoing Rule;

foregoing Rule;

$$\frac{1}{m} \frac{x}{x^{2}} + \frac{x^{3}}{47} + \frac{x^{4}}{47} + \frac{x^{5}}{57^{5}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{77^{7}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{77^{7}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{77^{7}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{6}} + \frac{x^{6}}{47^{7}} +$$

be the Logarithm of the Ratio of a to b; whose Difference is x, and Summ z. And this Series converges twice as swift as the former, and therefore is more proper for the Practice of making of Logarithms: Which if performed, is with that Expedition; that whereas x, the Difference, is but the Hundredth-part of the Summ, the first

Step --- fuffices to seven Places of the Loga-

rithm, and the second Step to Twelve. But if Briggs's first twenty Chiliads of Logarithms be supposed to be made, as he hath very carefully computed them, to fourteen Places; the first Step above is capable to give the Logarithm of any intermediate Number, true to all the Places of those Tables.

After the same Manner may the Difference of the said two Logarithms be very fitly applied to find the Log. of Prime Numbers, having the Logarithms of the two next Numbers above and below them: For the Difference of the Ratio of a, to 17, and,

of $\frac{\pi}{a}$ to b, is the Ratio of a b, to $\frac{\pi^2}{a}$; and half

of that Ratio is that of \sqrt{a} b, to $\frac{1}{a}$; or of the

Geometrical Mean to the Arithmetical. And consequently the Logarithm thereof will be the half Difference of the Logarithms of thole Rationes

$$\frac{1}{m} \frac{xx}{2 \cdot 7 \cdot 7} + \frac{x^4}{4 \cdot 7} + \frac{x^6}{6 \cdot 7} + \frac{x^8}{8 \cdot 7}, \, \text{Cc.}$$

Which is a Theorem of good Dispatch to find the

Logarithm of $\frac{3}{2}$.

But the same is yet much more advantageously performed, by a Rule derived from the foregoing;

and beyond which in my Opinion, Nothing better can be hoped. For the Rasio of ab, to $\frac{?^2}{4}$, or $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ $\frac{ab}{4}$ $\frac{bb}{4}$ $\frac{ab}{4}$ \frac{ab}

Here note, that — is all along applied to adapt

these Rules to all Sorts of Logarithms. If m be 10000, Sc. it may be neglected, and you will have Neper's Logarithms, as was hinted before; but if you desire Briggs's Logarithms, which are now generally received, you must divide your Series by

2.30258, 50929, 94045, 68401, 79914, 54684, 36420, 76011, 01488, 62877, 29760, 33328:

Or, multiply it by the Reciprocal thereof, Viz.

0.43429, 44819, 03251, 82765, 11289, 18916, 60508, 22943, 97005, 80366, 65661, 14454.

But to save so operose a Multiplication (which is more than all the rest of the Work)it's expedient to divide this Multiplicator by the Powers of x, or y, continually ; according to the Direction of the Theorem; Especially where x is Small and Integer, reserving the proper Quotes to be added together, when you have produced your Logarithm to as many Figures as you desire, of which Method I will give you a Specimen.

If the Curiosity of any Gentleman, that has Leisure, would prompt him to undertake to do the Logarithms of all Prime Numbers, under 100000 to 25 or 30 Figures, I dare assure him that the Facility of this Method will invite him thereto; nor can any Thing more easy be desired. And to encourage him, I here give the Logarithms of the first Prime Numbers under 20 to 60 Places, computed by the accurate Penn of Mr. Abraham Sharp (from whose Industry and Capacity) the World may expect in Time great Performances, as they were communicated to me by our common Friend Mr. Euclid Speidall.

N. Log.
2 0.30102, 99956, 63981, 19521, 37388, 94724, 49302, 67681, 89881, 46210, 85413, 10427

3 0.47\12, 12547, 19662, 43729, 50279, 03255, 11530, 92001, 28864, 19069, 58648, 29876

7 0.84509, 80400, 14256, 83071, 22162, 58592, 63619, 34835, 72396, 32396, 54065, 03635

11 1.04139, 26851, 58225, 04075, 01999, 71243, 02424, 17067, 02190, 46645, 30945, 96539

13 1.11394, 33523, 06836, 76920, 65051, 57942, 32843, 08197, 29188, 38706, 82718, 01191

1.23044, 89213, 78273, 91854, 01698, 94328, 33703, 00075, 67378, 42504, 63973, 80368

19 1.27875, 36009, 52828, 96153, 63334, 75756, 92931, 79511, 29337, 39449, 75989, 06819.

The next Prime Number is 23, which I will take for an Example of the foregoing Doctrine; and by the first Rules the Logarithm of the Ratio of 22 to 23, will be found to be either

As likewise that of the Ratio of 23 to 24, by, a like Process.

$$\frac{1}{23} - \frac{1}{1058} + \frac{1}{36501} - \frac{1}{1119364} + \frac{1}{32181715}, &c.$$
or $\frac{1}{24} + \frac{1}{1152} + \frac{1}{41472} + \frac{1}{1327104} + \frac{1}{39813120}$

And this is the Refult of the Doctrine of Mercasor, as improved by the Learned Dr. Wallis.

But by the second Theorem, viz, $\frac{2x}{7} + \frac{2x^3}{7} + \frac{2x^5}{7}$, 3c. The same Logarithms are obtained by sewer Steps; To wit.

$$\frac{2}{-45} + \frac{2}{273375} + \frac{2}{922640625} + \frac{2}{2615686171875}, 6c.$$

$$\frac{2}{47} + \frac{2}{311469} + \frac{2}{1146725035} + \frac{2}{3546361843241}$$

$$\mathcal{C}_{c}.$$

Which was invented and demonstrated in the Hyperbolick Spaces analogous to the Logarithms.

by the Excellent Mr. James Gregory, in his Exercitationes Geometricæ; and fince further profecuted by the aforesaid Mr. Speidall, in a late Treatise, in English, by him published on this Subject. But the Demonstration, as I conceive, was never till now perfected, without the Consideration of the Hyperbola, which is a Matter purely Arithmetical, as this is, cannot so properly be applied. But what follows, I think I may justly claim as my own, viz. That the Logarithm of the Ratio of the Geometrical Mean to the Arithmetical between 22 and 24, or of $\sqrt{528}$ to 23, will be found to be either,

$$\frac{1}{1058} + \frac{1}{1119364} + \frac{1}{888215334} + \frac{1}{626487882248}, &c. or, & \frac{1}{1057} + \frac{1}{1057}$$

All these Series being to be multipled into 0.4342944819, &c. if you design to make the Logarithm of Briggs. But with great Advantage with Respect of the Work, the said 4342944819, &c. is divided by 1057, and the Quotient thereof again divided by three Times the Square of 1057, and that Quotient again by f of that Square, and that Quotient by thereof, &c. till you have as many Figures of the Logarithm as you desire. As for Example, the Logarithm of the Geometrical Mean between 22 and 24, is found by the Logarithms of 2, 3, and 11 to be

1.3613!696126690612945009172669805 41087462810146814347315886368 12258521544181829460074 6583235184376175 4208829765

Summ 1 . 36172783601759287886777711225117

From the Logarithm given to find what Ratio it

Which is the Logarithm of 23, to 32 Places, and obtained by five Divisions only, with very small Divisors; all which is much less Work, than simply multiplying the Series into the said Multiplicator 43429, Sc.

Before I pass on to the Converse of this Problem, or to shew how to find the Number appertaining to a Logarithm assigned, it will be requisite to advertise the Reader, that there is a small Mistake in the aforesaid Mr. James Gregory's Vera Quadratura Circuli, and Hyperbola, published at Padua, Anno 1667, wherein he applies his Quadrature of the Hyperbola, to the making of the Logarithms: In p. 43. he gives the Computation of the Lord Neper's Logarithm of 10. to 25 Places, and finds it 2302585092994045624017870, instead of 2302585092994045684017991; erring in the eighteenth Figure, as I was assured upon my own Examination of the Number I here give you, and by Comparison thereof, with the same wrought by another Hand, agreeing therewith to 57 of the 60 Places.

Being desirous to be satisfied how this Difference arose, I took no small Trouble of Examining Mr. Gregory's Work; and at length sound that in the inscribed Polygon of 512 Sides in the eighteenth Figure was a 0, instead of 9, which being rectified, and the subsequent Work corrected therefrom, the Result did agree to a Unit with our Number. And this I propose not to cavil at an easy Mistake in managing of so vast Numbers, especially by a Hand that has so well deserved of the Mathematical Sciences; but to shew the exact Co-incidence of two so very differing Methods to make Logarithms, which might otherwise have been questioned.

-L4 + -- L5, &c

24

and 1 - m L --

m⁵

L⁵, &c. will be any infinite Index when the garithm what it will.

expresses, is a Problem, that has not been so much considered as the Former, but which is solved with the like Ease, and Demonstrated by a like Process, from the same general Theorem of Sir Isaac Newton: For as the Logarithm of the Ratio of 1, to 1+q, was proved to be 1+q $\frac{1}{n-1}$, and that of the Ratio of 1, to 1-q, to be $1-1-q^{\frac{1}{m}}$: So the Legarithm which we will from henceforth call L, being given 1+L, will be equal to $\overline{1+g}$ in the one Case; and 1-L, will be equal to $1 - q|^{n}$, in the other: Consequently $\overline{1+L|_{-}^{\frac{1}{m}}}$ will be equal to 1+q, and $\overline{1-L|_{-}^{\frac{1}{m}}}$ to 1-q; that is, according to Sir Isaac Newton's faid Rule, 1 + m L + - L2 + - L3 + $-L^4 + - L^5$, C_c , will be equal to 1 + q, and $I - mL + \frac{m^2}{2}L^2 - \frac{m^3}{2}L^3 + \frac{m^4}{2}L^4 - \frac{m^4}{2}L^4$ LI, \mathfrak{C}_c will be equal to 1-q:m, being any infinite Index whatsoever; which is a full and general Proposition from the Logarithm given to find the Number, be the Species of Lo-

But

But if Neper's Logarithm be given the Multi-plication by m is faved (which Multiplication is indeed no other than reducing the other Species to his) and the Series will be more simple, Viz.

ries especially in great Numbers converges so slowly, that it were to be wished to be contracted.

If one Term of the Ratio, whereof L is the Logarithm, be given, the other Term will be had easily by the same Rule: For if L were Neper's Logarithm of the Ratio of a the lesser to b the greater Term ; b would be the Product of a into

$$\frac{L^{2}}{1 + L - \frac{L^{3}}{2} + \frac{L^{3}}{6}}, &c. = a + aL - \frac{aL^{3}}{2}$$

$$+ \frac{aL^{3}}{6}, &c. & But if b were given, a would be$$

$$bL^{3}$$

equal
$$b = bL + \frac{bL^2}{2} - \frac{bL^3}{6}$$
, &c. Whence by

the help of the Chiliads, the Number appertaining to any Logarithm, will be exactly had to the utmost Extent of the Tables. If you seek the nearest, next Logarithm, whether greater or lesser, and call its Number a, if lesser, or b if greater; then the given L, and the Difference thereof from the said nearest Logarithm you call 1; it will follow that the Logarithm L, answering to the Num-

ber, will be either a into
$$1 - l + \frac{l}{2} + \frac{l}{4} +$$

Series will converge the swifter. And if the first 20000 Logarithms be given to fourteen Places, there is rarely Occasion for the three sirst Steps of this Series, to find the Number to as many Places. But as for Ulacq's great Canon of 100000 Logarithms, which is made but to ten Places; there is scarce ever need for more than the first Step a + al, or a + m a l, in one Case; or else b - bl, or b m bl in the other, to have the Number true, to as many Figures as these Logarithms consist of.

· If future Industry shall ever produce Logarithmick Tables to many more Places than now we have; the aforesaid Theorems will be of more Use to deduce the correspondent natural Numbers to all the Places thereof.

In Order to make the first Chiliad to serve all Uses, I was desirous to contract this Series, wherein all the Powers of l are present, into one; wherein each alternate Power might be wanting, but found ir neither fo simple or uniform as the other; yet the first Step thereof is, I conceive, most commodious for Practice, and with all exact enough

for Numbers not exceeding fourteen Places, such as are Mr. Briggs's large Tables of Logarithms; and therefore I recommend it to common Use.

It is thus;
$$a + \frac{al}{1 - \frac{l}{2}}$$
, or $b - \frac{bl}{1 + \frac{l}{2}}$, will be

the Number answering to the Logarithm given, differing from the Truth by half the third Step of the former Series. But that which renders it yet more eligible, is that with equal Facility, it serves for Briggs's, or any other fort of Logarithms, with the only Variation of Writing, instead of 1,

the only Variation of Writing,
$$\frac{1}{m}$$
 instead of 1,

a l

that is $a + \frac{a}{1} - \frac{1}{2}$, and $b - \frac{b}{1} - \frac{1}{2}$, or $\frac{1}{m} - \frac{1}{2}$
 $\frac{1}{m} b - \frac{1b}{2}$

and $\frac{1}{m} + \frac{1}{2}$, which are easily resolved into Analogies. Viz.

logies, Viz.

As 43429, $\Im c. - \frac{1}{1}$: to 43429 $+ \frac{1}{4}$:: so is a to the Number sought. Or, As 43429, Sc. $+\frac{1}{2}$: to 43429 $-\frac{1}{2}$:: so is b to the Number sought.

If more Steps of this Series be defired it will be found as follows.

$$a + \frac{al}{1 - \frac{l}{5}} - \frac{\frac{1}{15}al^5}{1 - l} + \frac{\frac{1}{15}al^5}{1 - 2l}, \ \&c. \ As$$

may easily be demonstrated by working out the Divisions in each Step, and collecting the Quotes, whose Summ will be found to agree with our former Series,

Thus, I hope, I have cleared up the Doctrine of Logarithms, and shewn their Construction and Use independent from the Hyperbola, whose Affections have hitherto been made Use of for this purpose; tho this be a Matter purely Arithmetical, nor properly demonstrable from the Principles of Geometry; nor have I been obliged to have Recourse to the Method of Indivisibles, or the Arithmetick of Infinities; the whole being no other than an easy Corollary to Sir Isaac Newton's General Theorem for forming Roots and Powers.

How easily and compendiously Logarithms may be made according to this Method of Mr. Halley's, as also from the Quadrature of the Hyperbola; the Reader may be fully fatisfy'd from Mr. Hen. Sherwin's Introduction to his Excellent Mathematical Tables, Lond. 1705. where also is a Method for computing the natural Sine, Tangent, or Secant of any Arch, immediately from having only the Length of the Arch given, &c.

Some further Uses of the Logarithms not mentioned in Vol. I.

1. To find the Arithmetical Complement of a Logarithm.

Suppose 2.5065050 Begin at the Left-hand & Its Compt. Arith. 7.49349410 write down under it the Complement of each Figure to 9, but of the last to 10.

N. B.

N B. This is all one with subducting the Loga- Arithmetical Complements, will answer the End rithm from 10. 0000000. And its frequently of as truly as subtracting the Logarithms themselves. good Use to take the Complement Arithmetical of a Logarithm instead of the Logarithm it self; especially when there are Two or more Logarithms in had this Question about Interest. any Case to be subtracted : For then adding their

As suppose in the double Rule of Three, you

What is the Interest of 5173 l. for 321 Days at 6 l. per Centum?

Write down first the Arith. Comp. of the Logarithm of 100 = 8.000000 Next under it the Arith. Comp. of the Logarithm of 365 = 7.4377071 The Logarithm of The Logarithm of the Principal 5173 = 3.7137425 321 = 2.5065050The Logarithm of the Days

The Summ of all is the Answer = 2.4361058

For rejecting the first 2 in the Characteristick you will find the Number answering to the Logarithm 2.4361058 to be 272 l. 964. and Reason will direct you where to make your Decimal Points in the Numder 272964; for the Interest in that Time can't be so much as 2729 l. nor so little as 27 1. As well as the Rule determines that Number to confift of 3 Places of Integers, whose Characteristick is 2.

Therefore the remaining Figures .964 are a Decimal of a Pound, expressing something more than 19 Shillings.

2. And indeed all Questions of Interest are very eafily and expeditiously answered by the Logarithms.

As suppose; At 6 l. per Cent. what is the Interest of 15 l. 7 s. 6 d. for 12 Years?

Write down first the Logarithm of 1.06 which expresses = 0.0253058 the Rate of Interest.

Which Logarithm multiplied by 12 makes = 0.303669**6** Then write down the Logarithm of the Principal, Viz. of the Decimal 15. 875 = 1.2007137

The Summ of which Two last Logarithms added into one Summ = 1.5043833

> which is a Logarithm answering to the absolute Number, a Decimal expressing 31 l. 18 s. 10 d. $\frac{1}{2}$ q. nearly.

3. It will be very necessary rightly to understand the Use of the Tables of Logarithms with Numbers from 1 to 10, to be 10 or 100, from regard to Decimal Fractions. For the Rule for finding the Logarithm of a Fraction being; To fubtract the Logarithm of the Denominator, from the Logarithm of the Numerator, and to take the Remainder as the Logarithm of the Fraction required : That Logarithm of the Remainder, must always be the Logarithm of a Decimal Fraction, whose Value is the same with that of a Vulgar Fraction proposed.

Wherefore the most natural, easy, and useful Way to find the Logarithm of a Fraction is this:

Suppose the Index of the Logarithms of all 10 to 100, to be 11 or 101, from 100 to 1000, to be 12 or 102, from 1000 to 10000, to be 13 or 103, and so upwards: This being allowed, the Index of the Logarithm of a Number, one Place below Unity must be 9, or 99; if two Places below Unity, it must be 8, or 98; if three Places below Unity, it must be 7, or 97; if sour Places below Unity, then the Index must be 6, or 96; the Latter of these Ways is often convenient to distinguish the Index of a whole Number, from that of a Decimal Fraction, and often necessary when the Power of the Root of a Decimal Fraation is required.

Example, The Logarithm of \(\frac{1}{4} \) is found thus: 3 Log. 0.4771213

From which Subtract the Denominator, 4 Log. 0.6020600 From which Subtract the Denominator,

The Remainder is the Logarithm of .75 Log. -9.8750613

Note, That the Denominator of a proper Fraction, is always greater than its Numerator; so that supposing the Index of the Logarithm of 3, to be 10, or 100, the Index of the Remainder will be 9, or 99, (that is one Place below Unity) and the Rest of the Logarithms, except the Index, is found in the Table of Logarithms to an-Iwer to 75, 750, 7500, 075, 75, or any other

Number, whose two significant Figures are 75, and those which follow or preced, all Cyphers. It was the former of these Ways by which Mr. Briggs and Mr. Gunter made the Characteristicks of their Tables of Logarithmetick Sines, and Tangents; where it may be noted, when the natural Sine or Tangent, is a Decimal Fraction only, the Index is under 10; but where it is a mixt Num-

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ber, there the Index is 10, or more: For Example, The Natural Tangent of 5 Degrees is .0874887, the Artificial 8. 9419518; and the Natural Tangent of 85 Degrees, 11.430052, the Artificial is 11, 0580482.

But it is needless to use these new Indices, except some Term given ot sought, be less than an 4. To find the Logarithm of a Mixt Number.

Reduce the Number given into an Improper Fraction, then subtract the Logarithm of the Denominator, from the Logarithm of the Numerator, the Remainder is the Logarithm fought.

Example, Let 42 be the Mixt Number given; this reduced to an Improper Fraction is 17.

The Logarithm of the Numerator, viz. 57, is 1. 7558748 The Logarithm of the Denominator, viz. 12, is 1. 0791812

The Loarithm of $4\frac{2}{13}$, = $4\frac{75}{100}$, whose Logarithm is 0. 6766936

If the Fraction annexed be a Decimal, teek for in the whole Number to which it belongs; which it as if it were a whole Number, observing to is further illustrated by the adjoyning Table, prefix to its Logarithm a suitable Index; which where the Logarithms, except the Index, are the always is an Unit less than the Number of Places, same in these Eight Examples.

The Index of the Logarithm of 47500 is 4, because the Absolute Number consists of 5 Places, for the same Reason in 475, the Index of its Logarithm is 2, in 47.5 it is 1; but the Index of a Proper Decimal Fraction is so many Units as the Cyphers before it wants of 9, or 99; so the Index of .0475 is 8, or 98, and of .00475 is 7,

Numbers. Logarithms. 47500 1 4. 6766936 4750 6766936 6766936 475 6766936 47.5 0. 6766936 4.75 9.6766936 8.6766936 .475 | 99, or, .0475 | 98, or, 8.6766936 .00475 | 97, or, 7.6766936

Of raising Powers by Logarithms.

Multiply the Logarithm of the Number given by she Index of the Power required, the Product will be the Logarithm of the Power Sought: So the Logarithm of $32 = 1.5051500 \times 3 = 45154500$, the Logarithm of 32768, which is the Cube of 32.

In the Multiplication, or Raising of Powers, viz. Squaring, or Cubing, &c. of any Decimal Fraction by Logarithms; the Index of the Logarithm of the Product or Power, must consist of so many Units, as the Number of Cyphers inter-cepted between the Place of Units, and the first fignificant Figure in the natural Number wants of 9, 99, 999, &c. only to the Index of the Logarithm of the Power (i. e. the Square, or Cube, &c.) there will be such a Figure presix'd as wants an Unit of the Index of that Power, or Number, by which the Logarithm was multiplied: For

Example, Let the Cube of .009 be required; the Logarithm of .009 is 7. 9542425 × 3 = 23. 8627275 = .00000729, the Cube of .009, and the Index of the Logarithm of the Power, or Product is 3; therefore 6 Cyphers must preced the first fignificant Figure of the natural Number; and 2, is prefix'd fince the Index or Number multiplying was 3. But when the Number of Cyphers, preceeding the fignificant Figures of the Power or Product exceeds 10, its necesfary to admit another Figure into the Index of the Logarithm, and make it the Complement to a Hundred: As suppose the 6 Power, or the

Cubo - Cube of the Sine of o-1 be requir'd its Logarithm in the Table is 4637261; but in Vol. IL

this Case must be 96. 4637261, which multiplied by 6, the Index of the Power proposed, becomes 578. 7823566, whose Index being 78, subtracted from 99, leaves 21 for the Number of Cyphers, that must preceed the first Figure of the natural Number or Power, which is gures preceeding the Index, as the Result of the Multiplication is 5, less by an Unit than the Number multiplying, being 6, the Index of the

This suggests a certain Rule for Extracting the Roots of Fractions by the Logarithms; Viz. Prefix a Figure to the Index of the Logarithm of the Number whose Root is to be Extracted, less by an Unit than the Index proper to the Root required, which is to be the Divisor; then Divide the whole Logarithm together with its Index whose Logarithm is 78. 7823566, be demanded; prefix 6—1, i. e. 5 to its Index, it is then 573. 7823566; which being divided by 6, the Index proper to the Root fought, the Quotient is 96. 4637261, whose natural Number is .0002908882; 3 Cyphers preceding the first Figure, because the Index 96, wants so much of 99. But when the Root of an absolute Number 199. ber is required, there needs no Figure to be pre-fixed to the Index of its Logarithm; fince it is always supposed, that the Index of the Power (which must be the Divisor) preceeds it. Ex. Gr. If the Cube-Root of 6751269, whose Logarithm is 6. 82993854, be required; it is an Kkk

indifferent Thing, whether 3, the Index of the Root to be Extracted, be prefixed or not, fince that alters Nothing: For 3)36. 82993854(Quotes 12. 2764618, the Logarithm of 189, the Cube-Root fought.

Another Method to Raise any Powor of a Decimal Fraction.

Multiply the Arithmetick Complement of the Logarithm of the Fraction given by the Index of the Power required, the Arithmetick Complement of the Product is the Logarithm of the Power fought: For inftance the .625 Power of .0032 is found to be .0275879.

.0032 Logarithm 7. 5051500 Arithmetick Complement 2. 4948500 Multiply by .625

> 124742500 49897000 149691000

Product 15592812500

Its Arithmetick Complement 8.4407187500

Note, That so many Cyphers must the Logarithm of .0275879, preceed the Fraction as the Index of its Logarithm wants Units of 9, or 99, which in this Example is one, and in the next 15, quired.

being always the same Number with the Index of the Product.

Again, Let the 6. 25 Power of .0032 be fought: The Logarithm of .0032 (as before) is 7. 5051500, and its Arithmetick Complement 2. 4948500 x 6. 25 = 15. 5928125, its Arithmetick Complement is 84. 4071875, which answers to .00000, 00000, 25538, which is the 6. 25 Power of .0032.

To extract any Root of a Decimal Fraction.

Divide the Arithmetical Complement of the Logarithm of the Fraction given, by the Index of the Root required, the Arithmetical Complement of the Root fought: For inftance, let the .625 Root of .0275879 be required, its Logarithm is 8.4407188, and its Arithmetical Complement = 1.5592812 Divided by .625, the Quotient is 2.4948500, and its Arithmetick Complement is 7.5051500 the Logarithm of .0032, which is the Root required.

Again, Let the 6. 25 Root of .00000, 00000, 00000, 25538 be required, its Logarithm is 84. 4071875, and its Arithmetick Complement is 15. 5928125, Divided by 6. 25, the Quotient is 2. 4948500, and its Arithmetick Complement is 7. 5051500, the Logarithm of .0032 the Root required.

LOGISTICA Lines, is that which is otherwife called the Logarithmick Line; where the Ordinates apply'd in equal Parts of the Axis are in Geometrical Proportion.

LOGISTICK Spiral. See Logarithmich

LONGITUDE of a Place, is only the Distance counted in the Equator between its Meridian, and the first; or indeed between that and any other: It may be found by the Difference of Time between the coming of any Point in the Heavens first to one Meridian and then to the other. For every 15° of the Equator answering to an Hour in Time, one Degree of it being 4 Minutes of Time, and one Minute of a Degree there being 4 Seconds of Time; and 15 Minutes one Minute of Time. The Difference of Time being mrned into Degrees will truly give the Longitude, or Vice Verso. Hence several Ways have been thought of to find the Longirude at Sea; the great Desideratum of the Art of Navigation. As by the Eclipse of the Moon, her Transis over or Appulse to any eminent fix'd Star; the Eclipses of Jupiter's Satellites, &c. which are all true in Theory, and may be practifed a-shore with the greatest Exactness. For the Time of any one of these Phanomena being truly calculated for the Meridian of London (suppose, or any other:) And Tables may be easily made of all of them, which the Navigator may carry to Sea with him. If then he could but observe the Time of the Eclipse or Transit at Sea with accurate Exactness, the Difference of Time of the Eclipse happening to him sooner or later than at London, would give him the exact Longitude of the Place of the Ship either East or West from the Meridian of London. But the Misfortune is, such an Observation of an Eclipse, and the exact Time of the Impression or Emersion of the desicient Body into or out of the Shadow, is not to be made without Telescopes of fuch a Length as the Metion of the Ship will not ermir to be used at Sea. Tho, by the by, if Ships were sent with good Instruments and Men that know how to use them, to do this at all the Capea and Head-lands of the World, it would be a Thing of the greatest Use; and by settling the Longitude of all those Places, would cut all long Voyages into many short ones, and afford means of continually rectifying the dead Reckoning at Sea. But to return: Others being fully satisfied of the Improductableness of the Method of Eclipses for finding the Longitude at Sea; have happily thought of doing it by a Clock of Watch: Which if indeed it could be made to go right all the Time of a long Voyage, would infallibly give the Longitude at any Time when the true Hour of the Day or Night could be had under any Meridian or in any Place of the Earth: For the Clock going true for the Meridian it was first fer at, will shew the true Hour exactly in that Place, and then the true Hour being found by the Sun or Stars in the Place where the Ship is, the Difference between that and the Clock's Hour, will be the Difference of Meridians in Time, or Longitude in Degrees. But no such Movement hath ever yet been made, and I fear scarce ever will, which will keep going, and going true in all Climates, and especially in some of the Southern ones; where the Dews are so great as to rust the Parts of it, and so retard, if not Rop its Motion enfrom the Motion of the Ship, Because I believe that may be obviated, and a Movement made to go true notwithstanding that, as perhaps the World may see in some Time, there being now some very ingenious and skillful Heads and Hands employing themselves that Way. But in the mean while, I judge the best Way would be to depend on the Movement only for 24 Hours; for if it will go true for so long by the Motion of the fix'd Stars, it may be rectifyed every Day to the Stars or Sun's Hour; and so will show the Difference of Longitude the Ship hath gained in that Time. How the Seamen find their Departure of Longitude by Trigonometrical Calculation, you will find in Plain and Mercators Sailing.

LOOP, in the Iron Works at the Forge; is the Term for about 4 of C. Ib. of Iron which is melted and broken off from a Sow in the Fire of the Pinery, and at last is brought into a Bloom. This

Work they call Shingling the Loop.
LOOP-HOLES, are Holes made in the Comings of the Hatches of Ships, and in their Bulkheads, to fire Muskets thro' in a close Fight; and the same are they in the covert Defences of all Fortifications.

LOPHIA, a Term in Anatomy, for the upper Part of the Cervix, or back Part of a Humane

LOQUELA fine dle, was formerly the Term for an Inparlance or a Respite in Law; or for a Demur to an Indefinite Time.

LOT, or Lotbe, is every thirteenth Dish of Lead in the Derby-shire Mine, which is a Duty

paid to the King

LOURGULARY, is a Word in Statute pro Stratis Lond. printed A. D. 1573. Art. 43. and then fignified, casting any corrupt Thing into it, to spoil or poyson the Water.

LUCRATIVE Interest, in the Civil Law, is fuch as is paid where there hath been no Advantage made by the Debtor, and no Delay nor Deceit in him. This is condemned by both the Civil and Canon Law.

LUNDRESS, did formerly fignify a Silver Penny; or a Sterling or Easterling in a restrained Sente, and was so called, because coined only at: London and not at the Country Mints.

LUNE or Lunula. In Phil. Trans. N. 265. you have a Way to find the Dimensions of the Solids, which will be formed by the Revolution of the Lunes of Hippocrates of Scio, by Mr. Abr. de

LUNGS. These Organs of Respiration are seated in the middle of the Cavity of the Thorax; and divided into two Lobes by the Mediastinum, of which, the left is ordinarily subdivided into 2 The Figure of both Lobes together resemble the Foot of an Ox or Cow, being a little concave between the 2 Lobes, where they embrace the Heart; and behind, wherethey lie upon the Vertebra: But before, where they touch the Sternum and Ribs, they are Convex.

The Colour of the Lungs in a Fatus is of a pale Red; but after the Air hath once entred into them they lose their Red, and remain always pale; yet' in adult Persons, they are often variegated with

the one and the other,

They are tied to the Sternum by the Mediasti-num before, and to the Vereebra by the Plura behind, when it rifes from the Vertebræ to the Heart, airely, I don't mention the Inconvenience arising by the Vena and Arteria Pulmonaris; and some-Kkk 2

times to the Pleura, where it covers the Ribs, particularly in the left Side, and especially after

Pleurily.

The Lobes of the Longs are covered with a double Membrane; of which the External is a Production of the Pleura; and the Internal, not only covers immediately the Subfance of the Longs has in inner Longing fill up the Interffices. Lungs, but its inner Lumina fill up the Interftices which are below the Bunches of the small Lobes with little veneular Cells: The fine Capillary Blood-Vessels are so thick upon this Membrane, that it seems to be Nothing but a Net-work of Veins and Arteries.

The Substance of the Lungs is composed of an infinite Number of little Lobes of various Figures and Magnitudes; but their Surfaces are so adapted to one another, as to leave but very few, and

those small Interstices.

These Lobes are disposed like so many Bunches of Grapes upon the Sides of the Bronchia. little Lobe contains within its own proper Membrane an infinite Number of little orbicular Vei-Sels, which leave small Interstices between them; and which are full of small Membranes, like shole which tie the Lobes together.

The Extremities of the Branches of the Windpipe open into the Cavities of Vesicles, which are probably formed by its Membranes; but the Capillary Blood-veffels are only spread upon the Vescles like a Net, with frequent and large Inoscu-

lations.

The Vessels which enter the Lungs are the Traches or Aspera Arteria, by which we draw in and expire Air: And the Arteria Pulmonalis, which comes from the Right Ventricle, and the Vena Pul-menalis, whose Trunk opens into the left Anricle of the Heart: Each of these divides into two Branches, for the two great Lobes of the Lungs, where they are subdivided into as many Branches as there are little Lobes or Vesicles in the Lungs. Whete-ever there is a Branch of the Trachaa, there is also a Branch of the Vein and Artery, and the Trachas is always in the middle.

On the Branches of the Trachaa (which they call the Bronchi or Bronchia) runs a small Artery called by Ruysh, Arteria Bronchialis, and a small Vein, which Somnichellius calls Vena Pneus The Artery comes from the Aorta, the Vein from

the Subclavian.

The Blood in the Arteria Pulmenalis being of the Nature of Venal Blood, and all Secretion being performed in the Arteries, the Nourishment for the Lungs must be brought by the Arteria Bronchialis: And there is the same Contrivance for the Nourishment of the Liver.

Upon the Bronchia, even to their minutest Ramifications, run likewise the fine Thread of the

eight Pair of Nerves.

Besides these, the Lungs have also Lympherich; which discharge themselves into the Thoracick Du&; but they are smaller, and make more frequent Inolculations, almost than any other.
This is the Passage of the Vessels thro the Lungs;

but because the Trachaa hath a particular Stru-Aure, it demands a particular Examination.

The Traches then, or Aspers Arteris, is a Canal fitnated in the first part of the Neck, before the Oesophagus; its upper End is called Larynx, from whence it descends to the 4th Versebra of the Back, where it divides and enters the Lungs; this Canal is made of Annular Cartilages, at imall

and equal Diftances from one another: And these grow smaller fill as they approach the Lungs; and those of the Bronebi are so close to one another, that in Expiration, the second enters with the first, and the third with the second, and so the following always enters into the preceeding

Betwixt the Larynx and the Lungs, these Cartilages make not compleat Rings; but their hinder Parr, which is contiguous to the Oefopbegus, is membranous, that they may the better contract, dilate, and give Way to the Aliments, as they go down the Osfophagus. But the Carrilages of the Bronchi are compleatly Annular; yet their Capillary Branches have no Cartilages; but instead of them fmall circular Ligaments which are at pretty large Distances from one another. The use of the Carrilages is to keep the Passage for the Air always open; but in the Capillary Bronehi, they would hinder the subsiding of the Vessels.

These Cartilages are tied together by two Memranes, the one Exernal the other Internal. External is composed of circular Fibres, and covers the whole Trachas externally, The Internal is of exquisite Sense, and it covers the Cartilages internally. It is composed of three distinct Membranes: The first is woven of two Orders of Fibres; those of the first of which are Longitudinal, for the shortning of the Traches, and these make the Cartilages approach to and enter one another. The other Order is of Circular Fibres, for the contracting the Cartilages. When these two Orders of Fibres act, they help, with the External Membrane, in Expiration, in Coughing, and in altering the Tone and Notes of our Voice.
The fecond Membrane is altogether Glandulous,

and the Excretory Vessels of those Glands open into the Cavity of the Trachea, in order to moisten its Cavity by a Liquor which they separate; and to defend it from the Acrimony of the Air.

The third and last Membrane is a Net-work of Veins, Arteries and Nerves: The Veins are Branches of the Cava; the Arteries of the Caraci-

des; and the Nerves of the Recurrent.

From the Structure of the Lungs thus described, Dr. Piecairn bath deduced Mechanically the great effect, they by means of the Air produce upon the Blood. For while the Fasts is in the Womb, the Venicles of the Lungs lying flat one upon another, compress all the Capillary Blood-vessels which are spread upon them; but as soon as it is born and alive, the Air rushes into the empty Branches of the Traches, and blows up the Vencles into their Spherical Figures; by which Means, the Pressure or Compression being taken off from the Bloodvefiels, and they equally expanded with the Lungs, all the Blood hath a free Passage thro' the Pulmonary Artery. But when the Air is thrust out again by the Contraction of the Cavity of the Thorax, it being a fluid Body, compresses the Vesicles and Blood-vessels upon them every where equally. By which Compression the red Globules of the Blood, which thro their lanquid Motion in the Veins, were grown too dry to circulate in the fine Ca-pillary Vessels, are broken and divided again in the Serum, and the Blood made fit for Nutrition and Secretion.

This Pressure of the Air upon the Blood-vessels, Dr. Keil saith, he hath demonstrated to be equal to 100 lb. weight; and in Coughing or Crying,

it may exceed 400 lb.

But

But the these are the necessary Consequents of Respiration, yet several Experimens incline him to think, that some Particles of the Air must likewise enter the Blood-vessels, and mix with the Blood in the Lungs.

For, first, he saith he is assured, from repeated Experiments, that Air will escape the Pores of any Number of Bladders, when compressed only by the Weight of the Water, into which it is sunk; and therefore the Pressure of 100 lb. Weight in ordinary Respiration, must thrust some Particles

of it into the Blood-vessels.

2. The Honourable Mr. Boyle, in his New Pnoumatical Experiments, shews us, That Animals cannot live when shut up in common Air, tho' by a Gauge he hath sound it to retain its wonted Prefure; and tho' the Receiver hath been immersed in Water cooled with a Solution of Sal Armoniae. The same Experiments assure us, That Animals will live longer when shut up in compress'd Air than in common Air, and that when they are dying in the common Air, they may be revived by

preffing in more fresh Air.

3. It may be demonstrated, (saith the same Dr. Keil) That the Difference between the Gravity of the Air in the City, and that of the Country, (which can be but very small, upon the Account of the Effluvia, as the Barometer shews it to be) can never be the Cause of that Difficulty of Breathing, which some have in the one and not in the other; for they are not near so sensible of the different Gravities of the Air in the same Place, as they are of a much smaller Difference in two distinct and remote Places, where the Contents of the Air are different.

The Lungs are composed of an infinite Number of little Lobes, of different Figures and Magnitudes, but yet so joyned as to leave but small Vacuities behind them. Each Lobe consists of an Infinity of small Spherical Vesicula formed by the Coats of the small Branches of the Trachas; so that they may be confidered, when blown up, as so many fine Tubes ending in fine hollow Spheres. On the Sides of these Vesicala, the Blood-vessels are spread in a fine Net-work: But before the Fasus is brought to light, these Vesicula lie flat on one another, and by their Pressure on the Bloodwessels hinder its Passage thro them; but as soon as the Fatus enjoys the Benefit of the Air, that doth by its Weight and elastick Force, rush in thro' the Pipes of the Trachas into these Vesicula and blows them up; whereby they stand erect on the Trunks of those like Wind-pipes, and give a free Passage to the Blood thro these Vessels spread upon their Sides. And when by the Weight of the Thorax, and the Acts of its Muscles, together with those of the Abdomen and Diaphragma, this Ela-flick Fluid, the Air, is thrust out of those Vesseula thro' the Traches in Expiration, these Veficula pressing one against another, and the elastick Fluid acting on their Sides, and consequently on the Blood-Vessels thereon spread, separate the Globules of the Blood from one another, render it more capable of Circulation, in the narrow Pas. fages of the Capillary Vessels.

And there seems to be a yet more considerable Use of this Natural Function behind; which is, so form shose Blastick Globules of which the Blood principally consists. It is undoubted Fact and Observation, that the Blood consists of a Lympha, which is the common Vehicle, several Salts, Ra-

mensa of a thick Confistence (which is probably the unformed Part of the Chyle and Aliment) and these Globules of which we are now speaking, tho fometimes they are of different Colours, as White, Blue, Parple : This any one may discover with an ordinary Microscope. Now tis certain that these Globules may be burft, as in Obstructions; and all exhausted, as in violent Hamorrhages, and yet be all recovered and recruited again; wherefore they must be formed, formewhere in the Body, from the Chyle. And fince tis certain that they are nor folid Particles, as appears both by Ocular Inspection and Truth; also that they do actually change their Globular Figures into those of Oblong Spharoides, as they move thro' the Capillary Vessels; as therefore from their Colour, and from their being coagulated by Acids, and having their Figures destroyed; it is highly probable, that they may be listle Bubbles blown from the viscid Pars of the Chyle, by the Force of some more subtle elastick Aura. Now no Place in the Body can afford this elastick Fluid, but the Lungs ; and this may be the Reason why the Chyle enters into chose swo Voins only, which are just returning into the Heart immediately to be fent into the Lungs. For fince in our gross Element of Air, there is always lodged a finer Elastick Fluid, which is the principal Agent in all the subtle Effects commonly ascribed to the other: tho' the groffer Element cannor, yet this finer Fluid, (by the vast Force used in Expiration) may be thrust in thro the Sides of these Vesicula, to the Blood-vessels. And fince these Blood Globules must be generated somewhere, and that there is no Place in the Body, this subtle elastick Fluid can be squeezed thro with sufficient Force to get into the Blood thre' the Sides of the Blood-veffels, but in the Lungs: 'tis very probable these Globules are these formed, after this manner. The viscous Part of the Chyle being by the shortest and safest Course possible brought into the returning Part of the Blood, is sent from the right Venericle of the Heart to the Lungs, and is spread upon the Sides of the Vesicula thereof in little fine Tubes: this fine fluid Elastick being squeezed, in the Act of Expiration, thro' a Pore, continued thro' the Veficle of the Lungs and the Side of the Bloodvessels, is forced into the viscous Part of the Chyle now running by in the Serum, and by its perpendicular Pressure on the Sides of that Cavity it forms, produces a little small Bubble, of a determinate Magnitude and Thickness of Shell, from whence is hath its Colour : After this, by the Force of the succeeding Fluid, this little Bubble is broken off from the Pore, and carried along the Arrery; and the Cohesion of the Parts of the Shell of this Bubble being greater than the Force from without, whereby the thin Serum acts upon it, it is preserved in its Figure in all the various Morions of the compound Fluid of the Blood. And if it happen that these little Bubbles should be burst (as they most certainly are by 1000 Canses) whenever they come, to the Lungs they are new formed again; whereby the Circulation is render'd conftant and uniform. For mould these Bubbles be all destroy de there must of Necessity rise a general Obstruction in all the Capillary Arteries. An Instance of the Fermation of such kind of little Bubbles a Mixture of Oyl and Vinegar affords, for that look'd on thro a Microscope, appears to be nothing but an Infinity of such like little Bubbles, formed by the Immission of the Air and Vinegar into little Shells

of Oyl. Vid. Cheyne's Phil. Princip. of Natural

Religion, p. 214.

LUNI-SOLAR Tear, in Chronology, is a Period made by multiplying the Cycle of the Moon (or 19) into that of the Sun, which is 28; which is 532: and in this space of Time 'twas thought, the Sun and Moon would come to be together again exactly.

LUSHBURG, 2 was a base Sort of Coin LUSHBOROW, 3 used in the Days of King Edw. III. which was coined beyond Sea to counterfeit the English Money; wherefore by a Statute in 25 Ed. 3. c. 2. it was made Treason for any one designedly to bring them into the Kingdom.

LUTHERNS, a sort of Windows in the Roof

of a House. See Dormers.

LYE under the Sea, is the Mariners Term for a Ship, which having her Helm lash'd fast a-Lee, lies so a-Hull, that the Sea breaks upon her Bow, or Broadside.

LYEF-YELD or Leff-Silver, was formerly a small Fine or pecuniary Composition, paid by the Customary Tenant to his Lord, for Leave to plow

LYMPHEDUCTS, are slender pellucid Tubes, whose Cavities are contracted at small and unequal Distances by two opposite Semi-lunar Valves, which permit a thin and transparent Liquor to pass through them towards the Heart, but which are shut up like Flood-gates on its returning. They rise in all Parts of the Body, but after what Manner needs no great Dispute; for without Doubt all the Liquids in the Body, excepting the Chyle, are separated from the Blood in the sine Capillary Vessels by a different Pipe from the common Chanel in which the rest of the Blood runs: But whether this Pipe be longer or no longer than the Thickness of the Coat of the Blood-vessel, whether

it be visible or invisible, it is fill a Gland whilst it fusfers some Parts of the Blood to pass thro' it, denying a Passage to others. Now the Glands that separate the Lympha are of the smallest kind, being invisible to the finest Microscopes ; but their Excretory Ducts, the Lymphasick Vessels, unite with one another, and grow larger as they approach the Heart; yet they do not open into one common Channel, as the Veins do; for sometimes we find 2 or 3 more Lymphæducksrunning one by another, which only communicate by short intermediate Ducts, or which unite and immediately divide again. In their Progress they always touch at one or two conglobate or veficular Glands, into which they discharge their Lympha. Sometimes the whole Lymphæduct opens at several Places into the Glands, and sometimes it sends in only two or three Branches whilst the main Trunk passes over and joyns the Lymphæducks arising from the opposite Side of the Glands, exporting again the Lympha to their common Receptacles. The Glands of the Abdomen which receive the Lymphæducts from all the Parts which it contains, as likewise from the lower Extremities, are the Glau-dula Inguinales, Sacra, Lumbares, Mesenterica, and Hepatica; all which fend out new Lymphaducts which pour their Lympha into the Receptaculum Chyli, as those of the Cheft, Head and Arms do into the Ductus Thoracicus, Jugular and Sub-clavian Veins. The Defign of the Lymphæducts emtying themselves into the conglobate Glands feems to be, that the flow Lympha may receive a new Velocity from the Elastick Compression of the Fibrous Cells of those Glands, whose Fabrick resembles that of the Spleen; and therefore they are improperly called Glands, because they separate no Liquor from the Blood. Set Keill's Anatomy. p. 52.

MAG

MACE-GRIEF, alias Macegreffe, Machearii; are such as willingly and knowingly buy or sell stollen Flesh.

MAGAZINE or Arfenal, is the Place in Fortified Towns, &c. where all forts of Stores are kept, and where Carpenters, Wheel-Wrights, Smiths, &c. are employed in making all things needful to furnish out a Train of Artillery.

MAGBOTE, was formerly a Recompence made in Money, or otherwise, for slaying or murdering one's Kinsman; for sometimes the Corporal Punishments in such Cases due were transmuted into Pecuniary Fines; when the Friends or Relations of the Party slain, were so content. Leg.

Relations of the Party slain, were so content. Leg. Canuti Regis T. 1, c. 2.

MAGNETISM. See Mr. Derham's Experiments and Reasonings on this Subject in Phil. Trans. N. 304. where he acquaints us, That he found (as Grimaldi and De la Hire had in Part done before) that a Piece of very well touched I ron Wire would, upon being bent round into a Ring, or coil'd round upon a Stick, Sc. most times quite loseits Verticity, and always have it much diminished thereby, But yet that if the whole

MAG

length of the Wire were not entirely bent, so that the Ends of it, tho' but for the length of one tends of an Inch, were less thrait; then the Vertue would not be destroyed in those Parts or Ends; tho' it would every where else. He found also, on repeated tryals, that tho coyling or bending the Wire as abovelaid, would always in the Day-time diminish and most times destroy the Verticity of a touch'd Wire; yet it would not do it in the Evenings: And he saith, he knows very well, that the Orb of the Activity of Magnets is larger or less at different times; which is confirmed by what is sound in Fact to be true of our noble large Load-stone which is kept in the Repository at Gressam College; for that will keep a Key or other Piece of Iron suspended to another, sometimes, at the Distance of 8 or 10 Foot from it; but at other Times, not beyond the Distance of sour Foot.

He found also, that swifting the Wire would considerably diminish, and sometimes destroy the Verticity; which in some Tryals made: on twisted Wire, was so confused and disordered; that he found by drawing one of the Poles of a Louidsone along near the Sides of the Wire, in some Placesit would

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attract, in others repell, and so attract and repell all along the Wire; and he fancy'd in some places, that one side of the Wire would be attracted and

the other repelled by one and the same Pole.

After this he try'd what fplitting or cleaving the Wire would do; and in particular, whether split Wires would have the same Properties as Load. stones cut asunder, and he found the Phanomena of this Experiment very odd; for sometimes the Poles of the Wire so split would be quite changed; so that the South Pole would become the North, in all Respects: Sometimes one half of the Wire would retain its Magnetism which it had before its splitting, and the other half would have it

quite changed, &c.

He observed also one thing to be very surprizing in these split Wires; which was, That laying one, or the other Side of the Half uppermost, would cause a great Alteration in its Tendency or Aversion to the Poles of the Magnet: But if you lay the contrary fide of that half uppermost, the same End shall be attracted by one and repelled by the other Pole, In other Pieces where the Ends are regularly attracted or repelled, only in an inverted Order (as if new touched) if it lay with the round fide uppermost at that time, and be then turned upside down, viz. the flat cleft side uppermost; it is ten to one, he saith, that one of the Ends is either attracted by both the Poles, or repelled by both; or else attracted and repelled by one, and

in Hesitation by the other.

He touched a Wire from End to End with only one Pole of the Magnet; which gave it so vigorous a Vertue, that he is almost of Opinion, 'sis the best Way of touching; the Consequence was, that the End where he began always turned contrary to the Pole that touched it: He then touched the same Wire (and others likewise) with the other Pole of the same Magnet, from the same End, and then that End turned the contrary Way. For Instance, mark one end of the Wire for the North End, and touch that Wire by drawing the North Pole of the Magnet divers times along the Wire from the North to the South End: This Wire so touched shall have a vigorous Verticity; but the North End shall stand South. But if you touch that or another Wire, (for it is all one, the latter Touch destroying the former) by drawing the North Pole of the Magnet from the South to the North End of the Wire, then this North End will turn North: And so it will be if you touch with the Southern Pole from the North to the South.

He found also, that if he touc'd an Iron Wire exactly in the Middle with but one Pole of the Loadstone, without drawing it backwards or forwards, in that Place would be the Pole of the Wire; and the two Ends would be the contrary Pole of the Wire, and were accordingly repelled or attracted by the Poles of the Magnet; and the middle, and about an Inch more on each fide, was attracted only by the Pole that touched it.

MAILE, was anciently a Kind of Money, as fome think; for Mailes were Half pence in Henry the Fifth's Time; being the half of the Silver Sterling or Penny: But more largely it seems to have been any Proportion of Grain, or any other Rens. This latter in the North is called Black-mail. See Black-mail in Val. I.

MAIN BODY, of Troops in an Army, is that which marches between the Advance and the Rear

Guard; and in a Camp, that which lies between the two Wings

MALETENT, or Maletolse; in the Statute called the Confirmation of the Liberties, 25 Ed. 1'c. 7. is interpreted to be a Toll of 40 s. for every Sack of Wooll; and in the Statute de Tallagio non concedendo in the 36th Year of the same King Edw. 1. sis appointed, that Nothing for hereafter shall be taken of Sacks of Wooll, under the Pretence of Maletent. It seems to come from maliem Felo-

MAL-VOISIN, was formerly the Name of a warlike Engine used in battering of Walls to cast Stones, &c. It was so called, because it was an ill or dangerous Neighbour.

MAN-BOTE, was formerly a Recompence for Homicide, or a pecuniary Compensation for kil-

ling a Man.

MANCA, was formerly a square Piece of Gold, commonly valued at 30 Pence; and Mancusa was as much as a Mark of Silver. See Canute's Laws. Twas called Mancusa, quasi Manu cusa.

MANCUSA. See Manca.

MANCIPLE, a Caterer; there was anciently an Officer in the Temple called by this Name. now the Steward. And the Name and Office is retained still in our Colleges, in both our Univer-

MANNER; besides what hath been said about Manner, I must take notice that they say in Archi-testure, That an Order Heroically and Giganti-cally designed; where the Division of the principal Members is put into a few Parts; but those having all a bold and ample Relievo, is after the Grand Manner. As for Example, in a Corniche, if the Gola or Cimatium of the Corona; the Coping, the Modillions or Dentelli make a noble Appearance by the Gracefulness of their Projectures; and that we see none of that ordinary Confusion which results from those little Cavities, quarter Rounds of the Astragal, and such little Ornaments as produce no effect in great and massy Works, and which do impertinently justle out the graceful and principal Members; then will the Manner of this Corniche appear folemn and great, and approve it self to be performed after La Grand Maniere. In Mr. Evelyn's Parallel of Ancient and Modern Architecture, Chap. 5. p. 25. you have a fine Draught of this Grand Manner, in an ancient Dorick Pillar which was found at Albano, joining to the Church of St. Mary near Rome.

MANSE, is a Parsonage or Vicarage-House for the Incumbent to live in, and was originally, and is now, an essential Part of the Endowment of a Parish-Church, together with the Glebe and

MANUALIA Beneficia, were formerly such daily Distributions or Portions of Meat and Drink, as were allotted to the Petty Canons and other Members of Cathedral Churches for their ordinary Sublistence

MANUMISSION, is the Term for making a Slave or a Bondman free: You have the Form of this as it was used in the Conquerour's Time, in Lambers's Apharouia, Fol. 126. The Terms of the Law make two Kinds of Manumission; one expressed, and the other implied. That expressed was by Deed, or Publick Declaration: That implyed was when the Lord made an Obligation for Payment of Money to his Villain at a certain Day; or fued him when he might enter without Suit;

or when he granted him an Annuity or Leased Land to him for Years, or for Life, &c.

MANU-OPERA, are stollen Goods taken up-

on a Thief apprehended in the Fact.

MANU-PASTUS, in the Law Dialect is often used for a Domestick Servant, one sed as it were by the Hand of his Master.

MANU-PES, is used in the Charter of Richard the Third for a Foot of full and legal length.

MANU-PRISOR, one who was Bail-pledge or

Security for another Person.

MANUS, was anciently used both for an Oath and him that took it. If a Man swore alone in the Court, he was faid to do it propria manu; but if he brought 3 or more Witnesses to MARCHET Mulieris, the same with MerMARCHETA chetum. swear for him, he was said tertia manu jurare.

MARCHES, are now the Bounds between England and Wales, or England and Scotland; and the Marches of Scotland are divided into West and Middle Marches. The Word Marches is used also in Stat. 24. H. 8. 12. for the Borders of the King's Dominions in general, as being derived from the Germ. March, which fignifies a Bound or Limit; and those Noblemen who lived near these Marches are frequently in our Statutes called Marchers,

MARITAGIUM habere, fignified formerly to have the free Disposal of an Heires in Marriage, which was a Favour granted by the King, who was the Guardian of all Wards or Heirs in Mi-

mority, to some special Favourite or Friend.

MARITAGIUM Liberum, Frank Marriage;
was when a Baron, Knight, or Free-holder granted such a Part of his Estate with a Daughter to her Husband, and the Heirs of his Body, to hold without any Homage or Service to the Donor.

MARK, the Saxons called it Mancus, Mancusa, and Mearc; and among them it contained 30 Pence, which of their Money was fix Shillings. Tis not certain when the Mark came to be valued as at 13 s. 4 d. But M. Paris, in the Life of Guarinus Abbot of St. Albans, tells us, that a Mark (A. D. 1194.) was of this precise Value. Since the Conquest there was never any Coin of this Name struck, as appears; but probably there might be fuch before in the Saxons Time, and with some Markor Stamp upon it, as may be concluded from the Word Mark. Stow in his Annals, p. 32, and 691, saith, a Mark of Gold was eight Ounces, twelve Mark of Gold Troy was 200 l. of English Money; after which Rate each Mark weighed 16 l. 13 s. 4 d.

Skene de Verb. fignif. saith, a Mark signifies an Ounce Weight, whereof the Drachm is the eighth Part, as the Ounce is the eighth of the Mark.

MARQUESS is now a Title of Honour next MARQUESS before an Earl, and next after a Duke. The Name seems to be derived from the Germ. March, a Bound or Limit; and therefore was as much as Custos Limitis, or Comes sibi Prafectus Limitis. Among the old Britains it was the Custom, and after them of the Saxons, to give the Title of Reguli to all the Lords that had the custody and charges of their Marches or Bounds; as Selden shews in his Mare Clausum, Lib. 2. c. 19. But in Richard 2. his Time, the Title of Marquesses instead of Lords Marches came to be given to such as were Governours of the Marches.

MARS. Mr. Flamstead and Cassini have by accurate Observation found the Horizontal Parallax

of this Planet to be about 25 Seconds, and certainly not greater; a large Account of the Method of observing and finding which, you will find under the Word Sun in this Vol.

MARTYROLOGY, was anciently a Register kept in the Religious Houses, wherein they set down the Donations of their Benefactors, and the Day of their Deaths, that so on each Anniversary they might commemorate and pray for them: therefore several Benefactors made this a Condition in their Charters. Kennet's Paroch Antiq.

MASSES, in Painting, are the large Parts of a

Picture containing the great Lights and Shadows.

MASTER of the Mint: In the second Year of H. 6. that was the Title of him that now is called the Warden of the Mint, whose Office it is to receive the Silver and Bullion that comes to the Mint to be coined, and to take Care thereof.

MASTER of the Court of Wards and Liveries; was the chief Officer and Judge of that Court of Wards, kept the Seal of it, and was named and assigned by the King. But this Court and all its Officers, Members, Power, and Appurtenances, is taken away by a Statute made the 12th of Car.

MASTER of the Horse, hath the Rule and Charge of the King's Stable: This Officer is very honourable, and usually a Nobleman, is men-

tioned in 39 Eliz. 7. and 1 E. 6. 5.

MASTER of the Posts, was an Officer of the King's Court that had the appointing, placing and displacing of all such as provided Post-Horses to carry the King's Messages and other Business. Ho also was to pay them their Wages, &c. This Officer is mentioned in 2 Ed. 6. 3. but now by a Statute made 12 Car. 2. c. 34. he is appointed by the King's Letters Patent, with Rates and Rules prescribed in the said Act.

MASTER of the Armory, is an Officer mentioned 39 Eliz. c. 7. and hath the Care of the King's Armour in any standing Armories; with Power of putting in and out all inferior Offi-

MASTER of the Jewel House, is mentioned in 39 Eliz. c. 7. and is an Officer of the King's Household of great Credit; being allowed Bouge of Court, that is, Diet for himself and the Clerks of the Office, and hath a Lodging in the Court. He hath Charge of all the Gold and Silver Plateused at the King's Table, or belonging to any Officer of Account attending the Court; and of all Plate remaining in the Tower of London, as also of Chains and loose Jewels not fixed to any Gar-

MASTER of the Household. This Officer is called Grand Master, &c. and Lord Steward of the King's Household in 32 H. 8. 39. And in the first of Q. M. and ever fince he is called Lord Steward, &c. and under him there is a principal Officer called by this Name of the Master of the Household.

MASTER of the Ordnance, mentioned in 39 Eliz. 7. and is a great Officer, to whose Care all the

King's Ordnance and Artillery is committed.

MASTER of the Faculties, is an Officer under the Archbishop of Canterbury, who grants Licenses and Dispensations; he is mentioned in the Statute of laying Impositions at Law of 22, 23. Car. 2.

MASTER of the Wordrobe, is a great Officer at Court; having his Habitation or Dwelling-House belonging to that Office, called the Wardrobe near

Puddle-wherf in London. He hath the charge and custody of all former Kings and Queens Robes remaining in the Tower of London, and of all Arras and Tapestry Hangings, Bedding, Se. and the Charge and Delivery our of all Scarlet Liveries belonging to the King or Queen. He is mentioned in 39 Bliz. 7.

MATERIA Subsilis, in the Cartefian Philoso-

phy is what is produced by the grinding or rub-bing one against another of the Particles of the second Elements; and so these compose what he calls his first Element. See Cartesian Syst. of the

World in this 2d Vol.

MATHEMATICKS. Befides the mention of such Authors as have written on the several Parts of this noble Science, and of which you have an Account under each particular Head; these that follow have written on Mathematicks more gene-

Prancisci Laurens Specimina Mathematica, &c. Andrea Tacquet Opera Mathematica, Antw. 1669.

The Works of Monsieur Fermat,

Dr. Wallis's Mathematical Works, in 3 Vol. Fol. Oxen

De Chales Curfus Mathematicus, 3 Vol. Fol. Ludg. 1674.

A Mash. Compendium, by Sir Jonas Moore. Lond. 1674. Twelves.

Blements de Mathematiques, ou Principes Gem raux de toutes les Sciences qui ont les Grandeuts

pour Objest, par J. P. a Paris, 1675. 4to. Steph. de Angelis de Infinitis Spiralibus Inversis Infinitis Hyperbolis alissque Geometricis Batavii. 400.

P. Gregii a St. Vincentio opus Geometr. Quadratura Circuli & Sett. Coni. Antw. 1647. Fol. Leybourn's Cursus Mathematicus.Lond. 1690.Fol. Simon Stevin Les Oeuvres Mathematiques. Ley-

den, 1694. Fol. Clavius's Opera Mathematica. Fol. Mr. Hayes Fluxions, London, 1704. Fol. Foster's Miscellunies. Lond. 1659. Fol. Pappus Alexandrinus's Math. Collect. per Com-

mandinum, Bononiæ, 1650. Fol. Sir Jonas Moore's System of Mathematicks, 2 Vol.

London, 1681. 4to. Cavallerii Trigonomesria. Directorum generale Uranometricum, Exercitationes Geometrica Geometria Indivisibilis Continuorum.

Barrow's Lectiones Geometrica et Optica. Lond. 1669. 4to.

Sturmins's Mathefis Enucleata. 1 Vol. 8vo. — Juvenilis. 5 2 Vol. 8vo.

Veteres Mathematici. Paris, 1693. Fol. Math. Collections in Eng. from Galileo. Lond. 1661. Fol.

Hook's Micrographical Lettions es Opera Postbuma. Scotii Cursus Mathemat. Herbipoli. 1661. Herigone's Cursus Mathematicus. Paris, 1644. 8vo. Mr. Blondell's Cours de Mathematique. pour Mr.

le Dauphin. Paris, 1683. 4to. Ozanam's Cours de Mathematique, in 8vo.

MATRICULA, anciently was the Word for a Register. Thus in the Church there was the Masericula Clericorum, which was a In or Catalogue is appointed, that every round Bushel with a plain
of the officiating Cleri, and Matricula Paupeand even Bottom, being made 18 Inches and wide of the officiating Cless, and Matricula Paupe and even Bottom, being made 18 Inches and wide sum, a Catalogue of the Poor to be received: and shroughout, and 8 Inches deep, shall be officiened a Vol. II.

to this Day being Registred as a Member in the University of Oxon is called Marticulation. MATROSSES, are Soldiers in the Train of

Artillery, next below the Gunners: Their Duty is to affift the Gunners in Travetting, Spunging, Firing and Loading of Guns, &c. They carry Fire-locks, and march along with the Store-Wag-

MAUND, was anciently a Measure of Gapacity with us, being a kind of great Basket or Hamper containing 8 Bales, or 2 Fatts. See the Book of Rates, Fel. 3.

MAXY, is the Timminors Term for a Weed, as they call it, of the Marchafus kind, from whence Maxy seems to be a Corruption. When the Hood or Vein of Oar degenerates into this or any thing

else that is not Tin, they calling Weed With us)

MEASURES of Capacity of Thele (with us) both liquid and dry, were first made from Trey Weight. See 9 H.3. 51 H.3. 12 H.7. Su wherein it is enacted, that eight Pound Trey Weight of Wheat, gathered from the middle of the Ear, and well dried, should make one Gallon of Wine Manfure, and that there should be but one Measure for Wine, Ale, and Corn throughout the Kingdoil. See 14 Ed. 3. and 15 Rich. 2. Bur Custom in rinte bath prevailed against this, having altered Meafures as well as Weighes; no other but Troj Preight being appointed by our Laws to be used. (See 14 and 17 of Ed. 73.) we having now three different Measures; viz one for Wine, one for Ale and Beer, and one for Corn. See the Table of them under Meesures, Vol. I. i... 1

Only let me add further from Mr. John Ward's Arithmetick. p. 34. That the the common Wine Gallon sealed at Guild-Hall in London, by which all Wines, Brandies, Spirits, Strong-waters, Mead. Perry, Sider, Vinegar, Oyl, Honey, &c. ate meafured and fold, is supposed to contain 231 Cubick Inches; and from thence, the Tierce will contain 9702 Cub. Inch. the Hogshead 14553, the Punchion 19404, the Butt or Pipe 29106, and the Tun 58212. Yet it hath been accurately experimented, that the Wine Gallon at Guild-Hall doth hold but 224 Cubick Inches; as indeed Dr. Wybard had before taken Notice of in his Tallametry, p. 289. Bur yet in May 25, 1688, when an Experiment was made for the Lord Mayor of London and the Commissioners of the Excise, in Confirmation of the Truth of the Account above, of the Capacity of the Standard Gallon; viz. that it is but 224 Cub. Inches: yet it was then thought fir to continue the common supposed Convents of 231 Cub. Inches for the Wine Gallon, and that all Computation in Gauging should be made from thence; and so I suppose it yet stands.

The Beer and Ale Gallon is larger than the Wine Gallon, in Proportion to the Excess of the common Pound Averdupois above the true Pound Troy: that is, as 12. 231 :: 10 1413 to 2811, which is very near the Cubick Inches in the Ale Gallon. The Ale Quart contains 70+ Cubick Inches; the Gallon will be 282.

Dry Measure seems to stand still in Proportion to the old Wine Gallon of 224 Cub. Inches. common received Content of the Corn Gallon being 272.4. for as 12. 14. 18: 3 224. 272 1. and legal Winchester Bushel, according to the Standard in his Majesty's Exchequer! Now a Vessel thus made will contain 2150.42 Cubick Inches; and consequently the Corn Gallon can be but 2684 Cub. Inches.

MECHANICAL Philosophy, was that which the most ancient of the Phanician and Greek Philo-- Sophers have adhered to for the Explication of the Phænomena of Nature; and these made use oriiginally of no other Principles, than the Confideration of Empty Space, the Dollvine of Atoms, and in particular, the Gravitation of Bodies. These fit lently attributed the Cause of Gravity to something which was plainly distinct from Matter; and this Cause our most modern Natural Philosophers, in their Enquiries into Nature, did by no means take (into: Confideration. They have happily avoided vaitning at any Hypothefis to explain the Phenomena of natural Effects, and leaving the Philosophy of Canfer to Metaphysicks, they have rightly considered that it is the chief End, Design, and Businest of Natural Philosophy to consider Effects; and by reasoning upon them and their various Rhunomena, to proceed regularly at last to the Gauses of Things; and especially to the Knowledge of the First Causa. And certain it is, that all true Progress and Proficiency in this Kind of Natural Whilesophy, if it don't immediately lead us to the Knowledge of the First Cause, yet will surely bring ine still nearer and nearer to it; and therefore is a most noble, exedient, and valuable Study. Vid. Newe, Ope. Lat. Ed. p. 315

294 Aufligen on this Subject are, on Guidi, Whaldis Methanicarum Liber. Venetilis,

5 Paulus Guldinus de Centra Gravitatis. Viennæ,

Christ. Hugenius de Motu Pendulorum. Paris,

Ejus dem Herologium Oscillatorium. Paris, 1673.
Gasp. Szotti Mechanica. Bjus dem Technica Curi-

Caffioli Mesbanice.

Wilkin's Mathematical Magick,

Alphonsi Berelli de Vi Percussionis Bononia, 1677, & Lug. Bat. 1686. 4to.

Dr. Wallis's Mechanica, sive de Motu. Trastatus Geometricus.

Andrea Boecleri Architectura curiosa nova & Amanitates Hydrogogices cum 200 Fig. Are incis. Norimbergæ. Fol.

pera molaria & aquatica : cum Figuris. Ibid.

M. Vitruvii de Architectura Libr. 10. cum Fig. Aneis Ed. ept. Amst. 1649. Fol.

Novo Teatro di Machine di vittorio Zonca. Padua. 1602. Fol.

Teatro di Machine di Jacobo Bestoni in Lioni.

Pauli Cassaci Mechanica, Lugd. Bat. 1684. 4to. Alexandri Marchetti Exercitationes Mechanica.

Pisis 1669. 410. Heronis Alexandrini Spiritalium Liber. Amster.

Recueil de plusieurs Machines par S. B. Paris. 1699. Fol.

La Statique; ou la Science des Forces mouvantes, par P. Ignace Pardies. Paris, 1673. 12mo. Machanick Exercifes, by Mosson. Lond. 1677, 4to. Recuell de diversis Pleces touchants quelquis muvelles Machines pay, D. Papin, à Cassil. 1695.

Mechaniek Powers, by Mandet and Mexon. Lon. Luca Valerii Lib. de Centro Gravitatis Soledorum. Rom. 1604.

Galileo de Mechanica & Motu locali Dialogi. Leya. 1638.

MEMBRETTO, in Architecture, is the Italian Term for a Pilasser, that bears up an Arch. These are often stuted, but not with above 7 or 9 Channels. They are frequently used to adorn Door-Cases, Gallery Fronts, and Chimney-Pieces, and to bear, up the Cornisses and Freezes in Wain-scot.

MEMORY. Dr. Hook, in his Op. Possbum. p. 139, 140, &c. supposes Memory to be as much an Organ as the Eye, Ear, Nose, &c. and to have its Situation some where near the Place where the Nerves from the other Senses concur and meet; and he thinks, that the Memory being both improveable and impairable, appears from thence to be plainly Organical; and that it is a Kind of Repository of Ideas formed partly by our Senses; and chiefly by the Soul her self.

MENSALIA were such Personages or Livings MENSALS as were united formerly to the Tables of Religious Houses; and therefore are by

Canonists called mensal Benefices.

MERCHEN-LAGE; was one of those 3 Laws out of which W. the Conquerer framed our Common Laws, with a Mixture of the Laws of Normand; and was the Law of the Mercians when they governed a third Part of this Land; for it was divided in the Year 1016. See Cambden's Britannia. 2.04.

nia, p. 94.

MERCHETUM, Merchet, in Scotch Marchet, was anciently a Commutation of Money or Cattle given to the Lord to buy off that old impious Custom of the Lord's lying the first Night with the Bridal Daughter of a Tenant; and after it was used for the Fine or Composition which the Tenants paid to have leave to marry their Daughters: Also no Baron or military Tenant could marry his sole Daughter or Heir, without Licence from the King pro maritanda Filia:

from the King pro maritanda Filia:

MERCURIAL Phosphorus, is a Light arising from the shaking of Mercury in Vacuo; of which see several Experiments in Philos. Trans. N. 303. See Phosphorus.

MERCURY, is the Term the Chymists gave and is now generally used for that ponderous Fluid, Quick-filver: The Texture of which feems to confift of exceeding small, smooth, solid, spherical or spheroidical Partieles ; because Mercury in never so small a Quantity, is by no means transparent, but opake, and will let none of the Rays of Light pass thro' its Pores: And therefore since 'tis probable that Light passes not through the folid Parts of transparent Bodies, but only thro their Pores, tis plain, if the Particles of Mercury be Spherical (as it appears those of all Fluids are) then their Diameters cannot be much greater than those of the Rays of Light; for the Interstices between the Particles are as the Cubes of the Diameters of the Globules by whose meeting they are formed; and therefore seeing Light cannot pass thro these Interstices, it it plain, that the Diameters of the Corpuscles of Mercury cannot be much greater than those of Light: And if these Particles

should be oval or spheroidical, their shortest Diameters must be of the Length of those of the Par-

ticles of Light, or not much greater.

The Solidity of the Corpuscles of Mercury, and the Smallness of the Interstices lest between them, accounts for the wonderful specifick Gravity of Mercury, above all other Fluids; and the exceeding Smallness of its Parts, for its easie Ascent by

MERIDIAN Line, is a Line of ready Use in Practical Navigation. 'Tis always placed on the Foot, or 2 Foot Gunter's Scales, and sometimes on the Side of Gunter's Sector, (and on the Cross-Staff, &c.) and continued to its whole Length. Tis divided unequally towards 87 degr. (whereof 70 gr. are about one half) in such manner as the Meridian in Mercator's Chart is divided and numbred.

It's Uses are many: For, 1. It serves them to graduate à Sea Chart according to the true Projection. 2. Being joined with a Line of Chords, it serves for the Protraction and Resolution of such Rightlined Triangles as are concerned in Latitude, Longitude, Rhumb, and Distance in the Practice of Sailing; as Mr. Gunter shews, p. 15. of his Book of the Cross-Staff; as also in pricking the Churt truly at Sea.

MESOLABIUM, See Renati Tran. Flusii Mesolabium ; cui accessis pars altera de Analysi & Mis-

lanea. Leodii Eburonum, 1668. 410. MESSENGER of the Exchequer: The four Pursuivants in that Court are called by this Name and their Duty and Office is to attend the Lord Treasurer, and to carry his Letters, Precepts, &c. MESSUAGE, is a Dwelling-House, with some

Land affigned for its Use; and by this Name a Garden, Shop, Mill, Chamber or Cellar may pass, Saith Plowden, Fol. 169. In Scotland it is what we call the Mannor-House, the principal Dwelling-

House within any Barony.

METALS Lines: On Gunter's Sector are sometimes placed two Lines called the Lines of Metals; they are noted with the Characters of the 7 Metals, O, C, Q, h, 2, d, and 2; and their Use is to give the Proportions between the several Metals in their Magnitudes and Weight, and by them such Problems as these are solved.

1. In Bodies of the same Figure of different Metals, by the Magnitude of one given, to find the Magnitude of the rest.

Take the Magnitude given out of the Lines of Solids, and open the Sector till it be appiled right in its proper Points; then will the Parallels taken between the corresponding Points of the other Metals, and measured on the Solids, give their several Magnitudes.

s. In Bodies of different Metal, but equal Magnitude, having the Weight of one, to find that

This Probl. is the Converse of the former, but nor in direct but reciprocal Proportion; apply the Weight given, taken out of the Lines of Solids into the Sector in its proper Points belonging to the Metals of the other Body, so the Parallel taken from the Point's belonging to the Body given, and measured in the Lines of Solids, shall give the Weight of the Body required,

3. A Body being given of any one Meral, suppose a Sphere of Lead of 16 d, and whose Diambeer is a (let d and a fignify any Magnitudes on Lengths) to make another like it and of squal Weight, but of another Metal, as Suppose Iron.

Take out the Diameter a, and apply it in the Lines of Metals in the Points of h belonging ed lead; then will the Parallel between the proper Points in &, be the Diameter of the Iroff Sphere required : And this compared with the other Diameter in the Line of Solids, will give 23 dl. for the Magnitude of the Body required,

4. A Sphere of Lead being given, whose Diameter is a, to make another Sphere of any other, as of Iron, whose Weight shall be determined; v. gv. that shall weigh thrice as much;

Apply the Diameter a over in the proper Points of h; and then the Parallel between the proper Points of & will give the Length of the Diamerer of an equal Sphere of Iron; and this tripled will be the Diameter required.

See Webster's Metallographia. Lond: 1670.

Alonso Barba's Art of Metals, Englished by the E. of Sandwich. Part 1. 8c 2. in 8vo. 1674. Sir John Bettus's Fleta minor; or, the Laws of Art and Nature, in knowing, judging, finding refining, &c. the Body of confined Metals. Georgius Agricola de Re metallica. Fol.

METOPS; the same with Metopa. METTESHIP, Metteschep, Mettenscep, feems to have been anciently a Fine or Penalty paid by the Tenant to his Lord for his Neglect or Omiffion of doing his customary Service. Perhaps ir should be written Mittenscep from the Saxon Mit-ten, to measure, and teap, Goods or Chattels. MICROGRAPHY, is the Description of the

Parts and Properties of fuch very small Objects as are only discernable by Means of the Microscope. On this Subject the late Dr. Hook hath written defignedly in his Micrography, as hath also Dr. Popter; and Leuenhoeck in 2 Vol. in Quarto, Lat. in which, as well as scattered up and down in many other Books written on other Subjects, a very noble Treasure of useful Discoveries is to be found.

and all made by means of the Microscope:
MICROMETER. In Philof. Trans. N. 25, you have from Mr. Richard Townley, an Account of the Micrometer invented by Mr. Gascoigne; and by this Instrument he found the Moon's Distance and Parallax from two Observations of her meridional and horizontal Diameter, before Mr. Auzout took this matter into Consideration: Which Micrometer Mr. Townley had, and is described by Dr. Hook, in Phil. Tranf. N. 29. and the manner how it is to be applied to a Telescope shewed. And Mr. Flamstead in N. 96. faith, that by the Micrometer and a Telescope of but 14 Foot he could take the Diameters of the Planets and their Diffances from the fixed Stars, to a Second almost. This Instrument is now brought to very great Perfection and ready use by our excellent Math. Instrument-maker Mr. John Rowley, under St. Dunftan's Church in Fleetstreer. Set its Use in finding the Sun's Horizontal Parallax, under the Word Sun in this Volume.

LIIz

MICRO.

MICROSCOPE: By those excellent Observations and Experiments which the admirable Sir If. Newson hath made on Colours, he flews Ways to conjecture very accurately of the Sizes of the component Particles of Bodies by their Colours; and in the Description of those, he tells us, (Book 2. Pars 3. p. 64.) he hath been the more particular, because it is not impossible but that Microscopes may (if not done already) at length be improved to that Perfection, as to discover the Particles of Bodies on which their Colours depend. For, saith he, if those Inftruments are or, can be so far improved, as with sufficient Distinctness to represent Objects five or six hundred Times bigger than at a FootDistance they appear to the naked Eye, I should hope that we might be able to discover some of the greatest of these Corpuscles; and by one which would magnifie 3 or 4 Thousand Times, perhaps they might all be discovered, but those which produce Blackness. And if this could be attain'd to, (viz. by Glasses to discover the constituent Paricles of Bodies) he fears it would be the utmost Improvement of the Sense of Seeing; for it seems impossible to see the most secret and noble Works of Nature within the Corpuscles, because of the Transparency of these Corpuscles.
The same Gentleman in Philos. Trans. N. 88.

from the Difference he had found between compounded and simple Colours, takes Occasion to communicate a Way for the Improvement of Microscopes by Refraction; viz. by illuminating the Object in a darkened Room with Light of any convenient Colour not too much compounded; by which Means the Microscope will with Distinct sess bear a deeper Charge and a larger Aperture.

And in N. 80, he saith, that he hath sometimes thought of making a Microscope which should have, instead of an Object Glass, a Resteding Piece of Metal. For these Instruments seem as capable of Improvements as Telescopes; and perhaps more, because but one Piece of restecting Metal is requisite in them; as is plain from this Fi-



gure; where A B represents the Object Metal, C D the Eye-Glass, F their common Focus, and O

the other Forus of the Metal in which the Object is placed.

The Description and Use of Mr. Wilson's Sett of Pocket-Microscopes, &c. mentioned in the Preface of Vol. I.

This Sett of Microscopes has Nine different Magnifying-Glasses; Eight of which may be used with two different Instruments, for the better applying them to various Objects: One of these Instruments is represented Fig. I. A A A, and is made of Ivory, it hath 3 thin Brass Plates, E E, and a Spring of Steel H within it; to one of the thin Plates of Brass is fixed a Piece of Leather F, with a small Furrow G.... both in the Leather and Brass to which it is affixed: In one End of this Instrument there is a long Screw, D, with a Contex-Glass C, placed in the End of it: In the other End there is a hollow Screw, o o; wherein any of the Magnifying-Glasses M, are screwed when they are to be made use of The 2 different Magnification of the true Distance of the Magnifying-Glasses M, are screwed when they are to be made use of the 2 different Magnification of the magnifying of the Magnifying-Glasses M, are screwed when they are to be made use of the 2 different Magnification of the true Distance of the Magnifying-Glasses M, are screwed when the strength of the Magnifying-Glasses M, are screwed when the strength of the other than

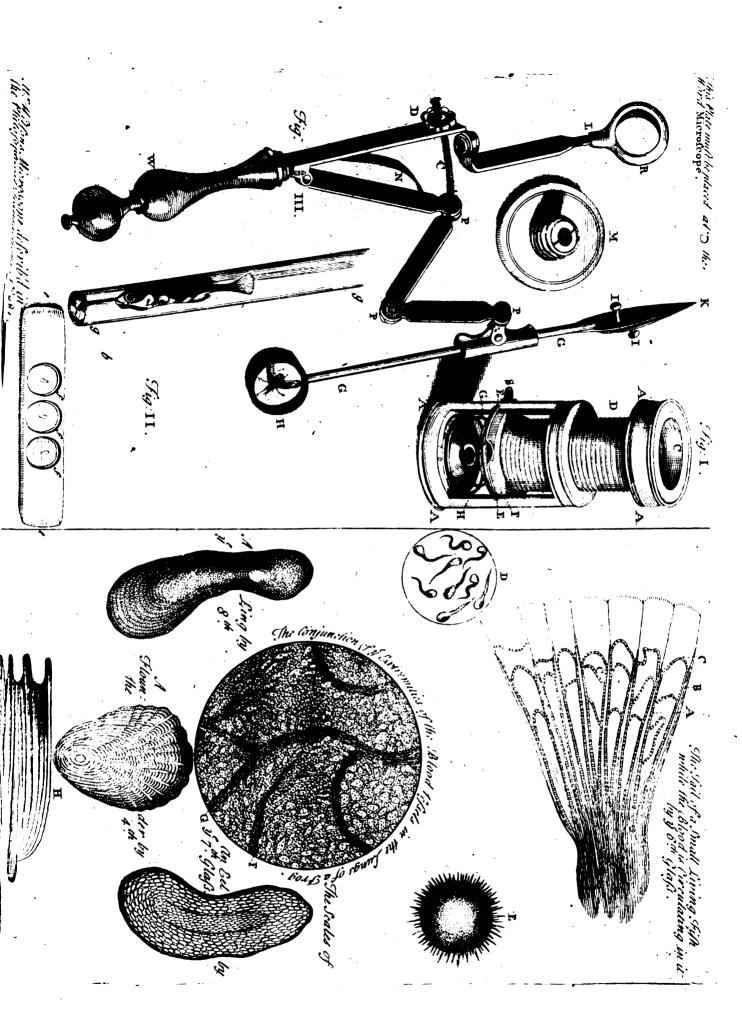
nifying-Glasses are all set in Ivory, 8 of which are set in the manner expressed at M. The greatest Magnisser is marked upon the Ivory wherein it is set with N° 1, the next N° 2, and so on till N° 8. The 9th Glass is not marked, but set in the Manner of a little Barrel Box of Ivory, as in Fig. IL

e e A flat Piece of Ivory, whereof there are 8 belonging to this Sett of Microscopes, (tho' any one who has a Mind to keep a Register of Objects may have as many of them as he pleases) in each of which there are three Holes f f f, wherein three or more Objects are placed between two thin Glasses, or Talks, when to be used with the greater Magnisiers.

The other Instrument Fig. III. is made of Brass or Prince's Metal, with Joints P P P, to turn eafily any Way with a small Pair of Tongs GG, which open at the Points K, by pressing together the two Heads of the Pins I I for taking up of Objects: At the other End of these Tongs GG, is screwed on a round Piece of black Wood H, with a Piece of Ivory let into it, for placing Opake Objects on, according to their Difference of Colour,

Upon the End L there is a Screw, into which the Glass set in the Barrel Box may be screwed; when the others are to be used, there is a Ring R of Brass to be screwed on the End L, into which Ring all the other Glasses M, may be screwed: So when any Object is taken up in the Points of the Tongs K, or laid upon the other End H, it may very easily (as one who sees the Instrument will perceive) be applied to the true Distance of any of the Glasses M, by the Help of the Joints P PP, and by means of the Screw C, with the Wheel D, Fig. III. which will bring the Object to the Exactness of the Centre or true Distance, being regulated by a Spring N.

The Use of the first mention'd Instrument, Fig. I. A A A A is thus: Take one of your flat Pieces of Ivory cc, or Sliders, (if you please to call them 10) and flide it in betwixt the two thin Plates of Brass E E, in the Body of the Microscope; so that the Object you intend to look upon be just in the middle, remarking that you put that Side of the Plate e e, where the Ring is, farthest from your Eye: Then you are to screw into oo, (the hollow Screw in the End of the Body of your Micro-scope) the 3d, 4th, 5th, 6th, or 7th Magnifying Glass M; which being done, while you are looking through your Magnifying. Glass upon the Object, you are to screw in or out, the long Screw D, Fig. I. in the other End of the Body of your Microscope, till you bring your Object into the true Distance, which you will know by seeing the Object clearly and distinctly: But seeing that in the greater Magnifiers you can see but a small Part of the Object. viz. the Legs or Claws of a Flea; while you are looking upon any Part of the Object, if ye take hold of the End of the Plate or Slider, e e, whereon the Object lies, and move it gently, you may see the whole Object successively, or any Part of the Object you please; and if that Part of the Object you design to look upon be out of the true Distance, remember your End Screw D, Fig. I. can always bring it in, by screw-After



After this manner may be seen all transparent Objects, Dust, Liquids, Chrystals of Salt, small Insects, such as Fleas, Mites, &c. If they be Insects, such as Fleas, Mites, &c. If they be Insects that will creep away, or such Objects as one insend to keep, they may be placed between the two Register-Olasses f. For by taking out (with the Point of a Penknise or small Plyers) the Ring that keeps in the Glass f, where the Object lies shee will fall out of themselves; so you may lay the Object between the two hollow sides of them, and put the Ring in as it was before: But if the Object be Dust or Liquids, a small Drop of the Liquid, or a little of the Dust laid on the outside of the Glass f, and applied as before, will be seen very easily.

As to the First, Second, and Third Magnifying-Classes, being marked with a upon the Ivory wherein they are set, they are only to be used with those Plates or Sliders that are also marked with a wherein the Objects are placed between two thin Talks, because the Thickness of the Glasses in the other Plates or Sliders, hinder the Object from approaching to the Centre or true Distance of these greater Magnifiers. But the manner of using them is the same with the former. Only remember to be careful when you put in or pull out the Plate or Slider e e, whereon the Object lies, or move it from one Object to another, not to let it rub your Magnifying-Glass, which is done by unscrewing a little the End Screw D, Fig. I. when ye put in or pull out your Plate, or move it from one Object to another.

For seeing the CIRCULATION of the BLOOD at the Extremities of the Arteries and Veins, in the transparent Parts of Fishes, Eels, &c. There are two Glass Tubes, the one bigger, and the other lesser, is express at g, wherein the Fish is to be put; when these Tubes are to be used, you are to unscrew the End Screw D, Fig. I. in the Body of the Microscope, until the Tube g g, can be received easily into that little Cavity G of the Brass-Plate, sastened to the Leather F, under the other two thin Plates of Brass E E: When the Tail of your Fish lies star to the Glass Tube, set it opposite to your Magnifying-Glass, and by screwing in or out your End Screw D, Fig. I. as is said before, you may easily bring it to the true Distance, and see the Blood circulate with great Pleasure.

If you would see the Blood circulate in a Prog's Foot, chuse such a Frog as will just go into your Tube, then with a little Stick, &c. expand the Minder Foot of the Frog, and apply it close to the Side of the Tube, observing that no Part of the Erog hinders the Light coming on its Foot, and when you have it at the just Distance, by Means of the Screw D, Fig. I. as abovesaid, you will see the rapid Motion of the Blood in its Vessels, which are very numerous in the transparent thin Membrane that's between the Frog's Toes: For this Object the 4th and 5th Magnifiers will do very well; bur you may see the Circulation in the Tails of Water-News with the 6th and 7th Glass, by reason the Globules of the Blood of those News are as big again as the Globules of the Blood of Frogs or small Fish, as has been taken Notice of in N. 280 of the Philosophical Transations, Page 1184.

N. B. The Circulation cannot be so well seen by the First, Second, and Third Magnissers, because the Thickness of the Glass wherein the Fish lies, hinders the Approximation of the Object from the true Focus of the Glass.

S, Fig. I. is a little Ivory Screw, upon which the Handles of the Brass Infrument W, Fig. 111. may be screwed, and serve for a Handle to this Ivory one also.

The Glass, placed in the Manner of a Barrel Box, Fig. II. is only to be used when the Brass Instrument (or in your Hand) being the least Magnisser, for greater Objects, such as Flics and common Insects, &c. A Hole being made in the Side of this Box, Fig. II. whereby it may be screwed on the Point L, Fig. III. of the Brass Instrument, remembring to put the End b next to your Eye, and the other to the Object; so if you take up an Insect in the Point of the Tongs K, or lay any opake Object on H the other End, you may approach them to the true Distance by means of the Joints and Screws spoken of before C, D, P, N, Fig. Ibid.

In the viewing of Objetts, one ought to be careful not to hinder the Light from falling upon them, by the Hat, Peruke, or any other Thing, especially when they are to look upon opake Objects: For nothing can be seen with the best of Glasses, unless the Object be in a due Distance, with a sufficient Light.

The best Lights for the Plates or Sliders, where the Object lies between the two Glasses, is a clear Sky-light, or where the Sun shines on any white thing, or the Reslection of the Light from a Looking-glass. The Light of a Candle is likewise good for the viewing of very small Objects, though it be a little uneasy to those who are not practised in Microscopes to find out the Light of the Candle.

By what is here said, it's hop'd that the Use of this Microscope, easy of its self, will be much easier to those that use it; yet it cannot be doubted of this, as of all other Instruments of this Nature, but that Usus plura docebie.

For the Conveniency of those who would Draw, or make any Sketches or Designs after Microscopical Objects, they may also have a Pedestal to fix the two Instruments above described, and make them stationary to any convenient Light. This Pedestal may be plac'd on a Table, &c. and after the Object and Light are fixed, as many Persons as please may view the Object, without any Trouble or Difficulty in stading the Light.

The rest of the annexed Figures were drawn by this Microscope from several Objects.

A the Artery, B, the Vein, C their communicant Canal, by which the Blood is seen passing from the former to the latter, in the Tail of the Fish, express d at gg.

D the Animalcula in Semine masculino, by the first Glass,

E one

MON

E one of the Farina of the Flower of Mallows, which magnified is the Area represented at D.

If the Branch of an Artery, G that of a Vein: The intermediate Spaces shew the Manner they communicate unto one another, in the Sides of the Lungs of Frogs, News, &c.

H one of the Feathers of a Moth's Wing.

MIDDLE Latitude, in Navigation, is half the Summ of any two given Latitudes; as suppose the two Latitudes were 50° 30', and 45°. 20', the middle Latitude will be 47°. 55.

There is a Method of working the leveral Cases of Sailing by Middle Latitude, which nearly agrees with Mercator's or Wright's way; and it is performed without the Table of Meridional Parts, either by the Tables of Logarithms or by Gunter's Scales. Of this Method you have a short Synopsis

in Mr. Jones's Navigation, p. 71.
MID-SHIP-MEN, are Officers aboard a Ship, whose Station when they are on Duty, is some on the Quarter-Deck, others on the Poop, &c. Their Business is to mind the Braces, to look out, and to give about the Word of Command from the Carrain and other superior Officers. They do also assist on all Occasions both in sailing the Ship, and in storing and rummaging the Hold. They are usually Gentlemen, who having served their Time as Voluntiers, are now upon their Preferment.

MILIARES Glandula, are those very small and infinitely numerous Glands which secern the Sweat and the Matter that exsudes in insensible Perspiration. See Skin.

MILLAINS, according to Mr. Wingate, are the third Subdivision of the Primes in Gunter's Line, and express the 1000th Parts of such Primes.

MINIUM or Read Lead. Mr. Ray at the End of his Collect. of Engl. Words, gives this Account of the making of Minium. First they take Lead and waste it in an Oven or Furnace; by bringing it to a Substance almost like Liebarge, and by stirring about with an Iron Rake or Hoe. Then they take it out and grind it with two Pair of Stones, which deliver it from one to another; and there is a Mill which moves at once fix Pair of these Stones. When 'tis thus reduced to a Powder, they wash it, and then put it into an Oven or Reverberatory Furnace, where by continual stirring with a Rake or Hoe of Iron, it comes to its Colour in 2 or 3 Days. But the Fire must not be violent, for then it will clod and change Colour. The Iron Rake is hung or poised by a Hook, else it would be too heavy to be moved by one Man.

MINT, is the Place where the King or Queen's Coin is formed, be it of Gold or Silver: The chief Mint of England is in the Tower of London; of which the present Officers are (1.) The Warden, who is the chief, and is to receive the Bullion, and oversee all the other Officers. (2.) The Master Worker, who receives the Bullion from the Warden, causes it to be melted and delivered to the Moniers, and takes it from them again when coined. (3.) Comptroller, who is to fee that the Money be made to the just Assize, and to oversee and controll the Officers, if the Money be not as it ought to be. (4.) The Assay Master, who weighs the Silver and Gold, and sees whether it be Standard. (5.) The Auditor, who takes all the Accounts. (6.) The Surveyor of the Melting, who is to see the Silver cast out, and that it be not alter'd after it's deliver'd to the Melter; which is after the Affay-Mafter hath made Trial of it. (7.) The Clerk of the Irons, who is to see that the Iron be clean and fit to work with. (8.) The Graver, who graveth the Dies and Stamps for the Coinage of the Money. (9.) The Melters, who melt the Bullion before it comes to coining. (10.) The Blankbers, who anneal, boil, and cleanse the Money. (11.) The Porters, who keep the Gate of the Mint. (12.) The Provost of the Mint, who provides for all the Moniers, and oversees them. And lastly, The Moniers, some of which shear the Money, some forge it, and some stamp or coin it, and some round it and mill it.

MITRE, in Architecture, is the Workmens Term for an Angle that is just 45 Degrees, or half a right one; and if it be a Quarter of a Right Angle, they call it a Half Mitre: And they have an Instrument made to this Angle which they call the Mitre Square, with which they strike Mitre Lines on their Quarters or Battens; and for Dispatch they have a Mitre Box, as they call it, which is made of two Pieces of Wood, each about an Inch thick, and one is nalled upright upon the Edge of the other; the upper Piece hath the Mitre Lines struck upon it on both Sides, and a Kerf to direct the Saw in cutting the Mitre Joints readily, by only applying the Piece into this Box.

MITRED Abbots, were formerly Governours

of luch Religious Houses, as had obtained from Rome the Privilege of wearing the Mitre, Ring, Crosser, and Gloves of a Bishop. It hath been a vulgar Error, that these Mitred Abbots were all the same with those Conventual Prelates who were fummoned to Parliament as Spiritual Lords; but some of those summoned to Parliament were not mitred; and some that were mitred were not summoned; the Summons to Parliament not any way depending on their Mitres, but on their receiving their Temporals from the King. Cowel's Inter-

preter

MITTA, was anciently a Saxon Measure containing 16 Bushels.

MIXT Tythes. See Tythes.

MOAT; the Brink of the Moat next the Rampart in any Fortification, is called the Scarp, and

the opposite one the Counterscarp.

MODEL, is an original Pattern which any Workman proposes to imitate; 'tis variously made of Wood, Stone, Plaster, &c. and should be (in Architecture, for Instance) made by a Scale, where an Inch or half an Inch represents a Foot, for the more exact compleating of the Design.

MOLMUTAN or Molmutin Laws, were the Laws of Dunwallo Molmutius, fixteenth King of the Britains; they were famous here till the Time of William the Conqueror. Molmutius was the first that published Laws in Britain; and these Laws, with those of Queen Mercia, are published

in Latin by Gildas, out of the British Tongue.

MONIERS. See Mint.

MONOCHORD. See the accurate Division of the Monochord, in Phil. Trans. N. 238. by Dr. Wallis.

MONOPOLIZERS, are such Persons as combine together to engrois, and to raise the Price of :Goods

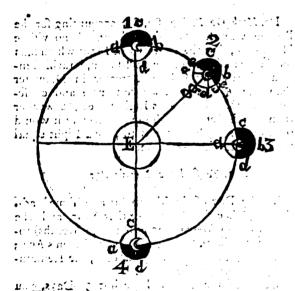
MONSOONS, are shifting Trade Winds in the E. Indian Ocean, which blows periodically, fome

for half a Year one way, others but for 3 Months, and then shift and blow for 6 or 3 Months directly contrary.

Iy contrary.

MOON. The Reason why the Calways shews the same Face towards us, is because she revolves because the revolves because the revolves because the revolves and the Axis in the Time of her Periodical Month.

For if in moving in her Orbit round the Earth . The did nor do so, but that the Horizon of the Disk ab kept always parallel to it self in all Positions, tis plain, that as the Moon moves on in her Orbit, enew Parts of the former dark Hemisphere will beigin to be enlighted (or rendred visible to us;) as appears plain from the Figure annexed. For sup--pose the Moon to have moved in her Orbit from to 2, and that her Diameter a b keeps parallel to its self in its first Situation; then her visible "Memisphere will be, not as before a d b, but e g f: and when she comes into Position 3, her visible Hemisphere will be c = d, instead of a = db, as at Arft : And laftly, when the Moon is at 4, her vifible Hemisphere will be a e b, which in the first Position was totally invisible. And this can't be otherwife, if the Moon in her Revolution round -the Earth, don't also revolve round her own Axis in the same exact Space of Time: But if you suppose her so to turn round her Axis, that the Diaemeter a b shall always be in a Normal Position to the Line E (; as in the 2d and 3d Politions e f. Motion round her Axis, always shew the same Face to you, as in Fact (abstracting from her Vi-brations, So) sho really doth.



The annual Regression of the Moon's Nodes is 25 Dregrees, and the Nutation of her Orbit about 20 Minutes.

The Phanomena of the Moon, on which, as Foundations, the Lunar Aftronomy is built, are fuch are these

1. That the Moon moves daily from West to East, and almost in the same Line with the Earth, or nearly in the Ecliptick.

For all the Secondary Planets describe lesser Orbits round their Primary, as they do round the Sun; and the Plains of their Orbits are not very different from that of the Ecliptick, and these Secondary Planets do also move the same Way as the Primary ones.

m the same Plane of the Ecliptick, deviating sometimes a little to the North, and sometimes to the South; as is apparent from her Meridian Affitudes. The Plane of her Orbit being inclined to that of the Ecliptick, and intersecting it in two Points, which are called the Moon's Noder.

3. The Phases of the Moon are continually changing; sometimes the cannot be seen at all, then the appears horned, bisected, gibbous, and at last round or full: And to on again in an inverse Order.

For being a spherical opake Body, and receiving all her Light from the Sun; tho he will always illuminate one Hemisphere of her, yet in the New-moon, when that Hemisphere is entirely turned from you, and her Body between the Sun and their Eye, tis impossible for her to appear visible: But as soon as by her Motion forward in her Orbit, Part of that Hemisphere comes to be obverted to the Earth, she will begin to appear falcated or with Horns of Light, and when she is got to be 90 degr. from the Sun, she will shew just one half of her illuminated Hemisphere, &c.

4. The Eclipse of the Sun happens only at the New-moon; the not at every one; and that of the Moon only when she is at the Full, the not at every Full-moon; as is plain from the Reason and Nature of Eclipses.

s. That obscure Part of the Moon's Body which the Sun's Rays do not illuminate, when she is Horned or Gibbous, or even in a Solar Eclipse, is not totally invisible, but appears with a reddish dirty coloured Light; and that Light seems to come to the Moon by Reslection from the Earth.

For when the Moon is at New to us, the Earth is at Full to the Lunar Inhabitants; and the Light of the Earth being about 15 times greater than that of the Moon, and the Moon so little as not to obscure above a 20th Part of the Earth, the Light from the Earth may easily be supposed to render her a little visible in even solar Eclipses.

6. The Eclipses of the Sun and Moon don't happen always in the same Places in the Zodiack, but in others moving still gradually backward, or in Antecedentia.

The Reason of which is, that the Moon's Orbit is different from that of the Ecliptick, intersecting it but in one Line, whose extreme Points are called the Nodes, and which Nodes do annually move backward or in Antecedentia. But the Eclipses cannot happen but when the two Luminaries are in or near these Nodes swherefore, &c.

7. There is a very sensible Difference in the apparent Length of the Moon's Diameter, at different Times.

For the Moon's Orbit being Elliptical, her Dilftance from the Earth will be very different, as fine is in different Parts of that Ellipsis; and 'tis found that her apparent Diameter is nearly reciprocally proportional to her Distance, which Distance is both greatest and least in the Syzygies, because the Excentricity of the Ellipsis is there greatest.

8. The apparent Motion of the Moon is not always equal, but greater and less by Turns, and

that very sensibly.

Which Phænomenon arises from several Causes concurring together. The first Cause of which is some Inequality even in the mean Motions of the Moon; for in the Barth's Peribelia the Moon is carried something slower than in the Aphelia.

The next Cause is the Elliptick Figure of the Lunar Orbit, from whence the Moon must move faster in her Perigaum than in her Apogaum; as

is the Case of all the Planets.

A 3d Cause, is the continual changing of the Excentricity of the Moon's Orbit; from whence must arise a greater Difference of her Velocity in her Perigaa, and of her Tardity in her Apogaa in the Syzygies of the Apfes than in the Quadra-

To all which we may add, that the Moon's Motion it self is a little retarded from the Syzygies to the Quadratures, and then accelerated a little again from thence to the Syzygies, in every Lunar Month.

9. The monthly Motion of the Moon in the Eeliptick is swiftest (caseris paribus) when she is in the Syzygies, and flowest when she is in her Quadratures to the Sun,

The Reason of which is to be had, not from a ny System of Astronomy, but from the Physical

Principles of the Newtonian Philosophy.

to. That Place where the Moon appears leaf and where her Motion is flowest, doth not keep always in the same Degree of the Ecliptick, but moves sensibly forward, or in Consequentia.

For the her Appraum go forward in the Syzy-gies, and backward in the Quadratures, yet because the former Motion is near twice as swift as the latter, the Excessin the whole Revolution of the Apfes must be forward, and consequently the Apogaum will move on in Consequencia, as by Observation 'tis found it really doth.

11. The Latitude of the Moon is moveable or changeable, being sometimes greater and sometimes leffer (according to the various Political of her Orbir to the Sun) even in the same Degree of proper

Longitude.

This Difference of Latitude arises from the varions Inclination of the Plane of the Moon's Orbit to that of the Enliptick. For, as was said above, there is an Inequality even in that Inclination; when the Line of the Nodes is in the Syzygies, the Angle of the Inclination is greatest, and least when that Line is in the Quadratures, and of a mean Quantity in the intermediate Positions.

12. The Moon's Orbit is more or less circular according to its various Polition in Respect of the

Sun.

And so it must be, since as was shown above, be Excentricity of her Orbit is greater when the Line of the Aples is in the Syzygies, than when it is in the Quadratures, by almost half the least Excentricity.

13. The Motion of the Moon is very unequal. and diffigular to its folf, whether you consider it in different Parts of the same Month, or in the Past for the Year before. similar Parts of different Months.

Nor is this strange, if you consider she various and dissimilar Mutations above-mentioned.

14. The Light of the Moon reflected to us is so weak, that even in the Full-moon, it will by no Burning-Glass be brought to afford the looft

Degree of Hear.
The Rays of Light have their Force decreased (at leaft) as the Square of their Diftance; an confequently the Force of the Sun's Rays reflected to us from the Moon, to those that come to as directly, is decreased, at least in the Proportion of the Square of the Moon's Distance from the Earth, to the Square of the Moon's Semi-diameper; and by Calculation it will be found, that the Light of the Moon brought hither, will be in Force but the fifty thousandth Part of that which comes hither directly from the Sun.

15. The same Face of the Moon nearly, is al-

ways turned towards the Earth.

The Reason of which is, that the turns round her own Axis, in the Time of her mentiquel Motion round the Earth, as I have demonstrated as above.

16. And yet there are some Librations, of this Face, so that some more Eastern and Western Parts of it, and sometimes some more Northern and Southern do alternately appear.

The Reason and Cause of which libratory Motion, Sir If. Newton, I think, first discovered ar

communicated.

Dr. Hook, Op. Post. p. 80, 31 accounting for the Reason why the Moon's Light affords no visible Heat, saith, that the Quantity of Light which falls on the Hemisphere of the Full-moon, is rarified into a Sphere about 288 times greater in Diameter than the C before it arrive to us; and confe-quently, that the Moon's Light is 104368 weaker than the Light of the Sung Wherefore it would require 104368 Full-moons to give a Light equal to that of the Sun at Noon.

1. To find the Moon's Age.

To the Day of the Month (at any Time) add the Epath (see that Word) for that Year, and the Months from March (including both Months) together, the Sum, if under 30, is the Moon's Age 3 if above 30, subtract thirty out of it, the Remainder is the Age of the Moon.

N. B. If the Month have but 30 Days, you

must subtract: but 29 instead of 30.

Example, May 26, 1708,

Epact 18 Days in May 26 Months from March 3

> 47 Deduct --- go

The Moon's Age 17 Days.

If the Time proposed had been between Jan. 1? and March the first, you must have used the B.

 $\prod_{i \in \mathcal{I}} \sum_{j \in \mathcal{I}_i} 1_{i \in \mathcal{I}_j}$

MOO

2. To find the Moon's being upon the Meridian or or Southing.

Multiply her Age by 4, and divide the Product by 5, the Quotient will give the Hours, and the Remainder multiplied by 12 will give the Minutes, when the Moon is less than 15 Days old; but when more than that, you must subduct 15, and work with the Remainder, as before.

Moon's Age 17 Days.
Deduct 15

Multiply by 4

Divide by 5) 8 (1 hour, 36 m.

Multiply by 12

36 Minutes.

3. To find the Time of the Moon's Shining.

Mustiply her Age by 48, and divide the Product by 60; the Quotient shall be the Hours, and the Remainder the Minutes: That is, if the Moon be under 15 Days old; but if above, subtract the Time of her Shining, found as above, from 24 Hours, the Remainder will be the Time of her Shining in the Morning.

Example. May 26. 1708.

4. To find how many Signs and Degrees the Moon is departed from the Sun fince her last Conjunction with him, or fince the last New-moon.

Double the Moon's Age, and divide the Product by 5, the Quorient is the Signs, and the Remainder (multipled by 6) are the Degrees.

Example. May 26. 1708.

The Moon's Age 17 Days.

2

5) 34 (6 Signs.

30

Remains 4

Multiply by 6

Therefore the Moon is gone from 24 Degrees. the Sun 6 Signs, and 24 Degrees.
Vol. II.

MOON's Parallax. There are two Ways of finding the Moon's Parallax.

1. From the Astronomical Tables, the Moon's Place must be accurately had for the Moment of the Observation; and then you must find by Calculation and by the Tables of Restractions, how many Degrees and Minutes the Centre of the (is elevated above the Rational Horizon. At the same Time also exactly, by a large Astronomical Quadrant, Sextant, &c. adjusted with Telescopical Sights. &c. the Elevation of the Moon's Centre aabove the Horizon of the Observer must be taken in Degrees and Minutes. The Difference between those two Astitudes will be the Parallax of the Moon at the Moment of the Observation, and for that particular Place of the Moon; which being found, the Horizontal Parallax may be had by this Analogy; As the Cosine of the Moon's Astitude to Radius: so is the Quantity of the present Parallax, to the Moon's Horizontal Parallax.

rallax, to the Moon's Horizontal Parallax.
2. Without Aftronomical Calculation, the Moon's Parallax may be thus found: Let her Dia meter be accurately taken by a good Telescope and Micrometer, when she is on or near the Meridian, and when near the Horizon, the same Night; the meridian apparent Diameter will be the greatest; the Difference of these two apparent Diameters, being given, in the same Night, you may determine the entire Difference between the Horizontal and Vertical Diameter by the former Ana-And from this Difference, which is proportional to the Earth's Semi-diameter, both the Moon's Distance and her Parallax may be found by an easie Calculation. And by the best Observation, the Moon's mean Horizontal Parallax hath been found to be about 57 Minutes, and consequently her mean Distance from the Earth about 60 Semi-diameters of the Earth; or about 24000 Miles English.

MOORS: The Lords Bayliss in the Isle of

MOORS: The Lords Bayliffs in the Isle of Man are called by this Name; their Office is to summon the Courts for the several Sheadings.

MORAL Philosophy, or moral Discipline, is what is usually called Ethicks in the Schools, being a practical Science which explains the Nature and Reason of, and withal teaches and instructs us how to acquire that Felicity or Happiness which is agreeable to Humane Nature.

MORAL Adions or Ads, are such as render the Rational and Free Agent good or evil, and consequently rewardable and punishable, because he doth them.

MORESK-Work or Morisho-Work, is a kind of Antick-work in Painting or Sculpture, after the Manner of the Moors, confifting of several Grotesco's.

MORSUS Diaboli, is the Term which some Anatomists give to the outer Ends (i.e. those next the Ovaria) of the Tuba Fallopiana; because their Edges there appear jagged and torn.

MORTARS of Mr. Coehorn, are made of Hammer'd Iron of about 4 Inches Diameter at the Bore, ten Inches and a half long, and nine Inches in the Chase. They are fixed at an Elevation of 45°. on a Block of Oak of about 20 Inches long, and 10½ broad, and about 4 thick. These like Hand-Mortars, throw Hand-Grenadoes. They are used chiefly in the bottom of the Trenches, where they are placed about a Yard Distance one from another, having each a Soldier to attend it; and there is an Officer to every 40 or 50 of them.

M m m

They fire sometimes 60 or 70 of these together, which throw their Shells into the Covertway, &c, and make a very terrible Slaughter.

MORTISE or Mortaife, is the Workmens Word in Architecture for the Hole made in one Piece of Timber to receive the Tennon of ano-

MORTMAIN Statute: There was a Statute made in 7 Ed. 1. de Terris in manum mortuam mon ponendis; to restrain the Donation of any Lands or Tenements to Religious or pious Uses, where they lay in a Dead Hand, without Succession or due Service to the Lord and the King. After which Statute the Lands so given away were forfeited to the King, if the immediate Lord of the Fee made not his Claim within a Year after such Alienation.

When the King by special Licence dispensed with the Statute of Mortmain, there was a previous Inquisition ad quod Dampnum, and a Return upon Oath that it would be no Prejudice to the This Law Dignity and Revenues of the Crown. of giving is now relaxed by Stat. 39 Eliz. c. 5. Lands to Hospitals; and by 14 of Car. II. c. 9. a-bout purchasing Lands and Tenements for the

Poor within London and Westminster.

MOSAIC Work, is corruptly so called; it should be Musaick; in Latin musicum Opus, and sometimes tis called also Pavimenta Tesselata.

MOTION: From the first of Sir If. Newton's three Laws of Motion or Nature mentioned under this Word Motion in Vol. I. by way of Corollary may be inferred, (1.) That no Particle of Matter, or any Combination of fuch (that is, no Body whatever) can either move of it self, or alter the Direction of its Motion, because 'tis entirely pasfive and indifferent as to Motion or Rest; so that neither Motion or Rest are essential to Matter. (2.) Tis plain also from hence, that naturally of it self, no Body can ever move in a Curve Line; for fince all Motion is originally and naturally rectilinear, itis impossible that any Body can move in a Curve or Line that is not strait of it self; because then it must of it self continually alter the Direction of its Motion, which cannot be, by the former Corollary; wherefore the Motion of the Heavenly Bodies in Circles or Ellipses cannot be accounted for by the natural Laws of Motion; but it is owing to the Will of the great Creator that they are kept in their Orbits by an attractive Force.

From the second of the three Laws of Motion, it follows, that all Effects will always be proportional to their Adequate Causes; and thus if any Degree of any Force will produce any Degree of Motion, a double Degree of the same Force will produce a double Degree of Motion, a Triple, a Triple, and so on in any Ratio whatsoever. And this Motion must proceed on in the same Dire-Ction with that of the moving Force, because tis from That only that the Motion arises; and Bodies once in Motion, cannot change their Directi-

on of themselves.

And if a Body be already in Morion, the Morion arising from a Force impress'd, if it be in the same Direction with that of the former Motion, it will increase it in Proportion to its Power; but if it be impress'd in a contrary Direction, it destroys the former Motion either totally or in part, that is, equal to the Force of the Impression. And when it hath a Direction any way oblique to that of the Multiplicand, which you begin with.

the former Motion, it is either added to, or subtracted from it, according as a Motion arising from a Composition of those two, is determined

MOUNT-EGG; after Tin from the burnt Ore is melted down and remelted, there will sometimes remain a different Slugg in the Bottom of the Float, this they call Mount-Egg; and the of a Tin Colour, yet is of an Iron Nature, as hath been

found by applying a Magnes to it.

MUD-SUCKERS, Limifuga, are a Sort of Water-Fowl which suck out of the Mud of Channels, Ge. some oily Juice or Slime with which they are nourished; hence they are always delicate Flesh, and their very Guts uncleansed from the Excrements are usually eaten, as those of Woodcocks, &c. These Mudsuckers have therefore very long Bills, and broad near the Tip.

MULIER, a Term used in our Common Law: some think to be a Corruption either from the Latin Melior, or the French Meilieur, and fignifies the Lawful Issue preferred before an elder Brother born out of Marrimony. Others will have it to be derived, quasi ex muliere natus & non ex concu bina; and so they use the Word Filius mulieratus, in Opposition to a Bastard; and in this Sense the Scotch also use the Word, and therefore this last Etymology is most probable.

MULTA or Multura Episcopi, was formerly a Fine or Mulct paid to the King, that a Bishop might have Power to make his last Will and Testament; as also to have the Probate of other

Mens, and the granting Administrations.

MULTIPLICATION: It often happens that tis needless to express at large all the Figures of the Product, especially where the Factors have each many Places of Decimal Parts; and therefore the following Compendium is as useful as

tis curious.

Suppose 3.141592 were to be multiplied by 52.7438; and that a Product which should have 4 Places of Decimals, would be enough for the present Purpose. First write down the Multiplicand, and fet the Place of Unites in the Multiplier under that Figure of the Multiplicand, whose Place you intend to keep in the Product. let 3.141592 be the Multiplicand, and you would have but 4 Places of Decimals in the Product; place therefore 2, the Place of Units in the Muleiplier, under 5 the 4th Place of Decimals in the Multiplicand. Thus, 3.141592

After this place all	8347.25	
the other Figures of	157 0796	
the Multiplier in a	62832	
contrary Order; viz.	2 1991	
the 5 Tens in 52 to	1257	
the Right-hand in the	94	
Place of Unites, and	25	
all the Decimal Parts		
to the Left-hand as	160 6000	

165.6995 you see in the Example. Then in multiplying begin always

The Product with 4 places of Decimals only.

at the Figure in the Multiplicand that stands over the Figure you multiply by; fetting down the first Figure of each particular Product, directly underneath one another, only you must have Regard to the Increase which would have arisen out of the multiplication of the two next Figures, which stand to the Right Hand of that Figure in

Thus

Thus, say 5 times 9 is 45, and one which would arise from 5 multiplying 2, makes 46; therefore write down 6 and go on as in common Multipli-

Then with the next Figure 2, fay twice 5 is 10; which with the Increase that would arise from 2 multiplying 9; will be nearly two Tens to be put down instead of the Cypher. Then say, twice 1 is 2, and one to be added from the twice 5 is 3; therefore write down 3, and go on as usually.

Next go on with 7, and fay, 7 times 1 is 7, but from the Confideration of 7 being multiplied into the two Figures 5 and 9, which stand to the Right Hand of the 1, there will be 4 to be added; so 7 and 4 make 11, write down 1 and carry 1, &c.

Another Example will make all plain. Let 257.356 be to be multiplied by 76.48, and the Product to be entirely confisting of Integers wirhout Decimal Parts.

First write down the Multiplicand, and then fer 6, the Place of Units, in the Multiplier under 7 the Place of Units in the Multiplicand (because you are to have no Decimal Parts) and write down the other Figures in a contrary Order, as above di-

84.67 180 15 1544 1 03 19682 The Product

257.356

clear of Fractions.

rected; proceeding also with each single Figure, as is there taught.

MULTONES Auri, were formerly Pieces of , Gold Coin imprest with the Figure of a Sheep or Lamb (perhaps the Agaus Dei) from whence they had this Name, Males being then used for a Sheep, as Mutto and Mato was also, whence our Word Maston. This Coin was more common in France; but that it was sometimes used also in England, appears by a Patent of 33 Ed. 1.

MUNDICK, is a Marchasite sound in the Tinmines, of a Colour white, yellow, or green. sometimes call it maxy; it seems to be a Kind of Sulphur, because Fire only separates it from the Tin, and it evaporates into Smoke. The mundick Ore is eafily known by its brown fad-coloured glittering, and by its foon colouring your Fingers. Some fay this nourishes the Tin, and yet they say also, where much Mundick is found there is little or no Tin; and 'tis certain, that if there be any Mundick left in melting the Tin, it makes it thick and cruddy, as they speak; that is, it is not so ductile as otherwise it would be.

MUNIONS, in Architecture, are the fhort upright Posts or Bars that divide the several Lights in a Window Frame.

MUSCLE; a Muscle is only a Bundle of Fibres, which being closely compacted at each End, make the two Tendons, each of which is inserted into fome fixt Parts of the Body. Every one of these Fibres confifts of a prodigious Number of lesser Fibrilla, which are so many very stender elastick Canals bound about by small transverse parallel Threads, which divide these hollow Fibrillæ into fo many elastick Cyftes or Vesiculæ, which are orbicular, being formed of two concave Segments of a Sphere. Into every one of these Vesiculæ, an Artery, Vein, or Nerve enter; the first to bring

and carry back the Blood; the last to carry thither the Liquidum Nervorum or Nervous Juice, which mingling in the Veficula, with the Blood, doth very probably (it having an acid Taste, and therefore confifting of Particles which are pointed and fo qualified to prick and break the Globules of the Blood) let out the imprisoned elastick Air which before was contained in the Globules, into those little Vesicula, whereby the elastick Cells of the Fibres will be blown up, and thereby their Longitudinal Diameters, from Cell to Cell straitned; and this must contract the Length of the whole Fibre, and so move that Organ, to which one of the Tendons is fixt. This, saith Dr. Cheyne, Phil. Prin. Natural Religion, p. 221. is undoubtedly the true manner of muscular Motion.

He thinks also, that the broken Shells of these Globules are carried back by the Veins to the Lungs to be new formed; which is the Reason that muscular Motion is so constantly and uniformly performed, as long as the Blood Globules and A-

nimal Spirits are in sufficient Plenty.

MUSCULUS Tube novus Valfalva vel Palaco-Salpingeus, a Muscle arising broad and rendinous from the Edge of all the lunated Part of the Os Palati, several of its Fibres being spread upon the Membrane that covers the Foramen Narium, then growing into a small thin Tendon, it is reflected about the Hook-like Process of the inner Ala of the Processus Pteregoidaus internus, and is inserted carnons into all the membranous, fleshly, and cartilaginous Parts of the Tube. Its Use is to di-late and keep open this Channel. Myogr. compa-

rata Specim, p. 47.
MUSCULUS Auricula Anterior, is a new (5th) Muscle of the Auxicle, and added to the four before discovered by Cusserius, by the Discoverer of it

Valsalva in his Treatise of the Ear.

It arises from the investing Membrane of the Temporal Muscle, above that Part of the Zygoma which proceeds from the Os Temporis; thence running strait down, it parts into two; one of which is inserted to the Fore Part of the upper Cavity of the Concha; and the other a little higher, into the Fore Part of the Cavity of the Scapha. He describes there also two new Muscles more, which from their Situation he gives these Names to.

MUSCULUS Tragi, and but in lean ema-MUSCULUS Anti-Tragius ciated Bodies he

owns there are not to be feed.

MUSICK. What follows is a brief Account of the Elements of Musick, communicated by the ingenious Mr. John Porks.

The Thing confidered in Musick is Harmonical Sound, or Sound so manageable, as to please the

Ear and Fancy of the Hearers.

The Sense of Sound is caused in us by the trembling motion of the Air, excited by the Per-cussion of some solid Body, as a Bell, String, Pipe, &c.

This Trembling of the Air is quick or flow. according to the Impression given by the Voice or Instrument. The quicker the Trembling is, the more acute and sharp is the Sound; and the slower,

the more grave and flar,

The same Degree of Quickness of the Trembling or Pulses of the Air being continued, the same Sound or Note is continued also. Hence a founding String keeping the same Note to the last, the greatest to the least Ranges of its motion.

The shews, that its Vibrations are in equal Time from

The shorter a musical String is, cateris paribus, the quicker are its Vibrations, and the more acute its Note: And, contrariwise, the longer a String is, the more slow are its Vibrations, and the more grave its Note.

Hence the Proportions of the Degrees of Acuteness and Gravity of Notes are computed from the Divisions of a Monochord, or strained musical String.

The Proportion of Quickness in the Vibrations of two Strings, and also of the Pulses of the Air excited thereby, is Reciprocal or Counter to the Lengths of the Strings; so swice the Length gives (cateris paribus) balf the Quickness of Pulses (or balf the Number of Pulses in the same time,) If the Lengths are as 3 to 2, the Velocity of Pulses is as 2 to 3, &c. Hence the Relation or Proportion of musical Notes is determined as follows.

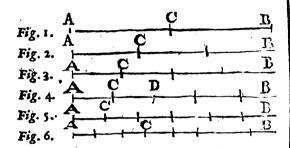


Fig. 1. Let AB represent a musical String (suppose a Bass Viol) strained so as to give a clear Sound. Let it be divided into two equal Parts at C. Stop the String at C, and the Part CB (being struck) will sound an OBave or Eighth to the Note of the whole String AB when unstopt. CB is in length to AB as 1 to 2; and the Vibrations of CB to those of AB (in the same Time) as 2 to 1. Hence the Proportion of an OBave or Diapason is Dupla, Double, 2 to 1.

Fig. 2. Let the String A B be divided into three equal Parts, of which A C is one. If the String be ftop'd in C, the Part C B will found a Fifth to the Note of the whole String. C B is to A B (in length) as 2 to 3, and the Vibrations of C B are to those of A B as 3 to 2 in Quickness. Hence the Proportion between the two Notes of a Fifth (Diapente) is Sesquialtera, 3 to 2.

Fig. 3. Let A C be a Quarter of the whole String A B. Stop in C, and the Part C B will found a Fourth to the Note of the whole String A B. Hence the Proportion between the Notes of a Fourth (Diatessaron) is Sesquitertia, 4 to 3.

Fig. 4. Let A C be a Fifth Part of the String A B. Stop in C, so will C B sound a Greater Third to the Note of the whole String A B. The Proportion therefore of the Notes of a Greater or Sharp Third is Sesquiquarta, 5 to 4.

Fig. 5. Let A C be the fixth Part of A B. Stop in C, so will C B sound a Lesser or Flat Third to A B, whose Proportion is therefore Sesquiquinta, 6 to 5.

If D B (Fig. 4) be \$\frac{2}{3}\$ of A B, B D will found a Greater Sixtb to A B.

• If C B (Fig. 6.) be f of A B, C D will found a Lesser Sixeb to AB.

From'what hath been said it follows, that

When two Notes in any of the precedent Proportions one to another, are founded together; their Sounds are agreeable and pleafing to the Ear, and are therefore called Concords. Of these the Eighth and Fifth are called Persest Concords; Thirds and Sixths are called Impersest Concords: The Fourth (anciently accounted a Concord) is by modern Musicians accounted a Discord to the Bass in Consort-Musick, as wanting a Fifth under to compleat the Harmony.

The above-mentioned are all the Simple Concords that the Ear allows of. If the Proportion between any two Notes be compounded of the Proportion of an Ostave with that of any other Concord, it retains the Name and Nature of the added Concord. So a Tenth, that is, an Eight and Third, is accounted but a Third; and so of the rest.

All other Proportions between 2 Notes founding together produce Discords, or Sounds harsh and unpleasing to the Ear, the Coincidencies of the Pulses being too remote one from the other.

By this it appears, that Commensurability in the Quickness of the Vibrations is necessary to Concordance; and the smaller the Numbers are that express the Proportion of the Pulses in the same Time, or the nearer their Coincidencies, the more persest is the Harmony. And consequently if their Pulses be of Incommensurable Velocities, the Discord will be in the bigbest Degree harsh and displeasing.

From this Account of Concords and Discords may a Reason be given of several Phænomena of Sounds, as particularly why two Strings of a Bass Viol that are Unisons or Ottaves one to the other, if one be struck, the other will tremble so as to be sensibly perceived if a small Bit of Paper be laid on it. For the String that is struck putting the Air into a certain Degree of trembling, which being the same, or next Degree of proportional Quickness to that of the unstruck String, sets it a trembling also. This Experiment, (and others of like Nature) Dr. Holder very well illustrates by the Instance of a Pendulum, which if you blow into Motion, and continue to blow unisonmly as it begins to go from you, it may be continued in Motion as long as you please; but if you blow irregularly (sometimes as it goes and sometimes as it comes) its Motion will be check'd, and at last cease.

Being once in a Room where was a Bass Viol, and striking one of the Strings, a loose Quarry of Glass in the Window jarr'd every Time that String was struck, which it would not do upon striking any of the other discording Strings. The Reason of which seem to be, that the Times of the Vibrations of the loose Quarry were equal (or in near Concordance) to those of the String.

Concordance) to those of the String.

From the foregoing Proportions may those of all other musical Intervals be computed by Compounding or Dividing. I'll give a few Instances, and for more refer to Dr. Holder's Grounds and

Principles of Harmony, where all Things are more

fully treated of.

Let it be required to find what Proportion the extreme Notes will have of Fourth and Fifth added together. The Proportion of the Notes of a Fifth is express'd by 3, that of a Fourth by 4: Compound these Proportions, so $\frac{1}{2} \times \frac{3}{4} = \frac{1}{6} = \frac{3}{4}$, which is the Proportion of an Offave: Whence it appears that a Fourth and Fifth added together make an Eighth. Again, to find the Difference between a Fifth and a Fourth; Divide by \(\frac{1}{2} \) \(\fr

To find the Difference between a Greater Sixth and a Fifth; Divide; (the Proportion of a Greater Sixth) by ? (that of a Fifth) it gives \$\frac{1}{2} \cdot \frac{1}{2}

To find the Difference of a Fourth and Greater Third, Divide $\frac{4}{3}$ by $\frac{7}{4}$ [$\frac{7}{4}$] it gives $\frac{16}{15}$, which is therefore the Proportion of a Semi-sone (or lesser gradual Interval) by which a greater Sharp Key.

Third and Fourth differ. In like manner may other Intervals be compared.

In a gradual Series of 8 Notes, there are contained 5 Tones, (or whole Notes) 3 Greater and 2 Lesser, and 2 Semi-tones (or half Notes) whose Order among themselves is different according to

The Key is the Principal or Fundamental Note. of a Tune, to which the rest have proper Resairons, and with which the Bass always concludes:

The Key is called Flat or Sharp, not as to the Key-Note it self, but with Respect to the Third, Sixth, and Seventh above it. A Flat Key is that which hath above it (and reckoning from the Key). a Lesser Third, Sixth and Seventh; and a Sharp-Key is that which hath a Greater Third, Sixth and Seventh; the 2d, 4th, and 5th being the same Intervals in both Keys.

The annexed Figures shew how a String is to be divided to express the Notes in a Flat or

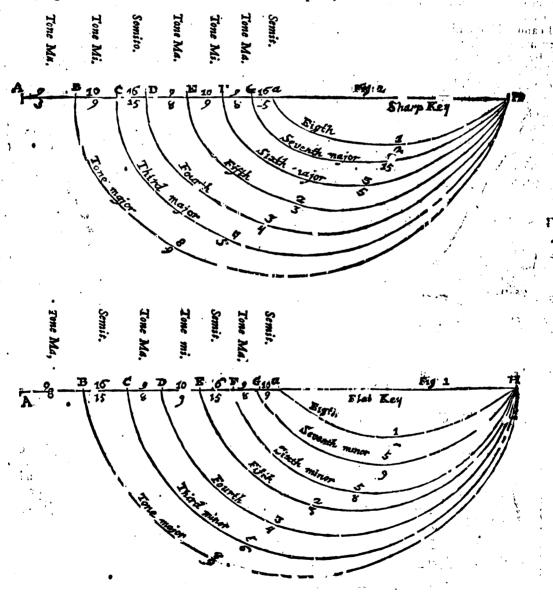


Fig. 1. A H is the whole String, whose Sound one to another, and also of the Length of Strings gives the Key-Note; B, C, D, &c. shew the Diffrom these Divisions to H: So is standing bevisions (or Stops) to express the Notes of a Flat tween D and E, shews, that DH is to E H as

The Numbers set to each little Part of the Line,

10 to 9; and so of the rest.

Upon the Arched Lines is express'd the Relation shew the Proportions of the next immediate Notes of the several Notes to the Key, and also of the founding founding Part to the whole String. So E H is 3 of a whole String, and founds a Fifth to the Key. In like manner Fig. 2. shews the Divisions in a

Sharp Key.

Suppose A H (Fig. 1.) be a Line 24 Inches long, then will A B be 23 Inches; A C 4 Inches, A D 6 Inches, A E 8 Inches, A F 9, A G 10 3 Inches,

A 2 12 Inches.

To express the Notes of a Sharp Key, let A H (Fig. 2.) be a Line 24 Inches long, then is A B 2 Inches, A C 4 Inches, A D 6 Inches, A E 8 Inches, A F 9 A G 11 A G 12 Inches.

If a middle fiz'd Gut-ftring be ftrained over a

Line thus divided at about a fifth Part of an Inch Distance from the Line, the Divisions mark'd in the Line will shew where to stop the String so as to express the several Notes.

Above and below the Eighth the Notes ascend and descend in the same order repeated, and therefore all Eights are called by the same Names, and (in the Gamus) figned with the same Letters of the

I cannot here omit two Observations that have been made relating to what has been faid: first by Sir Isaac Newton in his Treatise of Light and Colours, where confidering the Colours produced by the Sun's Light passing through a Triangular Glass Prism, and measuring the Space that each of the feven Colours (Red, Orange, Yellow, Green, Blue, Indico, Violet) take up, he found the Divisions of the whole Length of the coloured Image, to be the same with that of a Monochord into the Tones and Semitones of an Ollave. See pag. 92. of his Opeicks

The other Observation is concerning the Proportions of the Notes in a full Close upon an Organ or Harpsichord, viz. That they are as the Numbers 1, 2, 3, 4, 5, 6, in order, beginning from the as is here prick'd Bass, down.

All the Notes commonly used in Musick are compriz'd in their Order in a Scale which is call'd

The GAMUT.

11/11	•	-
	FX	
Ela Dia Gi	4 6	
Dia fol Cro fa	LC	[]
Alamire G GL 20 ut	σα	a /
F. Sa ut	0 F	
D. B. re	c d	H
B.Fu b mi	Б	H
G Sel reut	E	L:X
Ela mi		J.
Cfaut	C	
Are	A	
O WILLIAM	7	

Sometimes Ledger Lines are added above and

below, as Occasion requires.

In the first Column are fer the Names by which the Keys. or Notes, are commonly called, as Gamut, Aro, &c. In the second Column are set the 7 Letters belonging to the several Lines and Spaces. The third Column contains the Cliffs, and shews how many Degrees, or Notes, they are one above or below the other; which being known, the other Degrees of Distance are easily computed.

Five of these Lines, with their Spaces, are commonly sufficient for the pricking of a Tune; therefore is the whole Scale divided into 3 Systems or Staves, compassed in by arched Lines. Of these the lower 5 belong to the Bass, and are distinguish'd by this Mark Z upon the Line of F. The uppermost 5 Lines contains the Treble Part, which hath for its Cliff or Gs upon the Line of G. The Tenor, or middle Part, hath for its Cliff this Mark 其 upon the Line of C, which only is its proper Line, the other 4 being borrowed from the Treble and Bass.

Of Sol-faing, and Tuning Notes when prick'd down.

In learning to fing, it is necessary that the Notes Names, Places, and Difference in Sound from each other be well known, and a Habit got (by Practice) of naming and turning them right at Sight.

The Names in Use are but these 4 Monosyllables, fol, la, mi, fa; which yet must (and has been) own'd incongruous; for seven distinct Notes should certainly have as many Notes to distinguish them by. I shall therefore, after I have given a short Account of the Use of those Names. propose another way of naming the Notes in Singing, which I judge (and have found by Experience) to be better.

In order to Sol-fa a Tune, (that is, to name and tune the Notes right) the Place of mi must be sirst known, which is B in the Scale, as being the next Note above three Tones immediately succeeding each other. In case of Flats (b) and Sharp (\$\frac{1}{2}\$) the Place of mi is found as in this Table.

When
$$\begin{cases} F \text{ is} \\ F \text{ and } C \text{ are} \\ F G & C \text{ are} \end{cases}$$
 Sharp, mi stands in $\begin{cases} F \\ C \\ G \end{cases}$

The Place of mi being known, you ascend above mi by fa, sol, la, fa, sol, la; and descend below mi by la, sol, fa, la, sol, fa, calling all Eights by the same Name.

Mi in B. fa sol la fa sol la mi. Sol la fa sol la mi Mi in A. la fa sol la mi fa sol la fa sol la mi.

1,11

I'll now propose the other way of naming the Notes, that I mention'd before.

The seven musical Notes being express d in the Gamus by the 7 sirst Letters of the Alphabet, A. B, C, D, E, F, G; let these Letters be their Names whereby to express them in Singing. Only, for better Sound's sake, and to accommodate them to the Variations by Flass and Sharps, let A and E be call'd lA and lE. Let F be called Fà (with a broader Sound as in the Word Fall.) G and C are to be pronounc'd Ge and Ce; so will the 7 Names be IA, B, Ce, D, lE, Fà, Ge. When A and E are mark'd to be flat at the Beginning of the Staff of Lines, let them be called mA and mE; when B is Flat call it Be, as in the Word Benefit. When F is mark'd to be a Sharp, let it be call'd Fa, as in the Word Fatal. When C is Sharp call it Cee (its proper Name.) In like manner, when G is Sharp) let it be called Gee, not Ge.

By this means the proper Letter expressing each Note is preserv'd, and also a Provision made for Variation of the Name, according as the Note is varied to Flat or Sharp.

ing and a second second second second second second second second second second second second second second se



To fing a Tune true according as it is prick'd, is best and soonest learnt by the Assistance of one skill'd in Musick; but where such cannot be had, a Person who has naturally a Musical Ear and Fancy, may, (by the Method 1 shall here direct) attain to a competent Skill in Plain-Song, at least. In order to which, I shall only suppose that he can sing the Tune of Six Bells, which (with us in England, where that Number of Bells is so common) is no great Thing to suppose in a capable Learner.

There being in every Octave six Tones and two Semitones, (as has been shewn) it is necessary to true Singing, that these Tones and Semitones should keep their proper Places. In Order therefore to know and distinguish Tones and Semitones, the Learner must observe, that in the Tune of Six Bells, the Third and Fourth Notes (or Bells) are distant a Semitone; all the rest are distant (each from its next) by a Tone. A good Ear will easily observe the Third and Fourth Notes to be nearer Sound than the rest.

To apply the Tune of Six Bells to Notes prick'd.
in the Treble Cliff.



In this Example (consisting of 3 Bars or Divisions) you have in the first Bar the Notes of Six Bells, beginning at the Leger-line above the Staff, which is the Place of A, (according to the Order in the Gamue.) Begin with your Voice pretty high (that you may after reach the lower Notes in the other Bars) and sing 3 or 4 times distinctly the first six Notes, calling them 1, 2, 3, 4, 5, 6. Then call them by their proper Names, (set under the Staff) IA, Ge, Fa, IE, D, Ce; singing them in the same Tune that you did the Numbers 1, 2, 3, 4, 5, 6.

2, 3, 4, 5, 6.

Proceed to the second Bar, but first sing your former six Notes once or twice over, holding out the Note IB a little longer than the rest; then repeating only the three last Notes of the sirst Six, begin at IE in the second Bar, and sing IE, D, Ce, B, IA, Ge, in the Tune of Six Bells, keeping the three sirst Notes of this Six in the same Tune with the three last of the former Six. So are you led gradually one Note above an Oslave. If you stop at the lower IA, (one Note short of the last 6, you'will have a compleat Oslave from IA above to IA below, which is the Order of Notes in a Flat Key.

If your Voice will reach another six Notes, you may, in the Third Bar, repeat the two last Notes of the foregoing Six, and sing 1A, Ge, Fa, 1E, D, Ce, in the Tune of Six Bells.



In the 4th Bar, having fung the 6 Notes 1B, D, Ce, B, 1A, Ge, in the Tune of 6 Bells several times, try to sing them backward, as in the 5th Bar, Ge, 1A, B, Ce, D, 1E; which with a little heed may easily be done, as may also the other Six, beginning at 1A in the 6th Bar.

Here note, 1. That the Tune of Six Bells may

Here note, 1. That the Tune of Six Bells may begin either at IA or IE, and no where else without altering the Property by Flats or Sharps, of which anon. 2. That the two Semitones lie, one between B and Ce, and the other between IE and Fa.

The

The same Directions will serve for the following Notes set in the Bass Cliff, and therefore I shall only set down the Notes.

1, 2, 3, 4, 5, 6. 1, 2, 3, 4, 5, 6.

1A, Ge, Fâ, lE, D, Ce. lE, D, Ce, B, lA, Ge.

1st. Bar.

2d. Bar.

1, 2, 3, 4, 5, 6.

11, 2, 3, 4, 5, 6.

12, 3, 4, 5, 6.

13, G, Fa, 1E, D, Ce.

3d. Bar.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

16, D, Ce, B, lA, Ge. Ge, lA, B, Ce, D, lE.

Ath. Bar.

5th. Bar.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

14, Ge, Fd, lE, D, Ce. Ce, D, lE, Fa, Ge, lA.

6th. Bar.

7th. Bar.

Examples of rifing and falling the Voice by Leaps in the Treble Cliff.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

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1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

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1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 3, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 5, 4, 3, 2, 1.

1. 2, 4, 4, 5, 6. 6, 5, 6.

1. 2, 4, 4, 5, 6.

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1. 2, 4, 5, 6.

1. 2, 4, 5, 6.

1. 2, 4, 5, 6.

1. 2, 4, 5, 6.

6, 5, 4.

Ge, IA, B; Ge, B; B, Ge. Ge, IA, B, Ce;

7.

Ge, Ce; Ce, Ge. Ge, IA, B, Ce, D; Ge, D; D, Ge.
9.

Ge, IA, B, Ce, D, IE; Ge, IE; IE, Ge.

In the first Bar, sing the 6 Notes in order. In the 2d Bar, sing only the 3 first two or three times, then skipping he second Note D, sing IB, Ce several times, and then upwards Ce IE. In like manner proceed to the following Bars, singing the Notes in each Bar as they are prick d, till you have learnt to rarse and fall the Voice by the Leaps there set down.

lA, Ge, Fâ, lE, D, Ce; Ce, Ce; Ce, Ce,

In the 12th Bar, sing the 6 Notes, and in singing hold Ce the 3d Note, somewhat longer than the rest the better to hit it in beginning afterward at that Note: Then in the 12th Bar begin at Ce, and repeat Ce, B, lA, Ge, several times, and then going 2 Steps back, sing Six from lA to Ce, below; which will be an Octave to the Note Ce above.

Examples of raising and falling the Notes by Leaps in the Bass Cliff.

1, 2, 3, 4, 5, 6. 1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

1, 2, 3; 1, 3; 3, 1.

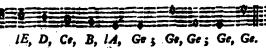
Ge, lA, B; Ge, B; B, Ge. Ge, lA, B, Ce 3

Ge, Ce; Ce, Ge. Ge, IA, B, Ce, D; Ge, D; D, Ge.

Ge, IA, B, Ce, D, IE; Ge, IE; IE, Ge.

lA,





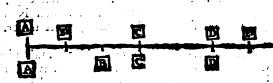
When Flats or Sharps (b, #) are fet at the Beginning of the Staff by the Cliff, they alter the Places for beginning the 6 Notes, by removing the Semisones (one or both) from their original Places; the Flat [b] removing its Notes a Semisone lower; and the Sharp [#] removing then a Semisone higher. When there are no Flats and Sharps, the Tune of Six Bells begins at IB and IA only; in other Cases as follows.

When \{ Be is flat \\ Be and m B are flat \} begin the \{ IA& D. \\ Tune of \{ Ge & D. \\ mA, Be& mB are flat \} \} \text{6 Bells at } \} \| Ge&Ce.

When { Fa is sharp begin the B& IE. When { Fa and C are sharp } Tune of B& Fa. 6 Bells at C & Fa.

An Example when B and E are flat.





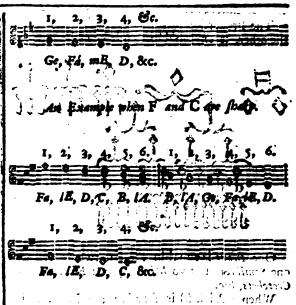
It may be a good Way to give Learners a Notion of the Alterations made by Flats and Sharps; in the Diftances of the Notes, to divide a Line into 12 equal Parts (which will do for this Purpose, tho in Strictness they should not be all equal) as the Line A a is here divided. Provide 8 little square Papers with these 8 Letters, A, B,C, D, E, E, G, a, upon each, one; and place them as on the underside of the Figure, which shews their natural Order, and the Places of the Semisenes between B and C, and between E and F. Suppose I should now see the Order of the Tones and Seminanes when B and E are signed flat in the Staff thus, to do this, I remove the Papers mark'd with B and E, one Degree (answering to

mark'd with B and E, one Degree (answering to a Semitane) lower, or nearer to A; and then the Papers will stand in Order as above the Line, and the two Semitones are now between A, B, and D, E. In case of Sharps, the Letter design'd to be sharp must be removed one Degree (or twelfth Part) higher, or nearer to a.

Thus may all the Varieties be represented to the Eye, and the Reason of beginning the Six Notes as is directed, be also understood.

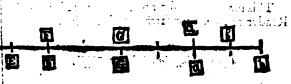
Of the Quantity of Notes as to Time.

Besides the giving to Notes their right Tune Vol. IL.



By the Table above, and shele two Estamples, may be understood how to place the Six Notes in any other Case of Flats and Sharps, or in other Cliffs. The Semitones in all Cases, he between the 3d and 4th Notes of the Six.

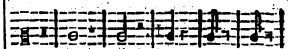
See more, with Application to Pfalmedi, in a Treatife called, A New and Eafy Method to learn to Sing by Book; Printed for W. Regers in Fleetftrees.



(according to their Places in the Staff of 5 Lines) Regard is also to be had to the Length or Short-ness of Time they are expressed in, which is known by the Figure or Shape of the Character by which they are pricked on the Lines.

The Names and Figures of the usual Notes in Respect of Time, and their correspondent Rests are as follow:

Breve, Semibreve, Minim, Cresbet, Quever, Semiquever,

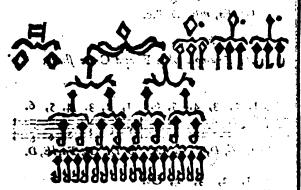


The Strokes or Marks set after each Note are called Rests or Pauses, and denote a Ceasing or Intermission of the Sound for the Time of the Notes they are join'd to.

Nas

The

The Proportion of the foregoing Notes, one to



One Breve is equal in Time to two Semibreves; one Semibreve to two Minams; one Minim to two Crotchets, &c.

When a Prick (.) is set after any Note, it increaces he Quantity ball as much more. So (3') is coyal in Time to () a Semibreve and Minim. A prick'd Minim (學!) is equal in Time to (字!) a Minim and Crotchet.

If the Words one, two, three, four be pronounced in a reading Tenor, the Time of promouncing cash Syllablemay be accounted the Meafure or Time of one Crasthes; and confequently, one, the, gives the Lime of a Minim; one, two, three, of a prick'd Minim; one, two, three, four, of a Semibreve.

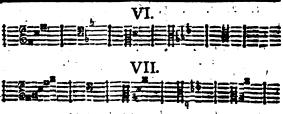
This may suffice for an Entrance, referring the Reader to Books for farther Information.

Of Singing in different Cliffs.

The Difference of Cliffs is what doth perplex Learners. They who can fing in the Treble Cliff, are at a Loss when they come to the Tener or Bajs Cliffs: I will therefore here give a Table, where-in all the usual Cliffs (or Positions of them) are so compar'd and order d, that he who can sing readily in one Cliff, may fing in any other in the Table.

A Table whereby all the usual Cliffs may be reduced to any one Cliff desired.





This Table, confifting of 7 Staves or Classes, contains in each Class all those (usual) Cliffs wherein the Semitones lie in the same Places of the Staff; and confequently what is prick'd in any Cliff, may be sung (or play'd) as if it were prick'd in any other Cliff of the same Class.

E. G. Suppose a Person hath learnt to sing in the Treble Cliff only, and would fing Notes prick'd in the Tenor Cliff on the middle Line with F#, thus let him look for this Cliff in the Table and he will find it in the second Class, where, at the Beginning is that is, the Treble Cliff with B flat. If he therefore fing the Notes as if they were in the Treble Cliff with B flat, he'll fing them as true as if he had understood the Tenor Cliff.

Ge, lA, B, Ce, D, lE, Fa, Ge. Examp Fà, Ge, IA, Be, Ce, D, IE, Fa.

In this Example, the Cliff at the Beginning of the Staff, is that to which the Notes are prick'd, and the Names (as in the Tenor Cliff) are fet above them. At the End is fet the Treble Cliff, in which the Notes may be fung, and their Names (as accounted in the Trable Cliff) as feet under.

Dr. Wallis, in Phil. Transact. N. 243. takes into Confideration the strange Reports we have of the Power of the ancient Musick; and the he judges they are in a great Degree Hyperbolical, if nor Pabulous; yet he thinks too that some Account may be given of the great Effects it's faid to have had, from these Considerations.

1. That Musick was then, if not new, a rare Thing; which the Rusticks, on whom it is reported to have had mighty Effects, had scarce even heard before; and on fuch, a little Musick will do great Feats; as we find at this Day a Fiddle or a Bagpipe hath at a Country Morice-Dance.

2. Their Musiek was much more Simple and Plain than ours now: They had no Conforts of 2, 3, 4, of more Voices or Parts; but one fingle Voice or Instrument a-part; which to a rude East is much more taking than compounded Musick 2 That not exceeding their Capacity, whereas This confounds them quite, and is by no means diffinguishable by them, so as to affect them with the Harmony of its Parts.

3. Musick, with the Ancients, was of, a much larger Extent than what we now call by that Name: for Poetry and Dancing (i. e. comely Motion) were then accounted Parts of Mufick when it had arriv'd to some Degree of Perfection. And we see that Verse of it self alone, if in good Measure, and moving Words, and this fet to a Musical Tune, sung by a decent agreeable Voice, accompanied with fost Instrumental Musick only, if with any; i. e. fuch as doth not drown or obscure the emphatical Expressions (like what we call Resistative Musick. tho' I doubt not more justly managed ; for I hope

the same Tone did not serve with them for making Love, Fighting, and delivering Letters) will work strangely upon the Bar, and move all the Affections suitable to the Tune and Ditty, especially if attended with a Gesture and Action suitable; for we see that fuitable Adien alone doth on the Stage, give great Life and Force to Words; and therefore all this together might eafily operate very ftrongly on the Fancies and Affections of ordinary People not used to such kind of Treatments: For if the deliberate reading of a Romance, (when well penn'd) will produce Mirth, Tears, Joy, Grief, Piry, Wrath or Indignation, suitable to the respective Intents of it, much more would it do, if accompanied with all these Attendants.

4. If it be ask'd, why may not all this be done now? I answer, no doubt it may: If the Address be made in proper Words, emphatically spoken, and in just Measures, with moving Arguments, pronounced by an agreeable Voice, and attended with a decent Gesture, and not drown'd by too much Musick, or over acted by apparent Affecta-

5. We should understand also, that the usual Design of what we now call Musick is very different from that of the Ancients; for that which we call fo, was but with them the Harmonick, i.e. but one Part of their whole Musick, which confifted of Words, Verse, Voice, Tune, Instrument,

and Acting.

6. When Musick arriv'd to good Perfection, it was applied by the Ancients to the exciting this or that particular Affection, Passion, or Temper of Mind the Tunes and Measures being suitably adapred to such Designs, whereas those are now almost quite neglected in our present Musick; the chief Design being now to please the Ear, when by a sweet Mixture of different Parts and Voices, with just Cadences and Concords intermix'd, a grateful Sound is produced: But this only the Judicious Musician, or one a good while used to fuch Compositions and Performances can distin-

gnish,
7. Tis true, that even this Compound Musick admits of different Characters; some is more brisk and airy, others more solemn and grave, as the different Subjects do require. But that which is most proper to excite particular Passions or Dispolitions, is such as is more Simple and Uncompounded; such as a Nurse's languid Tone sulling her Babe to Sleep, or a continued Tale (as in Ireland) or reading in an even Tone; or the loft Murmur of a little Rivulet running upon Gravel or Pibbles inducing a quiet Repose to the Spirits: and on the other Hand, the Briskness of a Jig, &c. on a Violin exciting to Dance; for these are more operative for such Ends than elaborate Composi-

tions of full Mulick.

The same excellent Author in N. 249. hath a judicious Discourse about the Impersection of that noble Instrument an Organ; where he observes, That each Pipe is designed to express a distinct Sound at such a Pitch, or at such a determinate Degree of Gravity or Acuteness, i. e. as it is now called of Flames or Sharpness; and the Relative or Comparative Consideration of the two or more fuch Sounds or Degrees of Flatness or Sharpness is the Ground of what we call Concord and Difcord; that is, a soft or harsh Coincidence. Concerning which there was among the ancient Greeks two Sects of Mulicians; the Aristoxenian and Py-

shagerean: But both agreed thus far, that Diaseffaren and Diapente do together make up Diapafon i.e. a Fourth and a Fifth make up an Bighth. And the Difference of these two, of a 4th and a 5th they agreed to call a Tone; which we now call a whele Note. Such is that in our present Musick of la mi; for la, fa, sol, la, or mi, fa, sol, la, is a perfect 4th, and la, fa, sol, la, mi, or la, mi, fa, fol, la, is a perfect Fifth. The Difference of which is la, mi; and this the Greeks called the Diagentick Tone, which disjoins two Fourths on each Side of it; and being added to either of them, makes a Fifth; which was That, in their Musick from Mese to Paramese, or in Ours from A to B, supposing mi to stand in B fa B mi, which is accounted its natural Position.

Now in order to this Aristoxenus and his Followers took that of a 4th, as a known Interval, by the Judgment of the Ear, and that of a Fifth likewise, and consequently that of an Offave, as the Aggregate of both, and that of a Tone as the Difference of those two. And this of a Tone (as a known Interval) they took as a common Measure by which they estimated other Intervals: And accordingly they accounted a Fourth to contain two Tones and \(\frac{1}{4}\), a Fifth three Tones and \(\frac{1}{2}\), and confequently an Eighth fix Tones, or five Tones and two half Tones; and at this Rate our practical Musicians talk of Notes and balf Notes at this Day; supposing an Ollave to consist of twelve half Notes.

But Pythagoras and those that follow'd him, not taking the Ear alone to be a competent Judge in a Case so nice, chose to distinguish these, not by equal Intervals but by due Proportions. And this is followed by Zarline, Kepler, Curees, and other Writers on Speculative Musick, in this and the last Age. Accordingly they accounted an Offave to be, when the Degree of Gravity or Acuteness of one Sound to another is double, or as 2 to 1. That of a 5th when tis Sefquialteral, or as 3 to 2. That of a 4th; when 'tis Sesquitertian, or as 4 to 3; accounting that the sweetest Proportion which is exprest in the smallest Numbers; and therefore next to an Unison they accounted the Odave, or of 2 to 1. Then that of a 5th, or of 3 to 2, and then that of a 4th, of of 4 to 3. And thus that of a 4th and 5th do together make an 8th, for $4 \times \frac{1}{2} = \frac{1}{4} = \frac{1}{4} = 2$: Or the Proportion of 4 to 3, compounded with that of 3 to 2 is the same with that of 4 to 2 or 2 to 1, and consequently the Difference of these two, which is that of a Tone or full Note, is that of 9 to 8: for \$)1(= + : Or if out of the Proportion of 3 to 2 you take that of 4 to 3, the Refult is that of 9 to 8. Now according to this Computation tisplain, that an Office is something less than 6 full Notes; for as hath been demonstrated by Euclid, and some others fince, the Proportion of 9 to 8 being 6 times compounded is something more than that of 2 to 1,1 for $+ \times + \times + \times + \times + \times + \times + = \frac{1}{12} + \frac{1}{12} + \frac{1}{12}$ which is more than $\frac{13}{12} + \frac{1}{12} + \frac{$ allowed to the Diazentick Tone, la, mi, the full Proportion of 9 to 8, as the unalterable Difference between the Fifth and the Fourth. All the Difficulty was how the remaining Fourth, viz. mi, fa, fol, la, should be divided into three Parts, so as to answer pretty near the Aristoxenians two Tones and an half; and might all together make up the Proportion of 4 to 3, which is that of a Diatessaron or Fourth.

Nnn 2

Many



Many Attempts were made to this Purpose, and according to these, they gave Names to the different Kinds of Musick, viz. the Diatonick, Chromatick, and Enharmonick, with the several Species or lesser Distinctions under these Generals.

The first was that of Euclid, (which obtained generally for many Ages) and which allows to fa, fol, and to fol, la, the full Proportion of 9 to 8; and therefore to fa, fol, la, which we now call the greater Third, that of 81 to 64; for + x = 11, and consequently to that of mi, fa (which is the Remainder to a Fourth) that of 256 to 243; for 34)4(256 i. e. if out of the Proportion of 4 to 3, we take that of 81 to 64, the Result is that of 256 to 243. To this they gave the Name of λείμμα, that is, the Remainder (over and above two Tones.) But in common Discourse, when we don't aim at speaking exactly, nor desire to be so understood, tis usual to call it an Hemitone or half Note, as being very near it; and the other two whole Notes: And this is what Ptolemy calls Diatonum Ditonum, (or the Diatonick Kind with two full Tones.) Against this it is objected, That the Numbers of 81 to 64, are too great for that of a Ditone or greater Third; which is not harsh to the Ear, but is rather sweeter than that of a single Tone, whose Proportion is that of 9 to 8. And in that of 256 to 243 the Numbers are yet greater much; whereas there are many Proportions (as $\frac{1}{2}$, $\frac{2}{7}$, $\frac{3}{7}$) in smaller Numbers than that of 9 to 8, of which in this Division there is no Notice taken, and consequently this Division is not the most convenient.

To rectify this, there is another Division thought more convenient; which is Ptolemy's Diatonum Intensum, of the Distonick Kind, but more Intense or Acute than the other; and this instead of two full Tones for fa, sol, la, assigns what we now call a Greater and a Lesser Tone; and this seems to have been more followed by the nicer Musicians of this and the last Age. To fa, sol, they assign the Proportion of 9 to 8, which is their greater Tone, and to sol, la, that of 10 to 9, which they call the lesser Tone; and therefore to fa, la, the Disone or greater Third, that of 5 to 4; for \(\frac{1}{2} \times \frac{1}{2}

Omitting to speak of the other Ways of Divifion, this is what we now call an Hemitone or half Note in mi, fa: is that of the greater Tone in fa, fol; and that of the leffer Tone in fol, la. Only with this Addition, That each of these

Only with this Addition, That each of thele Tones is now, on Occasion, by Flats and Sharps divided into Hemistones or half Notes; which answers to what the Greeks called the Change of Mood; and which is now done by removing mi to another Key, viz. $\frac{2}{3} = \frac{1}{12} = \frac{1}{12} \times \frac{1}$

This by the Help of Flats and Sharps, as they are now called, (dividing each whole Note by its greater or 'leffer into two balf Notes, or such as we call so.) The whole Oflave is divided into 12 Parts or Intervals, contained in an Organ between 13 Pipes; and these are commonly called Hemitones or balf Notes: Not that each is precisely an half Note, but somewhat near it, and so called. I say by Flats and Sharps, because sometimes one and sometimes the other is used: As for Instance, a Flat in D or a Sharp in C, do either of them denote a midling Sound (tho not precisely in the

middle) between D and C, flatter than D, and sharper than C.

According to this, supposing mi to stand in Bfa B mi (which is accounted its natural Place) the Sound of each Pipe is to bear these Proportions one to another, viz.

And so in each Offave successively following: And if the Pipes in each Offave be fitted to Sounds in these Proportions of Gravity and Acuteness, it will be supposed according to this Hypothesis, to be perfectly proportioned.

But instead of these successive Proportions for each Hemisone, it hath been sound necessary (if I do not mistake the Practice) so to order the 13 Pipes containing the 12 Intervals or Hemisones, as that their Sounds, as to Gravity and Acuteness, shall be in continual Proportion (that is, each to its next sollowing in one and the same Proportion) which altogether shall compleat that of the Osave or Diapason, or as 2 to 1, whereby it comes to pass, that each Pipe doth not express its proper Sound, but very near it, tho something varying from it: And this they call Bearing, which is somewhat of Impersection in this noble Instrument the Organ, the Top of all.

It may be ask'd, Why may not the Pipes be so ordered as to have their Sounds in just Proportion as well as their Bearing?

I answer, it might very well be so, if all Mufick were composed to the same Key, or as the Greeks call it, the same Mode; as for Instance, if in all Compositions, mi were always in B fa B mi, then the Pipes might be ordered in fuch Propor. tions as I have now defign'd. But Mufical Compositions are made in great Variety of Modes, or with great Diversity of the Pitch. Mi, is not always placed in B fa B mi, but sometimes in B la mi, sometimes in A la mi re, &c. And indeed there is no one of these B Pipes but may be made the Seat of mi; and if they were exactly to any one of these Cases, they would be quite out of Order for all the rest. As for Instance. if mi be removed from B fa B mi (by a Flat in b) to E la mi, instead of the Proportions but now designed. they must be thus ordered.

Where it is manifest, that the Removal of mi doth quite alter the whole Series of the Proportions. And the same would again happen if mi be removed from E to A, by another Flat in E: and again if removed from A to D, and so perpetually. But the Hemitones being made all equal, they do indifferently answer all the Positions of mi (tho not exactly to any) yet nearer to some than to others;

others; whence it is that the same Tune stands better in one Key than in another.

Nor can this ever be remedied, but only in Part, by making the Imperfection something less by the Interpolition of quarter or baif quarter Notes, &c. for it hath been long fince demonstrated, that there is no such thing as a just Hemitone practicable in Musick (and the like holds for the Division of a Tone into any other Number of equal Parts) for supposing the Proportion of a Full Note or Tone to be for as 9 to 8; that of the half Note must be, as .v. 9. to the .v. 8, that is, as 3 to the $\sqrt{.8}$. or 3 to 2 $\sqrt{.2}$, which are incommenturable Quantities: and that of a Quarter Note will be as 4/. 9. to 4/. 8, which is yet more incommensurable. And the like for any other Number of equal Parts; which therefore will never fall; in with the Proportions of Number to Number.

So that this can never be perfectly adjusted for all Keys, without something of Bearing, by multiplying the Pipes. Unless for every Key, or for every different Place of mi there be a different Set of Pipes, of which this or that is to be used, according as (in the Composition) mi is supposed to be in this or that Place. Which wast Number of Pipes for every Octave, would greatly encrease the Charge, and after all, make the whole impracti-

cable.

Authors of Note who have treated on this Subject of Musick.

Claudii Ptolemai Harmonicorum Lib. III. By Dr. Wallis. Oxon. 1682. 450. Porphyrii Comment. in Lib. 4. Harm. C. Ptolemai atque Manuelis Bryennii Comment, in 3 Libros Harmonicos ejufdem: Ptolemai. (Qui soli restant ex Gracis Musica Scriptoribus nondum Editi.) G. L. Cura J. Wallisii in Felio.

Syntagma Musice, Treating of Musick Philosophically, Mathematically, and Practically, by 3. Birchensba, Esq.

Musica Speculativa des Mengoli. Belogna. 1670.

Philosophical Effay of Musick, Lond. 1677. 450. A Treatise of the Natural Grounds of Harmony. By Dr. Holder, Lond. 1694. 8vo.

An Essay to the Advancement of Musick. By Tho. Salmon, M. A. 1672. 8vo.

Marci Meibomii Antiqua Musices Scriptores. G.L. Amft., 1652.

Morley's Introduction to Musick. Des Cartes's Musick,

30. Cochai Tetrachordon Musices. Cleonidis Musica. Fol. .

Fabis Stapulensis Elementa Musices.

Salmon's Theory of Musick in Philof. Trans. N.

MUTUUM, in the Civil Law, is a Loan simply so called; or a Contract introduced by the Law of Nations, in which a Thing that confifts in Weight, (as suppose Bullion) in Number, as Money: or in Measure, as Corn, Wine, Oil, &c. is given to another upon Condition that he shall return another Thing of the same Quantity, Nature, and Value, upon Demand.

So that this is a Contsact without Reward, and admits, properly speaking, of no Recompence. And therefore where Use and Interest is agreed on, they arise from some distinct particular Argu-

ment, or by Custom of the Country.

NAT

NAMATION, is the same as Distreyning or taking a Distress; and in Scotland 'tis used for Impounding.

NASALIS or Rhinaus, is a Pair of proper Muscles belonging to the Cartilaginous Part of the Nose; it arises fleshy from the Extremity of the Os Nasi and adjacent Part of the Os Maxillare, and is inserted into all the Cartilages of the Ala; its Use is to open and dilate the Nostrils, by putting that outwards.

NATIVO habendo, was a Writ that lay to the Sheriff, for a Lord, whose Villain claimed for his Inheritance, run from him, for the apprehending

and restoring him to his Lord again.

NATURAL History, is a Description of any of the natural Products of the Earth, Water or Air, such as Beasts, Birds, Fishes, Metals, Minerals, Fossiles, together with such Phanomena as at any time appear in the Material World; such as Meteors. ජිද

Some Writers on this Subject are these:

Plinii Historia Naturalis Dalechampii. Gen. 1631. Joan. Eusebii Nierembergii Historia Natura. Antw. 1635

Mart. Lister Historia Conchyliorum, Lond. 1685 Fr. Wiltoughbei Historia Piscium.

NAT

Ornishologia (ejusdem Authoris) sive de Avibus. Moufertus de Insectis. Lond. 1634. Garneri Historia Animalium Gurnerus Rolfincius de Vegetabilibus. Jenæ. 1670. 4to.

Martyn Lister's Historia Animalium Anglia. Fred Lackmund, Admirand. Fossilium Descriptiones. Swammerdam's Hist. Generalis Insectorum, G. Pisonis de Re Naturali, &c. Índia Utriusque. 3. Johnston's Historia Naturalis. History of Animals by the Academy of Sciences.

Plot's Natural History of Soxfordshire.

Historia Naturalis de Terrante. Merret's Pinax Rerum Naturalium Anglia.

NATURE. Besides the three Senses of this Word mentioned in Vol. I. it is sometimes used for this vast Machine of the Universe, the wise Production of Almighty God, consisting of a great Number of leffer Machines, every one of which is adjusted by the same Wisdom in Number, Weight and Measure.

Laws of Nature, fignify those Laws of Motion by which natural Bodies are governed in all their Actions upon one another, and which they inviolably observe in all the Changes that happen in

the natural State of Things. An Account of these Laws see in Motion.

Sir Isaac Newton at the End of his excellent Opticks, (Lat. Edit.) observes, That Universal Nature is very Simple and Uniform in its Operations. All the Motions of the heavenly Bodies are caused by that Astracting Force, Impulse or Power which we call Gravitation; and which is mutual amongst all those Bodies. All the lesser Motions of the Particles or Corpuscles of Matter whereby Bodies act on one another, are effected also, by some attracting and repelling Force; which is mutual and re-

ciprocal amongst them.

The Visinereia, is a Principle purely passive, by which Bodies persist in their State of Rest or Motion, whereby they receive Motion from others equalor proportionable to the moving Force; and whereby they refift as much as they are refifted. But from this Principle alone there never could have been any such Thing as Motion, any where in the Universe. There is a Necessity of supposing some other Principle to be the Origin of Motion, and its Constitution too: For from the various Compositions of two Motions, its plain that there cannot be always the same Quantity of Motion in the World, for if two Globes, connected together by a stender Thread, be supposed to revolve with an uniform Motion round their common Centre of Gravity; and at the same Time that Centre should move on Uniformity also in a Right Line coincident with the Plane of the Globes Orbits: Then will the Summ of the Motions of those two Globes, whenever they happen to be both in the Right Line described by the common Centre of Gravity, be greater than the Summ of their Motions can be, when they are in a Line at Right Angles to that. By which Instance 'tis apparent, That Motion is producible and destructible. But from the Tenacity and Astricion of the Particles of Fluid Bodies, and the Imbecility of the Elastick Force in solid Bodies, we may conclude, that the course of Nature tends more to the Destruction than the Production of Motion; and indeed it is continually decreasing, for Bodies that are either so perfectly bard, or throughly soft, as to have no Elasticity, cannot be reverberated back from one a nother, and from their Impenetrability only it would follow that their Motion would stop, and terminate. If therefore there were any such things as the Imaginary Vortexes of Des Cartes, their Motion must be continually decreasing, and at last must quite cease. Since therefore Motion is thus continually decreasing in the Universe, we must have Recourse to some active Principles, to increase and preserve it; viz. to such as the Cause of Gravity and Fermentation: By the former of which the Planets and Comets perpetually move in their Orbits, and Bodies by descending gain a great Velocity or large Quantity of Motion; and by the latter, the Heart and Blood of Animals is preseryed in Motion and Warmth: The internal Parts of the Earth are perpetually getting Heat, many Bodies burn and shine, Volcanoes and Earthquakes are produced, and the Sun it self preserves his Light and Heat, and warms and cherishes all Things: For we find very little Motion in the World (except what is voluntary in free Agents) but what depends on these active Causes.

So that after well confidering and undestanding these Things, our admirable Author, (whose Piery and Goodness is as eminent as his profound Mathematick Learning and Penetration into Universal Nature) concludes, that our perfectly good, most wise, and Almighty Creator, did in the Beginning of the World, create Matter so as that its original Particles, from whence all corporeal Natures were to arise, were folid, firm, impenetrable, perfectly passive and moveadle; and that they were made of such Magnitudes and Figures, and endued with such Properties, and in that Number and Quantity as was proportionable to the Space in which they were afterwards to move, in order to the most effectual obtaining of those Ends and

Purposes for which they were created.

And these original primary Particles being perfectly solid, must be much more hard and firm than any Bodies that can be made out of them with Pores, hidden Meetuses, or Vacuities interspersed; that is, so perfectly hard and firm, that they can never be worn away or diminished; for tis not reasonable to suppose that there should be any Force or Power in the ordinary Course of Nature, that can divide that into more Parts, which God in the first Creation of Things, hath made ons. As long therefore as these original Particles remain entire, there may for ever be Bodies made or composed of them; which shall have the far e Nature and Texture: But if these can be broken, worn away, or diminished, then the Nature of corporeal Things which is dependent on these in a te be changed. Earth and Water composed of eather fuch Particles as have been worn or broken, or of their Fragments, could not have at this D v, the same Nature and Texture, that original Earth and Water which was composed of these Particles when they were found and entire. Wherefore that the Nature of Things should last, and their Natural Course continue the same; all the Changes made in Bodies must arise only from the various Separations, new Conjunctions and Motions of these original Particles. For mix'd or compounded Bodies are broken or destroyed, not by the breaking to Pieces of their folid original Particles, but by separating them one from another, and disposing them in those Places where they touch'd one another but in a little Part of their Surface. And these Original Particles, seem not only to have in them the Vis Inertia and all those Passive Laws of Motion which necessarily arise from thence; but receive also Motion continually from certain Active Principles; viz. such as Gravity the Caufe of Fermencation and of the Cobesion of the Parts of Matter. And these Principles are not to be considered as occult Qualities which are seigned to arise from the Specifick Forms of Things, but as the Universal Laws of Nature by which Things them-selves are formed. For that there are really such Principles; the various Phænomena of Nature do demonstrate, tho' what their Causes are hath not yet been explained: For to affert that the several Species of Things are endued with Specifick Occule Qualities, by which they have a certain Force or Power in acting, is in Reality to say Nothing. But from the Phænomena of Nature to derive two or three general Principles of Motion; and from thence to explain how the Properties and Actions of all Corporeal Things may be deduced from those Principles, would be a very great Progress in Natural Philosophy, although the Causes of those Principles should be yet undiscovered.

NAVAL Architecture. See Shipping.

NAVE

NAVE, in Architecture, lignifies the main Bo-

dy of a Church,

NAVEL-STING. See Umbelical Vessels.

NAVIGATION. Backs on this Subject are; Sir Jenas Moor, in 2 Vol in Quarto. Wright's Correct Errors in Navigation.

Norwood's Epitome of the Art of Navigation. Sturmy's Mariners Magazine.

Seller's Practical Navigation.

Norwood's System \ His Seaman's Practice., of Navigation S — Companion.

Phillips's Geometrical Seaman.

Colfon's Calendar.

Martin's Art of Navigation, Perkin's Scaman's Tutor.

Eden's Art of Navigation.

Tresor de Navigation par M. Blondell. Collin's Plain Scale new plained.

Jones's Navigation.
Newton's Idea of Navigation and Geography,
Atkinson's Epitome of Navigation
Hodgson's Theory of Navigation demonstrated. 400.

NEALING of Secol, is heating of it in the Fire to a Blood red heat and then taking it out and letting it cool gently of it solf. This is done to make it folter, in order to engrave or punch up-

NEAR, at Sea, when the Conner commands, the Man at the Helm 19 fer the Ship full to Lee-ward, his Word is No near.

NEBULOUS-sears, seen thro good Telescopes appear to be Clusters of small Stars, as appears by the Observations of Cassing and Figureau. See Philos. Trans. N. 123.

NECYDALUS, the Same with Nympha, a lean used in the Natural History of Insects. See

NEIFE, Nativa: is a Bond-woman. An. 1 E. S. 3. and 9 R. 2. cap. 2. But it the married a Freeman the was thereby made free; and when once made free after, without some special Act done by her; as Diyorce or Confession in a Court of Record. Nor shall a Free-woman be bound by taking a Villains after their Father. There was also anciently a Writ of Neife, whereby the Lord claim'd his Neife; but all this is now out of Doors.

NEWEL, in Architecture, is the upright Post

that the Cale of winding Stairs turns round about.

NITRE See Clark's Natural History of Nitra.

Lond 1670, in 800. Mp. Boyle's Tract about the Redintegration of Sale Patra.

NOBLE; there both not been any Piece of Gold (or Silver) of this Name coined with us fince 9 H. 5. They were first coined by E. 3. 1344.

The Noble contained 80 Pence; its half, which was then colled Objected its 4th Barr the Own. was then called Obelus 40 d, its 4th Part the Quadrans or Farthing in these Days 20 d, NOCTURNAL. There are several Sorts of

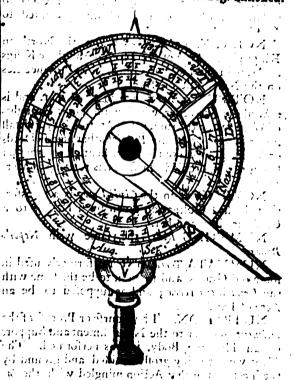
Nocturnals, of which some may be Projections of the Sphere; such as the Hemispheres or Plani-spheres on the Plane of the Equinoctial; but the Scamen ule only two, and the Manner of using either is the same. One of them is fitted for the Pole-Star and the first of the Guards of the Little Bear; and the other for the Pole-Star and the Guards or Pointers (as some call them) of the Great Bear.

The Instrument confists of three Parts or Pieces; the largest of which hath a Handle to hold it by when you would observe; and opposite to the Handle there is a small Tooth or Point, which (if it be made for the Little Bear) stands against the 25th of April; but if for the Great Bear, against the 17th of February; which are the Times of the Year when those Stars come to the Meridian at 12 at Night. On this bigger Part or Piecethen are two Circles described; the outermost hath the Months and their Days, and the innermost hath the 24 Hours of a Natural Day; on the backfide of this Piece also are the 32 Points of the Compass designed, and marked with their initial Letters.

The second Part of the Nocturnal hath two Circles described on it; of which the outermost is divided into 29 1 equal Parts, for the Days of the Moon's Age; and in the innermost into 24 Hours; And at the Beginning of the Days of the Moon's Age, and at XII, there is a Tooth to be

fet to the Day of the Months in the upper Part.

The third Part is an Index with a Fiducial Edge issuing from the Centre; and must be so long, that a good Part of it may extend beyond the outermost or biggest Piece. These three Parts are so ordered, that by Means of a small hollow Brass Socket they are made to move about the Centre of the Instruments. See the Fig. annexed.



The Hes of this Intrument are;

1. To find the Hour of the Night.

To do which, fet the Tooth to the middle Parc of the Day of the Month, and then turning the foreside of the Instrument towards you, Hold it up towards the North, and incline the upper Part toward you, till thro' the Hole in the Middle you can see the Pole-Star; there hold it fast, and turn the long Index about, till by its Edge you can see either the first of the Guards of the Little Bear, or the Pointers of the Great Bear, (according as the Instrument is made) and then shall the Edge of

the Index or Ruler, in the innermost Circle of the middle Part shew you the true Hour of the Night.

2. To find on what Point of the Compass the

This will appear on the backfide of the Nocturnal, after you have found the Hour of the Night, as above; for the Index will be on the same Point of the Compais as the Guards really are.

3. To find at what Hour the Meon will be full South on any Day of her Age.

Seek the Moon's Age in the outermost Circle of the middle Piece, and then right against it in the innermost Piece, is the Hour required.

Thus if the Moon be 11 Days old, you will find she will be on the Meridian at 8 Hours

48 min.

NODATED Hyperbola: So Sir IJ. Newton calls a peculiar kind of Hyperbola, which by turning round decussates or crosses it self. See Curves.

NOMINATION; this Word as well by the Canonifts as common Lawyers, is used for a Power that a Man hath by vertue of a Mannor or otherwise, of appointing or naming a Clerk to a Patron of a Benefice, to be by him presented to the Ordinary

NORROY, or North-Roy, i. s. the Northern Kings; is the Title of the Third of the three Kings at Arms in the Heralds-Office. His Province lies

on the North-fide of Trent.

NOTARY, is mentioned in 27 E. 3. 1. and is a Scribe or Scrivener, which makes short Draughts of Writings or Instruments. At this Day we fall him a Notary or Notary Publick, that attests Deeds or Writings to make them authentick in another Country, and chieffy in Russians Coloring. Country; and chiefly in Business relating to Mer-

NOVATION, in the Civil Law, is a transferring the first Obligation given by a Debtor to a

Creditor, into another.

NUMBRING Ruds, the same with Neper's

NUMMATA Terra, a Term formerly used in some old Grants, and thought to be the same with the Denariatus Terra; and is supposed to be an Acre of Land.

NUTRITION. The Course or Process of the Aliment in order to the Nourishment and Support of an Humane Body, is thus performed. The Meat we eat being groffy davided and ground by the Teeth, is in that Action mingled with the Salive, which helps to ferment and dilute it. Thence thro the Oesophagus or Gullet by the Constriction of its Fibres 'tis thrust down into the Stomach; where being further softened and swell'd by the Inices contained in the Glands of the Stomach, its Parts are farther broken and the intimate Cohefion

A continuo de la continuo del continuo del continuo de la continuo del continuo del continuo de la continuo del continuo d

estal of.

of them destroyed, and they divided one from 2nother, by the perpetual Motion of the Coats of the Stomach and by the Muscles of the Midrif and Abdomen. By this Pressure also of the Sides of the Stomach upon the contained Aliment, that is thrust down into the Intestines; at its Entry into which it is mix'd with the Bile and Pancreatick Juice, the one to sweeten, the other to dilute the Chyle. By the Peristaltick Vermicular Motion of the Guts, (arifing from the Alternate Action of their Spiral and Longitudinal Pibres) and by the Pressure of the Draphragm, and the Muscles of the Abdomen, the groffer Parts of the Chyle are derived downwards to be thrust out of the Body; while the finer are squeezed into the narrow Orifices of the Lasteal Veint, which opens into the Intestines; from whence in slender Channels they are carried into the Glands of the Mesentery; where they receive a fine thin Lympha from the Lymphatick Dulls, which further dilates it and focurs its containing Vessels; which Vessels going from those Melenterick Glands unite into larger Channels, and those into still larger, and at last pass directly into the common Receptacle of the Chyle; which is a kind of Bason formed for it in the Union of these Ladeal'and Lymphatick Vessels. From thence in one Duct it ascends into the Thorax, and sometimes dividing about the Heart, it immediately unites again, and creeping along the Gullet, it passes on to the left Subclavian Vein, where in one or two Months it pours in its Contents, and there mixes with the poor Venal Blood returning from all Parts of the Body. And thus doth the Blood receive its Supply and Noue rishment.

But if you take Nutrition in the Sense which some do, of the Blood nourithing the several Parts of the Body: Then will that kind of Nutrition be performed by a Secretory Duck arising from the Termination of an Artery, and carrying a fuirable Portion of the Blood to every Part to be nourish ed; so that every Point of the Body must be the Termination of a Secretary Dust thro which a pro-

20 21.

per Part of the Blood is brought in order to sup-ply that Part of the Body. NYMPHA, in such Insects as undergo a Transformation, is the very first Change of the Eruca, or of the Vermiculus Prior, or Maggot; or indeed, as Swammerdam hath proved (in his Hift. Infell. general.) rather the Growth and Increase of the Eru-ta, whereby the Figures of the succeeding Animal is beginning to be expressed by the Explication of its Members, which before lay involved up in the Bruce (like a Plant in its Seed;) so that in Reality it is only the Animal under that imperfect Form is called the Nympha, the Word being taken from Arifotle in his Hift. Anim. Lib. v. c. 19: where he uses it for the first Rudiment of an Insect. This Nympha is sometimes called Chrysalis, sometimes Aurelia, and sometimes Necydalus; all which Terms fignify the same Thing. spirit ;

and the second of the second o

Control of the Contro

The Seven Ansiphones or Alternate Hymns of Seven Verses, &c. sung by the Choire in the Time of Advent, was formerly called O, from their Beginning with such an Exclamation.

OATH, in the Law-Sense, is an Affirmation or Denial by any Christian of a Thing lawful and honest, before one or more that have Authority to give the same; for the Advancement of Truth and Right, calling Almighty God to witness that his Testimony is true. Tis called sometime his Cor-Testimony is true. Tis called sometime bis Corporal Oath, because he toucheth with his Hand some part of the Holy Scripture of the New Testament, and most usually of the Four Gospels (whence the Phrase for lawful swearing is Sacro-(antiis Tattis Evangeliis.)

OBEDIENTIA, was anciently used as a Term for Rent; but in the Common Law 'Tis taken for an Office, or for the Administration of an Office;

and thereupon

OBEDIENTALES, is used in the Provincial Conftitutions for those that have the Execution of

any Office under their Superiors.

OBIT, fignifies an Office for the Dead or a Funeral Solemnity: The Anniversary of any Person's Death was also called an Obis. And in Religious

Houses, &c. they had formerly an OBITUARY, which was a Register or Calendar wherein they enter'd the Obits or Obitual

Days of their Founders or Benefactors.

OBLATA; were formerly Gifts made (tho properly Offerings) to the King by any of his Subjects; and were so carefully taken Notice of by K. John and Hen. 3. that they were enter'd in the Fine Rolls under this Name of Oblata.

OBLATE; were the Consecrated Wafers or Hofts distributed to the Communicants in the Mass or Sacrament of the Altar; and sometimes

the customary Treats in Religious Houses have been called by this Name of Oblata.

OBLATIONS of the Alter, were customary Offerings from the Parishioners to their Priest, which were solemnly laid upon the Altar; of which the Mass or Sacrament Offerings were usually Three-pence at Christmas, Two-pence at Easter, and a Penny at the two other principal The customary Duesalso for Sacramentalia or Christian Offices, were comprehended under this Title; and also all little Summs for saying Masses for the Souls of Persons deceased.

OBLATIONES Funerales, were the Soul Scene or Offerings to expiate the Omissions or Defaults of the Party deceased in paying Tythes or other Ecclesiastical Dues: At sirst this was an Oblation at the Funeral, and was often the best Horse of the Defunct, led before the Corps, and delivered at the Church-Gate or Grave, for the Use of

the Parish-Priest.

To this Custom we owe the Original of Mor-If the Corps were buried any where else, tnaries. the Offerings were due to the Parish-Priest where

the Party died.

At the Burial of the Dead, it was a Custom for the furviving Friends to offer liberally at the Altar, for the pious Use of the Priest, and the good Estate of the Soul departed; and the Reliques of Vol. II.

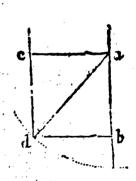
this superstitious Custom do still remain in North Wales, where at the Rails of the Communion-Table, there is a Tablet or flat Board fixed, to receive the Money, which at most Funerals is offered by the surviving Friends, according to their own Ability and that of the Deceased. Dr. Ken-

net's Gloffary

OBLIGATION, by the Civilians, is defined to be a Cause of Altion, and a legal Bond or Tie which compells by Action to give or to do according to the Roman Law. And they divide Obligations into Natural, Civil, and Mix'd: a natural Obligation is what arises only from meer natural Equity; and this they diftinguish into Bf. fedual and Ineffedual: The former of which, tho there is not Ground enough for Action by the Reman Law, yet may bar by Plea and Exception; but the latter hath no Affistance from any positive Law, but consists meerly in the Conscience or Pleasure of the Party. A pure Civil Obligation owes its Original or Birth to the Strictness of a positive Law, without Natural Equity. A Mix'd Obligation is a Legal Bond, having its Strength both from Natural and Civil Laws.

OBLIQUE Force, is that whose Line of Direction is not at Right Angles with the Body on whom it is imprest. The Ratio which such an Oblique Force to move a Body, bears to a Direct or Perpendicular Force, will by this Diagram be easily understood to be always as the Sine of the Angle of Incidence is to the Radius. Let a b be the

Side of any Body on which an Oblique Force falls, with the Direction da; draw d c at Right Angles to db, a Perdendicular let fall from d to the Body to be moved, and make a d the Radius of a Circle. Tis plain, that the Oblique Force da, by the Laws of Composition and Refolution of Motions will be resolved into the two



Forces de and db, of which de being parallel to a b, hath no Energy or Force to move that Body; and consequently db expresses all the Power of the Stroke or Impulse upon the Body to be moved. But db is the Right Sine of the Angle of Incidence dab; wherefore the Oblique Force da, to one falling perpendicularly is as the Sine of the Angle of Incidence to Radius. Q. B. D.
OBLIQUITY of the Ecliptick. 'Tis well

known that the Plane of the Terrestrial Equator is inclined to that of the Ecliptick in an Angle of 23 Degr. 30 Min. or rather more accurately 23°. 29! And this Angle (allowing for a very small Nutation of the Earth's Axis, which tho' neceffarily deducible from the Principles of the Newtonian Astronomy, need not here be considered) hath always yet continued the same : As any one may find if they will on the two Solftitial Days observe the Sun's Meridian Altitudes, and then freeing them from Refractions, Parallax, &c. Ŏ o o

fubrrace the Winter from the Summer Altitude; for then half the Difference between them will be found to be 23°.29'. the Quantity of the Angle of the Inclination or Obliquity of the Ecliptick to the Plane of the Equator.

OBOLUS, the now taken to fignify our Half-penny, anciently fignified the Half Noble. The Noble or Floren being called a Penny, and its quarter part a Farebing: And indeed in the old Histories and Accounts of Coin, you are to underfland by the Word Denarius, the whole Com, be it Angel, Rial, &c. and by Obolus its half; and by

Quadrans its fourth part.

OBSERVATION. The Seamen call an Ob-Servation the raking the Sun or any Stars Meridian Altitude, in order thereby to find their Latitude; and how they do this you will find under that Word: And they call finding the Latitude by the

Name of Warking an Observation.

OCCIPITO-Frontalis, is a Muscle of the Skin of the Occiput and Os Frontalis, which is usually called Occipitalis; it arises fleshy from the transverse Line of the Occiput, opposite to part of the Superior Termination of the Mastaidaus, and part of the Beginning of the Trapezius next it, and then tendinous from the rest of the Line backwards, arifing after the same Manner on the other fide: from thence it goes strait up, and soon becoming all tendinous, it covers the two Parieparal Museles, its outer Edge being fastened to the Os Jugale on each Side. This broad Tendon near the Coronal Suture grows fleshy, and descends with streight Fibres as low as the Musculi Orbiculares. It is inserted into the Skin at the Eyebrows having fent down between them a narrow fleshy Slip or Elongation which is continued over the Offa Nasi, as far as its Cartilaginous Patts, where its Fibres run off on each Side, and terminate in the Skin above the Musculus Nusi proprius When this Digrastick Muscle, which covers all the upper Part of the Scull like, a Cap, acts, it pulls the Skin of the Head backwards, and at the same time draws up and wrinkles that of the Forehead. and is antagoniz'd by the Corrugator.

OCCUPANCY, in the Civil Law, is the Pos. session of such things as at present belong to no private Person, but however are capable to be made so; as by seizing or taking of Spoils in War, of things wild by Nature, as Birds and Beats for Game, &c. or by finding things before undiscovered, or truly lost, or lost by their proper-

OCCUPIERS of Walling, are certain annual. Officers in the Cheshire Salt-works, who see Right: done between Lord and Tenant, and all Persons concerned; they appoint also how many Houses shall work at a Time, &c. and order a Cryer to proclaim the Time of kindling the Fires, Ge.

OCEAN, is the vast Collection or Union of all the Seas which compais round the whole Earth, and in which the two great Continents of Europe, Afia, and Africa on one fide of the Northern, and Southern America on the other, are but like two large Islands. This great and universal Ocean, is sometimes by Geographers divided into 3 Parts; as 1. The Atlantick and European Ocean, lying between Part of Europe Africa, and America. 2. The Indian Ocean, lying between Africa, the E. Indian Islands, and New Holland. 3. The great South Sea

or the Pacifick Ocean, which lies between the Philippine Islands, China, Japan, and New Holland, on the West, and the Coast of America on the East. Sometimes also with Regard to Europe, they call that the Hyperborean Ocean which encloses it on the North; and that which encloses it on the West, the Western Ocean. That Sea which encloses Asia, on the North and East is often called the Tartarean, and sometimes the Chinese Ocean; and on the South Asia is bounded by three Seas. which are called the Indian, Persian, and Arabian Also the great Sea on the East of Africa, Ocean. is called the Oriental Ocean, as is also that vast Sea which encloses America on the East.

OCTAVES, in old English the Uta's were eight Days after any eminent Festival; and such Festivals are enumerated in the Laws of Edward

the Confessor.

OCTO Tales. See Tales.

ODIO and Atia, was an old Writ mentioned in the Statute of Westminster 1. and made 3 E. 1. cap. 11. It was directed to the Sheriff, to enquire whether a Man committed to Prison for a Suspicion of Murder, be committed on just Cause, or only upon Malice : If the latter were the Cause, then another Writ came to the Sheriff to Bail him. But now this Course is taken away by 28 E. 3.

OECONOMICUS, was formerly used for the Executor of a last Will and Testament, as the Perfon who had the Oeconomy or Fiduciary Difpo-

sal of the Deceased's Goods.

OFFERTORIUM, formerly was used for a Piece of Silk or fine Linnen, to receive and wrap up the Oblations or occasional Offering in any

OGEE, Ogive, and as it is often written O-G- is a fort of Moulding in Architecture, confifting of a Round and a Hollow. Vitruvius makes it two quarter Circles. Scamozzi and some others, make the Arches flatter. Tis almost in the Form of an S, and is the same with what Vitruvius calls Cima. Cima reversa is an O - Gwith the Hollow downwards, as some define ir.

OLERON Laws, are so called, because made when King Richard I. was there (i. e. at Oleron, an Island in the Bay of Aquitain in France) they

have Respect to Maritime Affairs. OPACITY. Sir Is. Newton. O

OPACITY. Sir If. Newton, Opticks, Book 2. shews that the Opacity of all Bodies arifeth from the Multitude of Reflections caused in their Internal Parts: And he shews also, that between the Parts of the epake and coloured Bodies, there are many Spaces either empty or replenished with Mediums of other Densities; and he shews the true or principal Cause of Opacity to be this Discontinuity of their Parts; because some opake continuity of their Parts; because some opake Bodies become transparent by filling their Pores. with any Substance of equal or almost equal Den-sity with their Parts. Thus Paper dipp din Water or Oil, the Oculus Mundi Stone steep'd in Water, Linnen Cloth oil'd or varnished, and many other Substances soaked in such Liquors as will inti-mately pervade their little Pores, become by that Means more transparent than otherwise; as on the contrary, the most transparent Substances may, by evacuating their Pores or separating their Parts, be render'd sufficiently opake; as Salts or wet Paper, or the Oculus Mundi Stone by being dried, Horn by being scrap'd, Glass by being pouder'd or flaw'd, Water by being form'd into small Bubbles.

Bubbles either alone in the Form of Froth, or by shaking it together with Oil of Turpentine, or some other convenient Liquor with which it will

not perfectly incorporate.

Bur however, to render Bodies opake and coloured, their Interstices must not be less than of some definite Bigness; for the most opacous Bodies that are, if their Parts be subtilly divided (as when Metals are dissolved in acid Menstruums) become perfectly transparent. And on this ground it appears, why Water, Glass, Salt, and some Stones are transparent, for they are as full of Pores and Interstices as the Bodies are; but yet their Parts and Interstices are too small to cause Reslections in their common Surfaces: Wherefore white Metals become opake not from their Consity alone, but from their Parts being of such a bigness as sits them to reflect the White of the first Order. And as he shews, that the White of the first Order is the strongest which can be made by Plates of transparent Substances, so it ought to be stronger in the denser Substances of Metals than in the rarer ones of Air, Water and Glass. And he thinks that metallick Substances of such a Thickness as may fit them to reflect the White of the first Order der, may by reason of their great Density reslect all the Light incident upon them, and so be as opake and splendent as 'tis possible for any Body to be. See Colours. See Colours.

OPENING of the Trenches; is the first breaking Ground of the Besiegers, in order to carry on their Attacks against the Town. The Difference between this and carrying on the Trenches, is, that this is only the Beginning of the Trenches, is, that this is only the Beginning of the Trenches. It is begun by a small Foss or Ditch which the Pioneers make in the Night on their Knees, usually about a Musket-shot from the Place, but if there be no hollow nor rising Ground to savour them, they begin farther off. This small Foss is afterwards enlarged by the next Pioneers which come behind the first; and so 'tis dug deeper by Degrees till it be about 12 Foot broad and 5 Foot deep. The Earth that is dug out is thrown up as they go along; and serves them for a Parapet to save them from the Fire of the Town. The Place where the Trenches are opened, is called the End of the Trench.

OPPOSITE Sections. If a Cone be cut by a Plane through its Vertex, and afterwards by a fecond Plane parallel to the former, this latter Plane produced through the opposite Cone, will there make the opposite Sections. See Conick Sections.

OPTICK Pyramid, is made by Rays coming from the several Angles of the superficial Base of

A E

any Object, and united in a Point in the Eye of the Spectator. Thus if ABC DE be the Base of the Eye in O, the Oprick Pyramid OABCDE O. And when the Base is a Right-Line, as suppose AE or CD, then the Triangle OAE or OCD is called the

OPTICK Triangle, as the Angle AOE or COD, is called the Optick Angle.

OPTICKS, taken properly and simply, is that Science which teaches the Properties of Direct Vision; but in a larger Sense it may comprehend

the whole Doctrine of Light and Goloure, and all the Phænomena of visible Objects. In this large Sense our incomparable Sir Is. Newton calls his Book of Light and Colours, Opticks; and from thence the following Brief Introduction to this Science is taken.

DEPINITIONS

BEFFN. I.

By the Rays of Light I understand iss least Parss, and those as well successive in the same Lines an contemporary in several Lines. For it is manifest that Light consists of Parts both successive and contemporary; because in the same place you may stop that which comes one Moment, and let pass that which comes presently after; and in the same time you may stop it in any one place, and let is pass in any other. For that Part of Light, which is stopt cannot be the same with that which is let pass. The least Light, or part of Light, which may be stopt alone without the rest of the Light, or propagated alone, or do or suffer any thing alone, which the rest of the Light doth not or suffers not, I call a Ray of Light.

DEFIN. IL

Refrangibility of the Rays of Light; is their Difposition to be refracted or turned out of shair Why in
passing out of one transparent Body or Medium into
another. And a greater or toss Refrangibility of
Rays, is their Disposition to be turned mule or less
out of their Way in like Incidences on the same Modium. Mathematicians usually consider the Rays
of Light to be Lines reaching from the luminous
Body to the Body illuminated, and the Refraction
of those Rays to be the bending or breaking of
those Lines in their passing out of one Medium into another. And thus may Rays and Refractions
be considered, if Light be propagated in an Instana
But by an Argument taken from the Aquations of
the times of the Eclipses of Jupiter's Satellises it
seems that Light is propagated in time, spending
in its passage from the Sun to us about seven Minutes of Time: And therefore I have chosen to
define Rays and Refractions in such general terms
as may agree to Light in both Cases.

DEFINITIII. TO SERVE

Reflexibility of Rays, is their Disposition to be turned back into the same Medium from any other Medium upon whose Surface they fall. And Rays are more or less reflexible, which are turned back more or less easily. As if Light pass out of Glass into Air, and by being inclined more and more to the common Surface of the Glass and Air, begins at length to be totally reflected by that Surface 5 those sorts of Rays which at like Incidencies are reflected most copiously, or by inclining the Rays begin soonest to be totally reflected, are most reflexible.

DEFIN. IV.

The Angle of Incidence, is that Angle which the Line described by the incident Rays contains with the Perpendicular to the resteding or refracting Surface at the Point of Incidence.

0002

DE.

DEFIN. V.

The Angle of Reflexion or Refraction, is the Angle which the Line described by the restlected or refracted Ray contained with the Perpendicular to the restlecting or refracting Surface at the Roint of Incidence.

DEFIN. VI.

The Sines of Incidence, Reflexion, and Refraction, were she Sines of the Angles of Incidence, Reflexion, and Refraction.

DEFIN. VII.

Who dright mbose Reys are all alike Refrangible, I wall Simple, Hamageneal and Similar; and that whose Regrangible than others, I wall a companied, Hateregoneal, and Diffinitar. The former digits it call Homogeneal, not because I would affirm it form all respects; but because the Rays which agine in Refrangibility, agree at least in all chose their other Properties, which I consider in the following Discourse.

DEFIN. VIII.

The Coleurs of Homogeneal Lights, I call Primaty, Homogeneal and Simple; and those of Heterogeneal Lights, Heterogeneal and Compound. For these are always compounded of the Colours of Homogeneal Lights; as will appear in the following Discounter

AXIOMS.

1 ada rol

a multiple

AX. I.

The Angles of Incidence, Reflexion, and Refrac-

AX. IL

The Augh of Reflexion is equal to the Angle of Incidence.

AX. III.

If the refracted Ray be returned directly back to the Point of Incidence, it shall be refracted into the Line before described by the Incident Ray.

AX. IV.

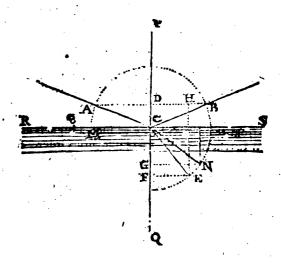
Refraction out of the rarer Medium into the denfer, is made towards the Perpendicular; that is, so that the Angle of Refraction be less than the Angle of Incidence.

A X. V.

The Sine of Incidence is either accurately or very nearly in a given Ratio to the Sine of Refraction.

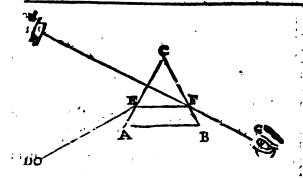
Whence if that Proportion be known in any one Inclination of the incident Ray, 'tis known in all the Inclinations, and thereby the Refraction in all Cases of Incidence on the same refracting Body may be determined. Thus if the Refraction be made out of Air into Water, the Sine of Incidence

of the red Light is to the Sine of its Refraction as 4 to 3. If out of Air into Glass, the Sines are as 17 to 11. In Light of other Colours the Sines have other Proportions; but the Difference is folittle, that it need seldom be considered.



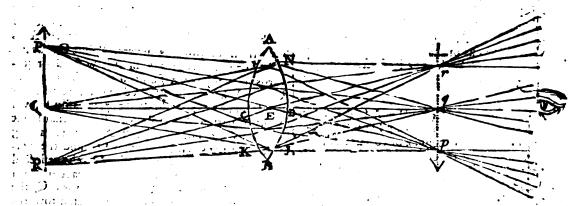
Suppose therefore, that R S represents the Sur-face of stagnating Water, and C is elepoint of Incidence in which any Ray coming in the Air from A in the Line A C is reflected or refracted, and 4 would know whether this Ray should go after Reflexion or Refraction: I erect upon the Surface of the Water from the point of Incidence the Perpendicular C P and produce it downwards to Q, and conclude by the first Axiom, that the Ray after Research and Refraction, shall be found some where in the Plane of the Angle of Incidence ACP produced. I let fall therefore upon the Perpendicular CP the Sine of Incidence AD; and if the reflected Ray be defired, I produce A D to B, so that D B be equal to A D, and draw C B. For this Line CB shall be the reflected Ray; the Angle of Reflection B C P and its Sine B D being equal to the Angle and Sine of Incidence, as they ought to be by the second Axiom. But if the refracted Ray be desired, I produce A D to H, & that DH may be to AD as the Sine of Refraction to the Sine of Incidence, that is, as 3 to 4; and about the Center C and in the Plane A C P with the Radius C A describing a Circle ABE I draw parallel to the Perpendicular CPQ, the Line HE cutting the Circumference in E, and joyning CE, this Line CE shall be the Line of the refracted Ray. For if EF be let fall perpendicularly on the Line PQ, this Line BF shall be the Sine of Refraction of the Ray CB, the Angle of Refraction being E C Q; and this Sine E F is equal to DH, and consequently in Proportion to the Sine of Incidence A D as 3 to 4.

In like Manner, if there be a Prism of Glass (that is, a Glass bounded with two equal and parallel Triangular Ends, and three plane and well polished Sides, which meet in three parallel Lines running from the three Angles of the one End, to the three Angles of the other End) and if the Refraction of the Light in passing cross this Prism de desired.



transverily to its three Parallel Lines or Edges, as 11 to 17, by the third Axiom.

there where the Light passeth through it, and let DE be the Ray incident upon the first side of the Pritm AC where the Light goes into the Glass; And by putting the Proportion of the Sine of Incidence to the Sine of Refraction as 17 to 11 find E f the first refracted Ray, Then taking this Ray for the Incident Ray upon the fecond fide of the Glass B C where Light goes out, find the next refracted Ray F G by putting the Proportion of the Sine of Incidence to the Sine of Refraction as 11 to 17. For if the Sine of Refraction as 17 to 11, the Sine of Incidence out of Class be to the Sine of Refraction as 17 to 11, the Sine of Incidence out of Class into Air to 11, the Sine of Incidence out of Glassinto Air Let A B C represent a Plane cutting this Prism must on the contrary be to the Sine of Refraction



Much after the same Manner, if ACBD re-Much after the same Manner, if AUBD represent a Glass spherically convex on both Sides be a reflecting or re-Spectacle-glais, or an Object-glass of a Telescope) and it be required to know how Light falling upon it from any lucid Point Q shall be refracted, let Q M represent a Ray falling upon any point M of its first spherical Surface A C B, and by esecting a Perpendicular to the Glass, at the point M, find the first refracted Ray M N by the Proportion of the Sines 17 to 11. Let that Ray in going out of the Glass be incident upon N, and then find the second refracted Ray N y by the Proportion of the Sines 11 to 17. And after the same Manner may the Refraction be found when the Lens is convex on one side, and plane or concave on the other, or concave on both Sides.

A X. VI.

Homogeneal Rays which flow from several Points of any Object, and fall almost perpendicularly on any reflecting or refracting Plane or Spherical Surface, Shall afterwards diverge from so many other Points, or be parattel to so many other Lines, or converge to so many other Points; either accurately or without any sensible Error. And the same thing will happen, if the Rays be resteded or refraded successively by two or three or more Plane or Spherical Surfaces.

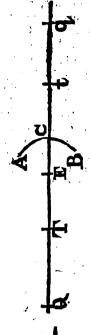
The Point from which Rays diverge, or the which they converge, may be called their Floud. And the Focus of the incident Rays being given, that of the refracted or reflected ones may be found by finding the Refraction of any two Rays, as 42 bove; or more readily thus,

the Focus of the inci-dent Rays, and Q q C a Perpendicular to that Plane. And if this

a Perpendicular to that Plane. And if this Perpendicular be produced to 4, to that 9 C be equal to Q C, the Point 9 thall be the Focus of the reflected Rays. Or if 4 C be taken on the lame fide of the Plane with Q C and in proportion to Q C as the Sine of Incidence to the Sine of Refraction, the point 4 thall be the Focus of the refracted Rays.



any Sphere whose Center is E. Bisect any Radius thereof (suppose E.C) in T, and if n that Radius on the same Stde the point I you take the Points Q and q, so that TQ. TE, and Dy be continual proportionals, and the point Q be the Focus of the incident Rays, the point Q shall be the Focus of the reflected ones.



Case 3. Let BCB be the refracting Surface of any Sphere whose Center is E. In any Radius thereof E C produced both faces. ways take E T and C r severally in fuch Proportion to that Radius as the leffer of the Sines of Incidence and Refraction hath to the difference of those Sines. And then if in the same Line you find any two Points Q and q, so that TQ be to E T as E to t q, taking t q the contrary way from which T Q lieth from T, and if the Point Q be the Focus of any incident Rays, the Point q shall be the Focus of the refracted ones.

And by the same means the Focus of the Rays after two or more Reflexions or Refractions may be

found. 🗧

Case 4. Let A C B D be 2ny refracting Lens, ipherically convex or concave or plane fracted Rays found as above, when the incident Rays on both sides the Lens are parallel to the same Axis; and upon the Diameter Ff bisected in E, describe a Circle. Suppose now that any Point Q be the Focus of any incident Rays. take sq in such proportion to E as E or TE hath to TQ. Let * g lie the contrary way from * which T Q doth from

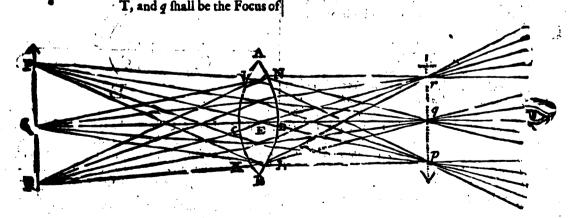
the refracted Rays without any sensible Error, provided the Point Q be not so remote from the Axis, nor the Lens so broad as to make any of the Rays fall too obliquely on the refracting Sur-

And by the like Operations may the reflecting or refracting Surfaces be found when the two Foci are given, and thereby a Lens be formed, which shall make the Rays flow towards or from what place you please.

So then the Meaning of this Axiom is, that if Rays fall upon any plane or spherical Surface or Lens, and before their Incidence flow from or towards any Point Q, they shall after Reflection or Refraction flow from or towards the Point q found by the foregoing Rules. And if the incident Rays flow from or towards several Points Q, the reflected or refracted Rays shall flow from or towards so many other. Points q sound by the same Rules. Whether the resected and resracted Rays flow from or towards the Point q, is cafily known by the Situation of that Point. For if that Point be on the same side of the reflecting or refracting on either side, and let C D Surface or Lens with the Point Q, and the inciwhich cuts both its Surfaces flow towards the Point Q, the reflected flow towards the Point q and the refracted from it; and if the incident Rays flow towards Q, the reflected flow from q, and the refracted towards Spheres,) and in this Axis let F and f be the Foci of the refracted Rays found as about

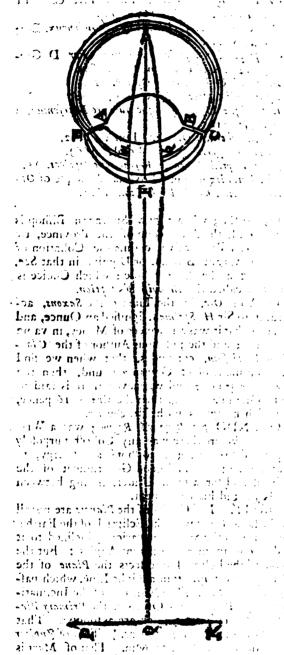
A X. VII.

Where-ever the Rays which come from all the Points of any Object meet again in so many Points Draw Q E cutting the said after they have been made to converge by Reflexion Circle in T and t, and therein or Refraction, there they will make a Picture of the Object upon any white Body on which they fall.



So if P R represent any Object without Doors, Light there to fall upon it: The Picture of that and A B be a Lens placed at a Hole in the Window-shut of a dark Chamber, whereby the Rays per Shape and Colours. For as the Light which that come from any Point Q of that Object are made to converge and meet again in the point q; and if a Sheet of white Paper be held at q for the of the Object, will go to so many other correspondent frondens

spondent Points p and r (as is manifest by the fixth Axiom;) so that every Point of the Object shall illuminate a correspondent Point of the Picture, and thereby make a Picture like the Object in Shape and Colour, this only excepted that the Picture shall be inverted. And this is the Reason of that vulgar Experiment of casting the Species of Objects from abroad upon a Wall or Sheet of white Paper in a dark Room.

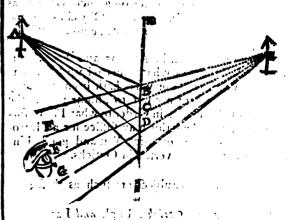


In like manner when a Man views any Object POR, the Light which comes from the several Points of the Object is so refracted by the transpal rent Skins and Humours of the Eye, (that is, by the outward Coar E F G called the Tunica Cornels, and by the criffalline Humour AB which is beyond the Rupil, m k) as to converge and meet again at so many Points in the Bottom of the Eye; and there to paint the Picture of the Object upon that Skin (called the Tunica Retina) with which the Bottom of the Eye is covered. For Anatomics, when they have taken of from the Roman the Bottom of the Eye is covered. For Anatoling-glass m n, it shall appear, not in its proper mists, when they have taken off from the Bottom of the Eye that outward and most thick Coat call any Rays A B, A C, A D, which slow from one led the Dura Mater, can then see through the thinled the Dura Mater, can then fee through the thin-

mer Coats the Pictures of Objects lively painted thereon. And these Pictures propagated by Motion along the Fibres of the Optick Nerves into the Brain, are the Cause of Vision. For accordingly, as these Pictures are perfect or imperfect, the Object is seen perfectly or imperfectly. If the Eye be tinged with any Colour (as in the Disease of the Jaundice) so as to tinge the Pictures in the Bottom of the Eye with that Colour, then all Objects appear tinged with the same Colour. If the Humours of the Eye by old Age decay, so as by shrinking to make the Cornea and Coas of the Cry-Stalline Humour grow flatter than before, the Light will not be refracted enough, and for Want of a sufficient Refraction will not converge to the Bottom of the Eye, but to some Place beyond it, and by Consequence paint in the Bottom of the Eye a confused Picture, and according to the Indistinct ness of this Picture the Object will appear confu-This is the Reason of the Decay of Sight in old Men, and shews why their Sight is mended by Spectacles. For those Convex-glasses supply the Defect of Plumpness in the Eye, and by encreasing the Refraction, make the Rays converge sooner, so as to convene distinctly at the Bottom of the Eye, if the Glass have a due Degree of Convexity. And the contrary happens in short-sighted Men whose Eyes are to plump. For the Re-fraction being now too great, the Rays converge and convene in the Eyes before they come at the Bottom; and therefore the Picture made in the Bottom, and the Vision caused thereby, will not be distinct, unless the Object be brought so near the Eye, as that the Place where the converging Rays convene may be removed to the Bottom, or that the Plumpness of the Eye be taken off, and the Refractions diminished by a Concave-glass of a due-Degree of Concavity; or lastly, that by Age the Eye grow flatter till it come to a due Figure: For short-fighted Men see remote Objects best in Old Age, and therefore they are accounted to have the most lasting Eyes.

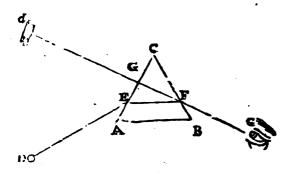
A X. VIII.

An Object feen by Reflection, or Refraction, appears in that Plate from whence the Rays after their lafe Reflection or Refraction diverge in falling on the Speciator's Eye.

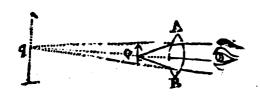


If the Object A be feen by Reflexion of a Look-Reflexion

Reflection made in the Points B, C, D, diverge in going from the Glass to E, F, G, where they are incident on the Spectator's Eyes. For these Rays do make the same Picture in the Bottom of the Eyes as if they had come from the Object really placed at a, without the Interpolition of the Looking-glass; and all Vision is made according to the Place and Shape of that Picture.



In like Manner the Object D seen through a Prism appears not in its proper place D, but is thence translated to some other place d situated in the last refracted Ray F G drawn backward from F to d.



And so the Object Q seen through the Lens AB, appears at the Place 4 from whence the Rays diverge in passing from the Lens to the Eye. Now it is to be noted, that the Image of the Object at q is so much bigger or lesser than the Object it self at Q, as the Distance of the Image at q from the Lens A B is bigger or less than the Distance of the Object at Q from the same Lens. And if the Object be seen through two or more such Convex or Concave-glasses, every Glass shall make a new Image, and the Object shall appear in the Place and of the Bigness of the last Image. Which Confideration unfolds the Theory of Microscopes and Telescopes. For that Theory consists in almost Nothing else but the describing such Glasses as shall make the last Image of any Object as distinct and large and luminous as it can conveniently be

I have now given in Axioms and their Explications the Summ of what hitherto hath been treated of in Opricks. For what hath been generally agreed on I content my self to assume under the Notion of Principles, in Order to what I have further to write. And this may suffice for an Intro-duction to Readers of quick Wit and good Understanding not yet versed in Opticks.

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per Fr. Mar. Grimaldi. Bononiæ. 1665. 410. Cogitationes Physico-Mechanica de Natura Visio-nis. Per J. Ott. Schaphusam. Heidelburgh. 1670. 450.

Synopfis Optica per Honorat. Fabrum, Lugduni. 1667. L'Occhiale all' Occhia overa Dioperica Praffica. del Carlo Ant. Mancini. Bolognæ. 1660. Lectiones 18 Cantabr, in Scholis Habita in quibus Opticorum Phenomenan genuina Rationes inveftigantur & exponuntur. Per D. If. Barrow. Lond. 1669. 4to. La Dioptrique Oculaire, par le Pere Cherubin D'Orleans, Paris, 1691 Fol. A Treatife of Dioptricks, or Will, Molineur, E(q; F. R. S. 400.

Catoperica & Dioperica Elementa. Par D. Gregorium, M. D. Oxoni 1695. 800.

Albazent & Vitellionis Opeica. Folionali Opeica. Anny 1613. Folio L. Opeique & Catoperique du Pare Marfennes, a 1651. Christ. Scheineri Optica. Lond. 1612.
Jacobi Gregorii Optica. Lond. 1663.
Joan. Bapeist. Porta de Refractione Optices. 15.
Mr. Leibnizz his one Universal Principle of Op-

OPTION; when a new Suffragan Bishop is consecrated, the Archbishop of the Province, by a customary Prerogative, claims the Collation of the first vacant Benefice or Dignity in that See, according as he shall choose; which Choice is

sicks in Att. Erud. Lipft Jun. 1682.

therefore called the Archeiste's Option.

ORA or Ore, in the Lithe of the Saxons, according to Sir H. Spelman, lignified an Ounce, and he saith, that it was also apiece of Money, in value 16 pence; and the judicious Author of the C bro-nicon Pretiosum, concludes, that when we find Mention made of 12 Orgein a Pound, then the Ora is 20 pence; and whenever there is said to be 15 Oræ in a pound, then the Ora is 16 pence, in which he agrees with Mr. Somner.

ORANDO pro Rege of Regno; was a Writ formerly (before there was any Collect purposely appointed,) requiring the Bishops and Clergy, to pray for the peace and good Government of the Realm, and for a good Understanding between

the King and his Parliantest. ORBIT. The Orbits of the Planets are not all in the same Plane with the Ecliptick of the Earth's Orbit round the Sun; but variously inclined to it and to one another at different Angles: But the Plane of the Ecliptick interfects the Plane of the Orbit of every Planes in a Right Line, which pafses thro' the Sun. The Quantities of the Inclinations of the Planes of the Orbits of the Primary Planets to that of the Ecliptick are as follows. of Saturn is an Angle of 2 Degr. 1. That of Jupiter is an Angle of 1 Degr. 20 Min. That of Mars is almost 2 Degr. Venus is a little more than 3 Deg. 20'. And that of Mercury is a little more than 7.

Degr.
ORDEAL, was the old Judicial Custom of proving the Guili, or attesting the Innocence of parties accused; chiefly by Water or Hot Iron. deal was simply call'd Judicium, in Opposition to Bellum, which was Duel or Combat Fight, the other customary purgation. Neither of these Tri-als were taken away by William the Conquerour, as Sir W. Temple afferts. Ordeal might be undergone by Servants or Deputies in the Cause and Name of their Masters; especially of those Lords who were Bishops and Ecclesiastical Men. Dr. Kennett's

Kennet's Glossary at the End of his Parochial An-

ORDINANCE of the Forest, is a Statute made about Forest Causes in the Thirty Fourth

Year of Edw. I. See Assize.
ORDINATE Figures (in Geometry) are the fame with Regular ones; that is, they are Equi-

lateral and Equiangular.

ORDONANCE, in Painting or Sculpture, is the just and elegant Composition of the whole Piece by a proper, natural, and agreeable Difposition of the Figures, so as to answer the De-

fign of the History.

ORGANICAL Description of Curves, is the Method of Describing them on a Plane by the Regular Motion of a Point. See some excellent short Theorems for this, invented by Sir If. Newson, under the Word Curves.

ORIGINALIA, is the Term for Records or Transcripts sent out of the Chancery into the Lord Treasurer's Remembrancer's Office in the Exchequer: These are distinguished from Recorda, which fignify the Judgments and Pleadings in Suits try'd before the Barons of that Court.

OSTINEÆ, so some Anatomists call the Entrance into the Cavity of, or the Mouth of the Matrix, where it joins the upper End of the Vagina, and makes a little Protuberance in the Form of

OVARIA: The Ovaria in Women are about half as big as the Testicles in Men; their Surface is smooth and equal in Virgins, but in Women of Years unequal and wrinkled. They are covered with a proper Membrane, which sticks close to their Substance, and with another common from the Peritonaum, which covers also the Spermatick Vessels. The Substance of the Ovaria is composed of Fibres and Membranes, which leave little Spa-

ces, in which there are several small Vesicles, round, full of Water, and which when boiled, harden like the Whites of Eggs; they have each of them two proper Membranes, on which there are several small Twigs of Veins, Arteries and Neryes. These Vesicles are called Eggs. The Ovaria have Nerves also from the Intercostals, and Lymphaticks, which discharge themselves into the common

Receptacle of the Chyle.

OVOLO or Echinus, in Architecture, is a part of the Ornaments or Mouldings of the Cornish of a Pillar; which in the Tuscan and Dorick Orders is turned like a Scima or Cymatium, and is substituted for the Support of the Corona; in the Dorick Order it usually hath a slender Regula above it, and in the Corinthian both above and below too. where it is likewise carved and adorned with a broad Welt like a Plinth.

OUSTER la main, in a legal Sense, denotes a Judgment given tor him that sued or traversed a Monstrans le Droit; and is indeed a Delivery out of the King's Hands; for when it appeareth on the Matter discussed, that the King hath no Right or Title to the Thing seized, then Judgment shall be given in the Chancery, that the King's Hand be amoved, and thereon an Amoveas Manum or Ouster la main shall be awarded to the Escheator; which is as much as if Judgment were given that he should have his Land again. Now, all Wardships, Liveries, Primier Seisins, and Ouster la mains are taken away by 12 Car. 2. c. 24,

OUTFANGETHEF, was a Privilege granted to some Lords of Mannors from the Crown, to try Foreigners or Strangers apprehended for Theft within their own Fee.

O YES, is a Corruption from the French Oyez ! hear ye! being the Form used by our Criers in Courts, &c. to make Proclamation of any Thing.

P. A. I

PACK of Wool, is a determinate Quantity of 17 Entresiens sur les Vies & sur les Ouvrages des plus Stone and two Pound Weight, being a common Horse Load.

PACTUM Commissorium, in the Civil Law, is an Agreement between Buyer and Seller, but on this Condition, that if the Price contracted for be not paid before a certain Day, that then the Bargain shall be void.

PAINTING. Books treating of this Art, and of the Eminent Artists, are as follow.

An Idea of the Perfection of Painting: Originally written in French by Rowland Treart, Sieur de Cambray, and rendred English by J. Evelyn, Esq; F. R. S. Lond. 1668. 8vo.

A General Idea of the Art of Painting, and a Relation of 7 Conferences held at Paris in the Ac-cademy Royal for the Improvements of the Arts of Painting and Sculpture.

Optique de Portraiture & Peinture, contenant la Perspettive Speculaire & Pratique Accomplic. &c. per Gregoire Huret de l' Academ. Royale de Peinture & Sculpture, a Paris. 1670. Fol. Vol. II.

PAL

Excellens Peintres Anciens & Modern, per M. Felibien.

PALATO-Salpingaus, a Muicle of the Tuba Eustachyana. See Musculus Tuba Novus.

PALATO-Staphilinus, is a Muscle of the Vvula, arising fleshy from the middle of the Os Palati, near its juncture with its Fellow of the other Side, and running strait forwards, it is inserted near the Extremity of their duplicated glandulous Membrane called the Gargareon: Its Use is to pull it forwards and downwards. Dr. Domglas,

Myogr. Comp. Spec.
PALLIFICATION, in Architecture, is the Pileing the Ground-work, or strengthning it with Piles or Timber driven into the Ground, when they build upon a Moist or Marshy Soil. Builders Dictionary

PALLISADES turning, are an Invention of Mr. Coehorn's, for in Order to preserve the Pallisades of the Parapet from the Besiegers Shot; he orders them so, that as many of them as stand in the length of a Rod, or in about 10 Foot, turn up Ppp

and down like a Trap; so that they are not in Sight of the Enemy, but only just when they bring on their Attack; and yet are always ready to do the proper Service of Pallisades.

PALLS, Pallia, were Vestures made of Lambs Wool (25. H. 8.20.) about 8 Fingers broad, and with two Labells hanging down before and behind: These the Pope gives or sends to Archbi-shops and Metropolitans, who wear them about their Necks at the Altar above their Ornaments. We retain something of the Figure of it, in what the Heralds call a Cross Pall.

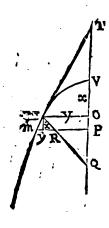
PANEL; some say is a little Part of any Thing; others, as Spelman, say it signifies a Schedule or little Page; which seems truest, for hence comes our Law Word to Empennel a Jury, i. e. to write the Names in a Pannel or Schedule of such Jurors as the Sheriff returns to pass upon any Trial.

PANNAGE, Pannagium; fignified formerly both the running and feeding of Hogs within a Forest, and also the Price that was paid for their so running. Pannagium Liberum, or Free Panmage, was a Liberty of free running for Swine within the Limits of such Forests or Woods; and was sometimes a Privilege granted to some private Persons, and to several Religious Houses. If this Parmage were not duely paid, there was a Process from the Exchequer and a Destraine by the Sheriff. The Title of Pannage was sometimes alienated from the Parish Priest to the Appropria-Dr. Kennet's Paroch. Antiq.

PAPILLÆ Pyramidales, are the Extremities of all the Nerves of the Skin, and serve more immediately for the Sense of Feeding and Touching; about them there is a Web of Nerves and other Vessels all covered with a Mucous Substance, to moisten them and keep them in good Order. Under these Papilla Pyramidales lie the Glandula Miliares, which see. See also the word Skin.

PAR, in Exchange of Money, is a certain Number of Pieces of the Coin of one Country, which contain in them an equal Quantity of Silver to that in another Number of Pieces of the Coin of another Country. v. g. Suppose 36 Shillings of Holland to have just as much Silver in them as 20 Shillings English; then Bills of Exchange drawn from England to Holland at the rate of 36 Shillings Dutch for each Pound Sterling is decording to Par.

PARABOLA. To draw a Tangent to the Parabola in a Point affign'd.



Let the Point affigned be

M, and the Parameter p.

Then the Equation expressing the Nature of the

Curve is |px=yy|

Suppose the Tangent found and all Things drawn

as in the Figure,
Tis required to determine the Subtangent TO; now the \triangle 's m R M and M O T being fimilar, let the former be noted with its proper Fluxionary Letters, and then this Proportion will arise;

y:x::y:=0 T). and the Equation of the Curve being px=yy the Fluxion (px=2yy)and dividing all by p; $\frac{2yy}{2} = x$, and substituting instead of x, in the Quantity = OT, you will find that $\frac{277}{p}$ = is also equal to OT. Then substituting px instead of yy, you will have 22 or 2x = 0 T: That is, in the common Parabela, The Subtangent is always = to twice the Abscissa.

N. B. In any Parabola if the Parameter be sup-posed = 1. and m be the Index of the Power of J. and a positive Number, whole or broken, then will | m=x | express the Nature of all Parabola's:

The Subtangent TO in the Parabola being equal to 2x: and $\square MO = (yy) = px$. by Reason of the similar Triangles MOT and MOQ : OT

 $(=2x) \cdot y :: y \cdot \frac{yy}{2x} = 0 Q$, and then putting

for yy its equal px it will be $\frac{px}{2x} = 0$ or $\frac{p}{x} = 0$

which gives you a very temarkable Property of the common Parabola: viz. That the Sub-normal, as the Line OQ is called, is always equal to half the Parameter of the Axis, and consequently a stand-

ing Quantity.

Wherefore 'tis a very ready Way to draw a Tangent to the Parabola, to fet off half p from O the Foot of any Ordinate downwards in the Axis, and from Q, draw MQ: And to it at Right Angles MT: For that shall be the Tangent required.

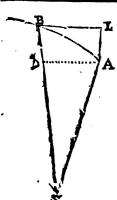
PARABOLICK Spiral. See Helicoid Parabela. PARABOLOIDS, are Paraboliform Curves in Geometry; whose Ordinates are supposed to be in a Subtriplicate, Subquadruplicate, &c. Ratio of their respective Abscissa; and putting & for the Abscissa, y for the Ordinate, and p for the Parameter, the Equation for the Cubical Paraboloid will be In the Biquadrical Paraboloid, the Cube of the Parameter into the Abscissa is equal to the Biquadrate of the Ordinate; that is, px=y+: and so of other Paraboloids ad infinitum.

But there is also another Species of the Parabeloids; v. gr. 1. Suppose the Parameter multiply'd into the Square of the Abscissa to be equal to the Cube of the Ordinate; that is, pxx=y3. Then the Curve is called a Semicubical Paraboloid. And,

2. When px3=y4. then 'tis called a Semi-biquadratical Paraboloid.

PARACENTRICK Motion of Impetus, is a Term in the New Astronomy, for so much as the Revolving Planet approaches nearer to, or recedes farther from the Sun, or Centre of Attraction.

Thus



Thus if a Planet in A move to B, then is SB. bB, the Paracentrick Motion of that Planet.

Hayes. p. 293. PARACENTRICK Sellicitation of Gravity, or Levisy (which is all one with the Vis Centripeta) is in Astronomy expressed! by the Line A L drawn, from the Point A parallel to the Ray SB (infinitely near S A) until it intersect the Tangent B L.

PARADIGRAMMATICE, is the Art of making all forts of Figures in Plaister. The Artists in this are called Gypfochi:

PARALLAX, in the Leipfick Acts for October, 1685, there is an Account of the Cassinian Method of finding the Parallaxes and Distances of the Planets from the Earth; practifed at Rome by the Abbot Fran, Blanchinus,

PARALLAX Diurnal of the Sun. How to

find it, see under Sun in this Vol.

PARALLEL Sailing in Navigation, is failing under a Parallel of Latitude: of this there are but 3 Cases. 1. Given Departure and Distance. Required Latiende.

The Canon is, As Diff. of Longitude to Rad. :: so is Distance, to Coine of the Latitude.

2. Given Diff. of Longitude between two places under the same Parallel; nequired their Distance.

The Canon is, As Rad. to Diff. Longitude:: fo is the Cosine of Lat. to Distance.

3. Having the Distance between two places in the same Latitude, required their Difference of Longitude.

The Canon is, As the Co-sine of Lat. to Distance :: so is Rad. to Diff. Longitude.

PARASTÆ, in Architecture, are the same with Pilasters; the Italians call them Membretti.

PARCEL-makers, are two Officers in the Exchequer that make the parcels of the Escheators Accompts, wherein they charge them with every thing they have levied for the King's Use within the Time of their Office, and deliver the same to one of their Auditors of the Court, to make an Accompt with the Escheator thereof.

Practice of the Exchequer, p. 99.
PARCELLING of the Seam of a Ship, is afterit is caulked, to lay over it a narrow piece of Canvas, and then pouring on it hot Pitch and

PARGETING or Parging, is the Workmens Word for plaistering of Walls.

PARHBLII and Parbelia, or such Phanomena as we call Mock-Suns, are the Representations of the Face or Figure of the True Sun, by way of Reflection in the Clouds.

PARLIAMENT, comes from parler to Speak, and Ment, Mind, in Fr. And the Writ which fummons our Parliament runs, ad consulendum, &c. de arduis Regni Negotiis. And therefore fignifies a Tolemn Conference of all the Estates of the Kingdoin, summoned together by the King or Queen's

Authority to treat of the weighty Affairs of the The ancient Britains seem to have had Realm. no such Assemblies; but that the Saxons had something like it, appears from King Ina's Laws, who flourish'd An. 712. W. the Conqueror divided the Land amongst his Followers, in such manner, that every one should hold of him in Capite; and these distributed part thereof among their Friends and Servants; who for the same owed them Suis and Service in their Courts. The chief of these were called Barons, who thrice every Year affembled at the King's Court, viz. at Christmas, Easter, and Whisfontide: and then the King was wont to come amongst them in his Royal Robes, and with his Crown on his Head, to consult about the publick Affairs of the Kingdom. But some say, this ancient Custom was changed by H. I. who in the 16th Year of his Reign, summoned the Commons to the great Council at Salisbury. Comell's Interpréter

PARODICAL Degrees in an Equation in Algebra, are the several Regular Terms in a Quadratick, Cubick, Biquadratick Equation, &c. the Indexes of whose Powers ascend or descend orderly in an Arithmetical Progression, as $7 \times 37^{2}m + 7r$ S is a Cubick Equation where no Term is wanting; but having all its Parodick Degrees the Indexes of the Terms regularly descending thus, 2, 3, 1, 0,

PARTICLES, are the very small parts of which any natural Body is supposed to be compounded; and these are often called the constituene or component Particles of any Natural Body. That these are almost infinitely small, the continual Effluvia which some Bodies do continually emit, and this without any sensible Diminution of their Bulk or Weight, as well as some other Experiments and Observations do plainly shew. But how to make any Conjecture at the several Sizes of these component Particles of Bodies, whether they are all equal in Bulk, or which are greater, and how much they are so, than others, is what Philosophers have hardly yet had Data or Discoveries enough to determine. But the wonderful Sir Isaac Newten, in his excellent Book of Opticks, hath opened a Door into this new World, and hath given some very good Rules whereby to guess at the Bigness of the Component Parts of Natural Bodies. For he having thewn in Prop. 5. Book 2. Part 3. That the transparent parts of all Bodies do most probably exhibit the same Colours with thin plates of Glass, or thin Bubbles of Water, and on the same Grounds; provided they are of the same Thickness and of the same Density with them. And fince their Parts seem for the most part to have the same Density with Water or Glass, as by many Circumstances its obvious to collect. To determine the Sizes of those Parts, you need only have Recourse to the Tables in the aforesaid Book for this purpose, in which the Thickness of Water or Glass exhibiting any Colour is express'd. Thus if it be desired to know the Diameter of a Corpuscle, which being of equal Density with Glass, shall reflect Green of the 3d Order, (as he diftinguishes it) by looking into the Table, you will

15, find that the Number 164 stews it to be-

parts of an Inch. In the general he proves also, That the Parts of Bodics on which their Colours depend are denser than the Medium, which pervades their Interstices. Prop. 6. B. 2. part 3.

Ppp 2

He shews also at the End of his Latin Opticks, That the Component Particles of all Bodies must be hard or solid, or else Fluid Bodies could not congeal; which its certain that Water, Oyl, Vinegar, and Spirit or Oyl of Vitriol will do by Cold; Quickfilver by the Fumes of Lead; Spirit of Nitre and Quicksilver together by dissolving the Mercury, and then evaporating the Flegm: Spirit of Wine, or Urine, by first well dephlegmating them, and then mixing them together, and the Spirit of Urine and of Salt, by subliming them together to make Sal Armoniack. Nay, the very Particles or Rays of Light seems to be hard Bodies, otherwise they could not in their different Sides have different Properties, as he hath shewn that they have (see Light.) Hardness therefore ought to be accounted as the Property of all simple Matter in the Universe; for all Bodies which we know, are either hard, or may be made fo. And if there are many hard Bodies, as we know is the Case of most, that have Pores interspersed, or Meatus placed between their Particles; those Particles themselves that are devoid of any such Vacuiries must needs be much harder.

'Tis probable that the most small Particles of Matter do attract one another, and adhere together with the greatest Force; and that these may combine into larger Particles, whose attracting Force is weaker; and many of these latter cohering together may form yet greater Particles of Bodics, whose attracting Force shall be yet weaker. And so on by a continual Series, 'till you come to the greatest of those Particles, on which the Chymical Operations, and the Colour's of Bodies depend (see Attraction and Colour) and these cohering into Masses may form Bodies of sufficient Magnitude

to become perceptible by Sense.

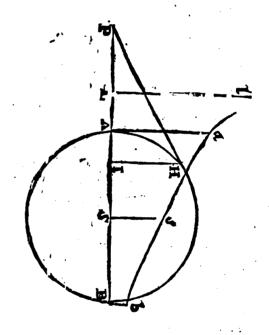
It hath been discovered of late by the wonderful Sir Isaac Newton, Mr. 3. Keil of Oxon, and such others as have proceeded on his Principles, That there is a Power in Nature, by which each Particle of Matter attracts every other Particle with a Force that increaseth in a greater Proportion than that by which the Squares of the Distance decrease; viz in a Reciprocal Triplicate, or Quadruplicate Ratio of the Distances. For, were it not so, the Attraction of these small Particles would not be much greater at the Point of Contact, than at some determinate Distance from it; as is evident in the Case of the Gravity of greater Bodies, whose power of Attraction is only reciprocally as the Square of the Distance; for we find that Bodies are of the same Weight, when at the Earth's Surface, or when at 100 Feet Distance. But when a little Salt is dissolved in a large Quantity of Water, there is no Attraction of the Particles towards one another, till by evapora-ting part of the Water, they are brought within a due Distance; and then they presently run to-wards one another, unite, and form Chrystals, whose Parts have a strong Cohesion. (See Astra-&tion in this Vol.)

Tis plain also, that the attractive Force in these Particles is (cæteris paribus) proportionable to their Solidity; for it must be compounded of the Summs of all the Parts of each Particle, and those parts will be most numerous in such Particles as are most solid; i. e. in such as have sewest and least Pores or Interstices between their Parts. For Particles or Corpuscles may be so compounded, that the most solid and compact Particles may constitute the lightest Corpuscle: That is, if the interspersed

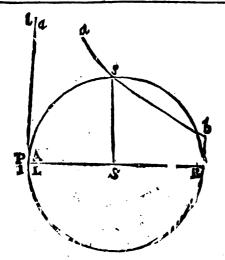
Vacuities between the Particles of Matter be large, so that sew of them may be diffused thro' a large Space. And such a Corpuscle, tho' consisting of Parts endued with a strong attractive Power, may yet be specifically lighter than another, which may consist of Particles not so solid, but yet much closer put together.

And because this Natural Philosophy of Particles is of the greatest Use to be fully understood, I shall here give you (from Dr. Keil's Book of Animal Secretion; &c.) some further Propositions about this matter. I say then, That if any Particles of Matter attrast each other with a Force that is in a Triplicate or yet greater Reciprocal Proportion of their Distances: The Force by which a Corpuscle is drawn to a Body, made up of such attrastive Particles, is infinitely greater at the Contact, or extreamly nearer it, than at any determined Distance from it.

Suppose the Sphere AH B composed of Particles that attract any Particle, as P, with a Force reci-



procally proportionable to the Cubes of their Diftances. Draw the Tangent PH, and from H let fall the Perpendicular HI: Biffect PI in L, and raise the Perpendiculars IL, Aa, Ss, Bb; and make Ss=SI. Then with the Asymptotes LB, LI thro's describe the Hyperbola bsa; and then the Area a ABb— \(\Pi \geq AS \times SI;\) will represent the Attraction of the Corpuscle P by Prop. 81. of Sir Isaac Newton's Princip. But when the Corpuscle P comes to touch the Sphere in A, then the Points P, L, A, I and H will all coincide; and Aa becomes the Asymptote of the Hyperbola, and the Area a ABb becomes infinite; and the Rectangle 2 AS \times SI being finite, the Area a ABb—2 AS \times SI, will be infinite; and consequently the Force by which the Corpuscle P is attracted by the Sphere, when it touches it in A, will be likewise infinite.



If the Sphere consists of Particles that attract in a quadruplicate Proportion of their Distances reciprocally, the Force by which a Corpuscle will be drawn to the Sphere will be $\frac{1}{PS^3 \times PI}$. But when the Corpuscle comes to touch the Sphere, PI becomes =0, and consequently whatever is divided by it becomes infinite, and therefore the attractive Force at the Point of Contact being proportional to $\frac{1}{PS^3 \times PI}$, will be infinite.

Prop. IV. If a Body confifts of Particles attracting with a Force that is in a reciprocal Proportion to the Cubes of the Distances, or in a greater; and if this Force is not infinitely greater than the Force of Gravity at the Point of Contact, or extreamly near it, at any determined Distance from the Point of Contact, it must be infinitely less than the Force of Gravity.

This is clear by the last Proposition: For in that Case, the Force of Attraction in a Corpuscle removed from the Contact is infinitely less than at the Contact it is not infinitely greater than the Force of Gravity by the Supposition: therefore the Force, by which a Particle removed at a determined Distance from the attracting Body is attracted, is infinitely less than the Force of Gravity.

Prop. V. The Force, by which the Particles of Matter attract each other, when extremely near the Contact, is not infinitely greater than the Force of Gravity.

This is evident; because in the strongest Cohesion of Particles touching one another, we find that the Weight of some Bodies will pull the Particles assunder, tho' that Body may be prodigiously greater and heavier than the Particles united. Sir Isaac Newson calculates from the Instection of the Rays of Light, that this Force near the Contact is 10000 0000 0000 0000 greater than the Force of Gravity.

Corol. Particles removed at a determined Diftance from the Body attracting, are not acted upon by it; because this Force must then vanish, or which is the same Thing, be infinitely less than the Force of Gravity.

Prov. VI. A large Particle attracts not more firongly than a small one at the same Solidity, but a

Diversity of Figures causes different Degrees of Attra-Rion in Particles, that are otherwise the same.

This attractive Power acts only on such Particles as are extremely near; and therefore of a large Particle, the remotest parts conduce Nothing to-Attraction: And for the same Reason the attractive Force varies, according as the Particles are Cones, Cylinders, Cubes, or Spheres: And, cateris paribus, a Spherical Particle has the strongest attractive Power.

Prop. VII. If Particles swimming in a Fluid, attract one another more strongly than they do the Particles of the Fluid, the Force, by which they come to each other, will be that by which their attractive Force, exceeds the attracting Force of the Fluid.

For the Particles of the Fluid, that lie directly between the attracting Particles, being more present than the other ambient Particles; they will from the Nature of Fluidity, with that Excess of Pressure, drive the other Particles out of their Places, and make way for the attracting Particles to come together.

Prop. VIII. If Particles swimming in a Fluid are more attracted by the Fluid, than by one another, they will recede from one another, with a Force that will be equal to the Difference of their mutual Astraction, and the Attraction of the Fluid.

For the Ambient Particles of the Fluid attracting more strongly, will with their Excess of Force draw the other Particles to themselves and make them to recede from one another.

Prop. IX. The Force, by which Particles attracting one another cohere, is greater, cæteris paribus, where the Contact is greater.

For the Parts that are farther remov'd from the Contact, conduce Nothing to the Force of the Cohesion; and a greater Power must be requisite to separate two Particles, which cohere in two Points, than two Particles which cohere only in one Point, if the Degree of Cohesion be equal in each Point. Thus two polithed Marble-stones (suppose a Foot square) adhere more strongly than any other two Bodies of a Foot square, which are not so solid, but have more Pores and Interstices between their Parts, and which will not receive so good a polish, by which the parts come to a close contact with one another.

Prop. X. If the attracting Corpuscles are elastick, they must necessarily produce an intestine Motion, greater or lesser, according to the Degrees of their Elasticity and attractive Forces.

For after meeting they will fly from one another with the same Degree of Velocity (abating the Resistance of the Medium) that they met together with; but when they approach other Particles in their Resilition, their Velocity must increase, because they are afresh attracted, and therefore meeting a second time, they will recede with a greater Velocity than they did at their first Concursion: And so their Velocities will be increased by every Concursion and Resilition, which must necessarily produce a sensible intestine Motion; and the stronger their attractive Force, and the greater their Elasticity, their Concursions and Resilitions will be the more sensible.

Prop. XL

Prop. XI. Particles attracting one another in a Fluid, moving either with a swift or slow progressive Motion, attract one another just the same, as if the Fluid was at rest, if all the Particles move equally; but an unequal Velocity of the Particles does migh-

tily disturb their Attractions.

The Particles do all by Hypothesis move equally, and consequently the progressive Motion of the Fluid does not alter their Distances, that is to say, it does not repel them from one another; and consequently they must attract one another with the same Facility as if the Fluid was at rest. But if some Particles move faster than others, some must change their Position in Respect to each other, and those parts, which by the force of Attraction would have come together, will by this unequal Motion be carried from one another. Thus Salts Motion be carried from one another. do not christallize, nor the terrestrial Particles of Urine attract one another, and unite, till the Water, in which they are dissolved, is almost cold; and the intestine Motion of its Particles, caused by hear, is quieted.

Mr. 3, Keil of Oxford in Phil. Transact. N. 315. advances these other Theorems about the small Particles of Matter.

- 1. That the least Particle of Matter assignable, may so fill any large assigned Space, that the Diameters of the Pores, Interstices, or Meatus between its Parts may be all less than any given Right Line; or, so that all the Parts of such a Particle, shall be nearer to each other than any given Right Line. See his Lesture De Divisibilitate Materia, in his Lectiones Physica.
- 2. Two Bodies may be assigned or given equal in Bulk, but yet any how unequal in Specifick Gravity, or in the Quantity of Matter in each; (o that the Summs of the Pores or Meatus in each, shall be nearly equal.

V. gr. Let there be a Cubick Inch of Gold and another of Air: Tho' the Quantity of Matter in the former may be 20000 Times as great as that in the latter : Yet the Vacuities in the Gold, may be to those in the Air, as 999999 to 1000000; i. t.

very nearly equal.

3. Those Particles which constitute Water, Air, or any other Fluid, (if they touch one another) are not absolutely solid; but are compounded of other Particles, which do contain within them many Pores or

And he thinks that such Particles of Matter as are the least of all others, and which are perfectly solid and devoid of all interspersed Vacuities, may be called The First or Primary component Particles of Matter, or Particles of the first Composition.

Such Moleculæ as are compounded by the Coalescence of any of these first Particles (only) may be called Particles of the 2d Composition. fuch Moles as are compounded of these second Moleculæ by several of them coalescing rogether may be called Particles of the third Composition: And so on till you come to Particles out of which the last Composition of Bodies is mude, and into which they are primarily disolved.

4. If a Particle of Matter touch any Body, the Force with which it tends toward the Body, or by which it adheres to it, is proportionable to the Quantity of the Contast, for such Particles as lie remote long and flender Cylinder.

from the Place of Contact add Nothing to the Cohesion.

And therefore according to the several Degrees or Quantities of the Consact of Particles, there will arise several Degrees of the Firmness or Cohesion of Bodies. And the greatest Force or Degree of Cohesion, will be when the Surfaces of the cohering Particles are perfectly plane; for there the Force by which any Corpuscie adheres to another, will (cateris Paribus) be as the Parts of the Superficies which do adhere to, or touch one another.

And from hence, and I believe hence only, can that hitherto difficult Problem, about the Cause of the Cohesion of the Parts of Matter in solid

and firm Bodies be solved.

5. Those Corpuscles or Particles of Matter are most easily separable one from another, whose Contacts with other Particles are fewest and least; as will be the Case of exceeding Particles of a Spherical Figure.

And from hence, and hence only, can the True

and Primary Reason of Fluidity arise.

6. If the Texture of a Body be such, that its Particles of the last Composition (see Prop. 3.) can be moved a little from their primary State of Cohesion or Contact by some external Force (such as the Weight and Compressure, or the Stroke or Shock of some other Body.) But yet so as that the Particles of the Body don't by this Pressure or Stroke, run into any new Contacts or Cohesions; Then, I say, they will recover again their former Contacts, by the Power of Attraction, or by a Force that will make them tend towards one another: And consequently, such a Body, will, after the Pressure or Stroke, recover again its former Figure and Position of its Particles.

And this is the Reason of the Elasticity of Bodies.

7. But if the Texture of a Body be such, that when its Particles are by some external Force removed from their former Contacts and Cohesions, they go immediately into others of the same Degree; that Body cannot recover its former Figure and Position of Parts.

And this is the Texture of fuch Bodies as are soft, and herein the Reason of their Softness con-

8. As Particles which are perfectly folid will attract one another the most strongly; and as in all other Particles the Power of their Attraction is proportionable to their Density or Solidity; so that the attractive Forces of even Particles persectly Dense or

Solid, depend much upon their Figures.

For if a small Particle of Matter be supposed to be formed into an indefinitely small Plate or Lamina, of a Figure perfectly circular; and if another Particle of Matter be supposed to be in a Right Line passing thro' the Centre of that Plate, and at Right Angles to its Plane: Then if you suppose that Particle to be distant from the circular Plate a tenth Part of the Radius of that Circle; I say, the Force by which that Corpuscle is attracted by the Plate is 30 Times less than if the attracting Matter had coalesced into a Spherical Figure: So that the Virtue of the whole Particle had been diffused, as it were from one Physical Point.

But yet this circular Plate will more strongly attract the Particle than any other Particle of the same Weight with it, that shall be formed into a

9. Salts

PAR

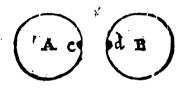
9. Salts are Bodies, whose Particles of the last Composition are endowed with a very great attractive Force: But yet between those Particles, there are very many Pores or Meatus, which are pervious to the Particles of the last Composition of Water; which aqueous Particles being strongly attracted by the Saline ones, do rush towards them with an Impetuosity, do disjoyn their mutual Contact, and dissolve their Cohesion.

10. A Body specifically beavier than Water, may have its Magnitude so diminished, that it shall be suspended by or swim in Water, and not descend by its own Weight.

And this is the Reason that the small Particles of Salts and Metals will swim in such Menstruums

as will dissolve those Metals, &c.

10. Greater Bodies attract one another with a less Force than lesser ones do.



For the Force with which the Bodies A and B attract one another, exerts it self only in those Particles which are near one to another, the remote ones having no such Force; wherefore there is no greater attractive Force required to move the Bodies A and B towards one another, than to move c and d. But the Velocity of Bodies moved by the same Force, are reciprocally proportional to those Bodies: Wherefore the Velocity by which A tends towards B, will be to the Velocity with which the Particle c, apart from the Body, tends towards B: as the Particle c to the Body A; much less therefore is the Velocity of the Body, than that of c would be, if it were separated from it.

From hence it comes to pass, that the Motion of the greater Bodies is naturally so slow and gentle, that 'tis usually impeded by an ambient Fluid or other Bodies round about them. But in lesser Bodies, this attractive Force is very active and vigorous, and is the Cause of a great many noble

Effects.

12. Two Particles of Matter, tho' they do not touch, may yet come so near one to another, as that their mutual attractive Force shall much exceed the Force of Gravity.

13. If a Particle placed in a Fluid be equally attracted every where by all the ambient Particles of the Fluid, no Motion of the Particle will arise from thence: But if it be attracted by some Particles more, and by others less, it will move that way where the Attraction is greatest, and the Motion produced will be answerable to the Inequality of the Attraction; (i.e.) it will be greater where there is a greater Inequality, and lesser where there is less.

14. If a Body be placed in a Fluid, and its Particles do more attract the Particles of the Fluid, than the Particles of the Fluid do one another; and if there be also in that Body any Pores or Meatus, pervious to the Particles of the Fluid; then the Particles

of the Fluid will soon diffuse themselves through those Meatus: And if the Cohesion or Connection of the parts of the Body be not so strong, but that it may be surmounted by the Impetus of the Particles of the Fluid rushing upon it, and every way into its Fores; there will arise from thence a Dissolution of that Body.

And from hence you may see the Reason of the Dissolution of Bodies in Menstruums: In order to which, Three Things are always necessary.

1. That the Particles of the Body to be dissolved do more strongly attract those of the Menstruum, than those of the Menstruum do one another.

2. That the Bodies have Pores pervious to the

Particles of the Menstruum.

3. That the Cohesion of the Constituent Particles of the Body be not so strong, but that it may be broken by the violent Action of the Particles of the Menstruums upon it.

15. If Particles mutually attracting each other do also mutually touch one another, no Motion can arise; for they can come no nearer to each other: But if they are separated from one another a very small Distance, a Motion must arise from their mutual Attraction. Tho if they are farther from one another than thus they cannot attract one another more than they will the Particles of the Fluid in which they are, and so no Motion also will be produced.

From these Principles all the Phanomena of Fermentation, and of all Effervescences do proceed. And from hence you may see the Reason why Oyl of Vitriol when mingled with a little Water, hath so great an Effervescence and Ebullition: For by the Infusion of the Water, the Saline Particles are a little disjoined from their mutual Contact; but since they do much more attract one another than

they do the Particles of the Water, and since they are not every way equally attracted, a considerable

Motion must from thence arise.

And from hence also you may see the Reason why so great an Ebullition arises from putting Filings of Steel or Iron into the former Mixture of Oyl of Virriol with a little Water; for the Particles of the Steel have a very great Degree of Elasticity, and from thence a strong Resection must arise. And from hence also tis that some Menstruums act with a greater Force, and will sooner dissolve Metals, when mingled with a little Water, than when pure and without such Mixture.

other have no Elasticity, then they are not reslected back from one another, but will form Congeries, Moleculas, Aggregates or Lumps of Particles; from whence what we call a Coagulation arises: And if these Lumps exceed in Specifick Gravity that of the Fluid, and are large enough, a Precipitation will succeed, Tho' a Precipitation may also arise from the specifick Gravity of the Menstruum in which the Particles swim, its being diminished or increased.

17. If the Figure of Particles mutually attracting each other, when swimming in a Fluid be such, that there is a greater attracting Force in some of their given Parts than in others, as also a greater Contact there; then those Particles will coalesce into Bodies having given Figures; and this way all Chrystallizations arise; and you may by Geometry determine the Figures of the Component Particles from having the Figure of the Chrystals given.

18. If between two Particles of a Fluid, another shall interpose, whose two opposite Faces or Sides have very great attractive Forces; this interposing Particle will glew or fasten the other two to its self; and when this is done throughout the whole Fluid, that Fluid will be frozen or turned into Ice.

19. If a Body of some Bulk emit a large Quantity of Effluvia, and the Particles of such Effluvia bave a very great attracting Force, then will these Effluvia, when they come near any lesser or lighter Body, by their attracting Force, surmount the Gravity of those Bodies, and list them up to the Bodies from whence they slow: And since the Effluvia are much more copious and thick at lesser Distances from the emittent Body, than at greater; the light Body will be attracted by still more and more dense Effluvia, and at last be brought to adhere to the emittent Body.

And this way most of the Phenomena of Elecericity may be solved.

PARTING, is one of the Refiners Ways to scparate Gold and Silver; 'tis done by Aqua fortis, which how to make, and the whole Manner of the Operation, see under Resining.

PARTY Jury. See Half Tongue.

PASCHA Clausum, is the Octaves of Easter or Low-Sunday, which closes or concludes that Solemnity; and die (tali) post Paschia Clausum, is a Date in some of our old Deeds; and the first Statute of Westminster is said to have been made Landesmain de la Close de Pasche, i. e. The Munday after Easter-Week.

PASNAGE, or Pannage, was anciently used in a double Sense for the running or feeding of Swine within a Forest, and for the Price or Rate of it. If the Pasnage were not duly paid, there was a Process from the Exchequer, and a Distress by the Sheriff. Dr. Kennes.

PASS, a Frame of Boards confisting of 2 or 3 Bottom Boards, and two Side ones, fet slope-wise, thro' which the Ore slides down into the Coffer of the Stamping-Mill for the Tin-works, is called by the Workmen the Pass.

PASSAGE, Passagium, 'twas a Tribute or Toll paid by Passengers or Travellers for the Repair or Maintenance of some Road or Passage.

PAVIMENTA Teffellata. See Teffellata.

PAY, the Seamen say, Pay more Cable, that is, let out more Cable; and pay cheap, that is, at the turning the Anchor out of the Boat, to turn it over-board faster.

PECTEN, in Anatomy, is the same with the Regio Pubis, or lower part of the Hypogastrium.

PEDIMENT, in Architecture, is a Triangular Frame with Cornish raised over the Front of a House, and sometimes over Doors, &c.

PEERS, in Architecture, are a kind of Pilasters or Buttresses, for Support, Strength, and sometimes Ornament.

PEERS, Pares, in our Common Law, are those that are empannelled on an Inquest upon any Man for the convicting or clearing him of any Offence for which he is call'd in question; and the Reason thereof is, because is the Course and Custom of our Nation, that every one shall be sried by his Peers or Equals. The Word is used also for the Nobility of this Realm, and Lords of the Parliament, who tho' distinguished as to degrees of Nobility, yet are equal in all publick Actions, as in

Votes of Parliament, in patting Trials on Noble-

PENNY, Denarius, was the first coined piece of Silver we have any account of; and for many Years the only one. In the Reign of H. 1. there were Half-pence. A Penny was so much the whole of the current Coin of the Kingdom, that Denarius signified the same thing with Nummus or Money. Dr. Hicks in his Dissertatio Epistolaris, p. 109. saith, that the Anglo-Saxons had but one Silver Coin amongst them, and that was a Penny; and Cambden and Spelman, and most of our good Antiquaries agree in this. The old Penny before 1279 was struck with a double Cross, so that it might easily be broken in the middle, or into sour Quarters; and so made into Half-pence or Farthings, saith Mr. Stow; on which it was then ordered, that Half-pence and Farthings should be made or coined round, as the Penny was before. The Penny was called Sterling, which see.

The Penny was called Sterling, which see.
PENNY-Weight, sormerly every Pound contained 12 Ounces, and each Ounce was divided
inty 20 parts, called Twenty-penny-weight; for
then Twenty-penny-weight weighed an Ounce:
and tho the Penny-weight be altered, the Deno-

mination still continues.

PENSA; formerly there were three ways of paying a Pound of Money into the Exchequer.

1. Payment of a Pound de Numero, which was just 20 Shillings in Tale.

2. Payment of a Pound ad Scalum, which was 6 d. over and above the 20 s.

3. Ad Pensam, which was paying the full Weight of 12 Ounces.

PENTECOSTALS, were, and are still in some few Dioceses, Whitson-Contributions paid to the Bishops, of which probably the first Occasion were certain pious Oblations made to the Cathedral Church at Pentecost or Whitsonside. They were also made by the Parisbioners to their Parisb Priest, and sometimes by inferior Churches or Parisbes to their Mother-Church. These Parisb Pentecostals were called Whitson-Farthings, and their Sum was divided into sour parts, of which one went to the Priest, one to the Poor, one towards the Repair of the Parisb-Church, and one to the Bishop. See Seephens of Procurations and Pentecostals, and Dr. Kennet's Parachial Antiquities in Glossary.

PERCH, Percica, is an English Measure of 16 Foot and a half in Length, called also a Pole and Rod. Forty such Perches in Length, and four in Breadth, make what we call an Acre of Ground. This is the common Statute-Perch; but in some Counties in England its Length is different; as in Staffordshire it is 24 Foot, in the Forest of Sherwood 25 Foot. In Herefordshire, tho' a Perch of Walling be but 16½ Feet, yet a Perch of Ditching is 20 Feet: In the Forest of Canke 'tis 25; in the Forest of Clarendon 20. Skene de verborum signisicatione sub. verb. Perticata Terra, saith, Particata Terra is a Roud of Land. There are also some other Measures mentioned which are now out of use. He saith three Feer and one Inch make an Elne; fix Elnes make a Fall; which he faith is the common lineal Measure. Six Elnes long and fix broad make a Square, and Superficial Fall of Land measured; and 'tis to be understood, he saith, that a Raip, a Rodand a Lineal Fall of Measure, are all one; only a Rod is a Staff or Polo of Wood, and a Raip is made of Tow or Hemp. Also ten Falls in Length and four in Breadth make an Acre: This is the Measure of Scotland.

PERI-

PERICARDIUM. Dr. Keil in An. Secretion, p. 32, 33. shews, that the Liquor in the Pericardium is the most fluid of any that is separated from the Blood; because the Particles of it unite first, and are secreted first; and those Particles which unite first will have the greatest attractive Force; and such must have their Corpuscles of a most spherical Figure, and must be most solid; so that their Contact will be the least that can be.

PERIOPHTHALMIUM, is a thin Skin which Birds can draw over their Eyes to defend them, without shutting their Eye-lids. The same with

the Membrana Nistitans.

PERISTERNA, in Anatomy, are the lateral

parts of the Thorax,

PERITONÆUM: The external Surface of this fost thin Membrane is unequal where it adheres to the transverse Muscles; the internal is very smooth. It hath a Number of small Glands which separate a Liquor which supplies the Intestines, and facilitates their Motion; and when these Glands are obstructed the Peritonaum grows thick, as in seve-The Peritonaum is a double Membrane, containing in its Duplicature the Umbilical Vessels, the Bladder; Ureters, Kidneys, and Spermatick Vessels, to all which it gives a Membrane, as also to the Liver, Spleen, Stomach, Intestines and Womb.

Its external Lamina hath two Productions, like to two Sheaths, which pass thro' the Rings of the oblique and transverse Muscles in the Groin, for the passage of the Spermatick Vessels in Men; and for the round Ligaments of the Womb in Women. These Productions being come to the Testicles in Men, dilate and form the Tunica Vaginalis. The Internal Lamina, which is very thin here, having accompanied the external Productions a little way, cleaves close to the Spermatick Vessels and round Ligaments of the Womb. The Peritoneum hath Veins and Arteries from the Phrenice, the Mammillary, the Epigastrick, and often from the Spermaticks. Its Nerves are of those which are distributed in the Muscles of the Abdomen; it hath likewisea sew Lymphaticks which discharge themselves into the Iliack Glands. By the Elasticity of its Fibres it easily dilates and contracts in Respiration, and in Conceptions. If it breaks it causes a Rupture either in the Navel or Groin. Its Use is to contain the Bowels of the Abdomen, and to give to each of them an outer Coat.

PERMUTATION of Quantities. See Varia-

tion and Combination.

PERNANCY: Taking or receiving Tythes in Pernancy, is taking such as are or may be paid in

PERPETUAL Motion; by this Term ought to be meant an uninterrupted Communication of the same Degree of Motion from one part of Matter to another, in a Circle, (or such like Curve returning into itself) so that the same Quantity of Matter shall return perpetually undiminished upon the first Mover: And perhaps if Men had rightly under-Rood that this is the true meaning of a perpetual Motion, abundance of Expence both of Money and Reputation might have been saved by the vain Pretenders to this piece of impossible Mechanism. For fince by the second Law of Nature or Motion, (see Motion) The Changes made in the Motions of Bodies are always proportional to the impress'd moving

Force, and are produced in the same Direction with it,

no Motion can be communicated to any Engine or

Perpendicular to the Base of the Table, as o q.

Machine greater than that of the first Force impressed; and therefore fince on our Earth, all Mossons are performed in a Fluid which refifts them, it must of Necessity retard them; and consequently a considerable Quantity of the Motion must be spent upon the resisting Medium; so that 'tis impossible the same Quantity of it can return undiminish'd on the first mover; which yet is absolutely necessary for the Continuance of the same Motion perpetually. Besides, in no Engine or Machine whatspever, can all Friction be avoided, there being in Nature no fuch thing as exact Smoothness or perfect Congrui-The manner of the Cohesion of the Parts of Bodies, the small Proportion the solid matter bears to the Vacuities between them, and the Nature of those constituent Particles not admitting it; wherefore this Frittion will also tensibly in time diminish the impressed or communicated Force, so tis nor possible the Mosson can be perpetual; which Effect can indeed never follow, unless the communicated Force be so much greater than the generating Force, as to recompense the Diminution made therein by all these Causes, in order to the Motion's returning undiminished upon the sirst Mover. But nil dat quod non habet, the generating Force cannot communicate a greater Degree of Motion, that it hath it felf, and consequently, the perpetual Motion is demonstratively impossible.

Besides, it being certain that a Body cannot move constantly in any Orbit with the same Degree of Motion from one fingle Impulse; fince that Degree of Motion and Velocity ariling from fuch a fingle Impulse, must by that means continually decrease, and so at last be quite spent and extinct : From hence it will follow also, that there can be no perpetual Motion in any Engine from one single Impulse ; for this Motion, that it may return again upon the first Mover, must be propagated in an Orbit; and consequently must by Degrees

cease and stop.

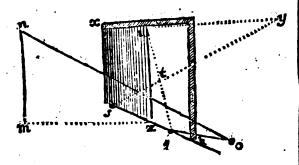
Per Qua Servitia, in Law, is a Writ Judicial issuing from the Note of a Fine, and lieth for Cognisee of a Mannor, Seigniory, Chief Rent or other Services; to compel him that is a Tenant of the Land at the Time of the Note of the Fine levied, to attorn unto him.

PERQUISITE, in the Law-fense, is any thing gotten by a Person's own Industry, or purchased with his own Money, different from that which descends to him from his Father or Ancestors:

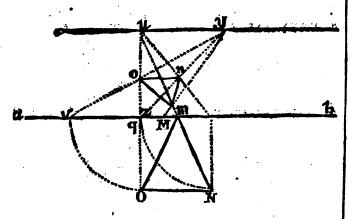
PERQUISITES of Court, are such Profits as grow to a Lord of a Mannor by Virtue of his Court-Baron, over and above the yearly certain Profits of his Land; as Fines of Copybolds, Herriots, Amerciaments, Waifes, Strayes, &c.

PERSONAL Services. See Services. PERSPECTIVE: The Foundation or Ground of Perspective, may be thus conceived. Suppose there be a Point, as o, which is seen by the Eye at n (whose Height above the Horizon is n m) thro' the Glass or transparent Plane $x \neq k$, which in Perspective is called the Table: And it be required to find the true Representation of this Point in Perspective; from m the point of the Horizon perpendicularly under the Eye at n draw at Right Angles to n m (the height of the Eye) the Line m 7; at 7 in the Table erect the Perpendicular 7 u equal to n m, and at Right Angles to it, from the Q:9 q

and draw the Line qu. Take q s = to q o, draw s y cutting uq in the point s, so is s the point required.



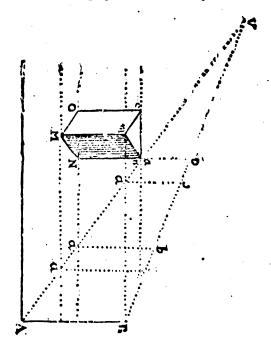
On this Foundation is the primary Rule of all Perspellive built, and all its Practices established, v. gr. Suppose an Equilateral Triangle (as mn o) or any other Geometrical Plane Figure were to be represented in Perspettive. Between the Eye and the Triangle draw somewhere the Right-line a b, which they call the Fundamental Line; then draw z v representing the perpendicular Distance of the Eye above that Line, be it what it will, and thro o draw, at Right Angles to z u, or parallel to a b, the Horizontal Line vy; then will the Plane lying between those Parallels represent the Table or Trans parent Plane. Then in order to find the perspe-CtivePoint for e, one of the Angles of the Triangle omn, draw og perpendicular to the Fundamental Line a b, and make q s equal to q o. Take u yequal to u z, and then from y draw sy; draw also vq, whose intersection with q s will find the point o, which will be the true Representation of o in Perspedive; proceed after the same manner with the Points M and N, and drawing the Lines on, in m, mo, the Triangle o n m will be the true Representation of the Triangle M NO. And thus proceeding with the Angular Points of any Figure, whether regular or irregular, you may draw any thing truly in *Perspettive*; only in Practice, se-veral compendious Methods will arise, which every one will discover on frequent Tryals.



And if the Scenographick Appearance of any Solid were to be represented, as suppose of a Triangular Prism whose Base is the Triangle M N O in the second Figure; you need only find the upper Surface of it after the same way as you found the lower or the Base, and then joining the corresponding Points by Right-Lines you will have the true Representation of the Solid in Perspective.

So that the Work is the same as before, only you take a new Fundamental Line, as much higher than the former, as is the Altitude of that Solid whose Scenographick Representation you would delineate.

But there is yet a more commodious Way of doing this, as follows; Having found, as above, the Baie; or Ichnographick Plane in no;



Let Perpendiculars be erected to the Fundamental Line, from the three angular points, which will express the Altitudes of those Points. But because these Altitudes, tho equal to one another in the Body or Solid it self, will appear unequal in the Scenographick View, for those that are further off will appear less, and the nearer, larger.

Their true proportionable Heights may be thus determined: Any where in the Fundamental Line let AB be erected perpendicularly equal to the true Altitude (or if the Figure hath different Altitudes, let them all be transferred into the Perpendicular AB) and from the points A and B (and from all the points of intermediate Altitudes, (if there be any fuch) draw Right Lines to the Eye point in V. or to any point in the Horizontal Line: Those Lines AV and VB will conftitute a Triangle with A B, within which all the Points of Altitude will be contained. Thro' the points o, n, and m, draw parallels to the Fundamental Line, as you see, and from the points a, a, a, erect Perpendiculars to those Parallels, and where they intersect the two Lines AV and BV; as in the points a, a, a, and b, b, b, &c, they will determine the apparent Height of the Solid in that Scenographick Position to the Eye at V. And in practice these Parallels and Perpendiculars are to be easily described by the Help of a good Drawing-Board or Table fitted for this purpole, and others of this Nature.

Authors on this Subject of Perspettive, are;

Alberti Dureri Perspectiva, cum Fig. Hansen Leucours Perspectiva, in High-Dutch. Ulm. 1617. Fol. Henrick Henrick Loutenfack Perspectiva, ditto. Franck, 1618.

La Perspective curieuse de Niceron, a Paris. 2665.

La Perspective avec la Raison des Umbres, &c. par Solanon de Cousa.

Reger Bacon's Perspective. Lat.

Joan Cantuariensis Archiepiscopi Perspectiva com-

Leinganno de Glocchi, Perspettiva practica. Leeda Regele delle Perspettiva.

Leeda Regele delle Perspettiva Verdmenni Frisii Perspectiva.

The Jesuits Perspective ; or, La Perspective

practique par un Religieux, &c. Maxen's Practical Perspective.

G. Ubaldi Perspectiva, Lib. 6.

La Perspective speculative & practique, par Mig-

Lamii Perspective.

Andrea Alberti de Perspectiva & Umbra, Lil.

PESA, Pensa, Pisa; is a Wey or Weigh, or a certain Weight or Measure of Cheese and Wooll, containing formerly 256 Pounds.

PESAGE, is a Duty paid for weighing of Merchandize and other Wares, to a certain common Weigher, whom they called Pefarius.

PETER-Pence, called also Hearth-pence, Rome Scot, and in the North Ream Pence; was a Levy of a Penny on every House wherein there were 30 Pence viva pecunia, to be collected and sent to Reme: This at first tho' only a Contribution, at last pass'd into a standing Tax; one half of it went for Alms to the English School at Rome, and the other half to the Pope's Use.

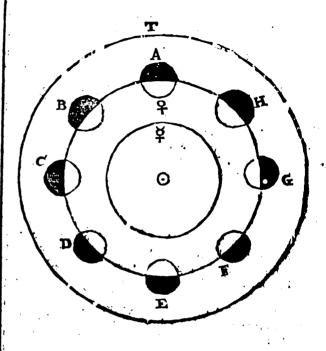
It was at first given by King Ina, and confirm'd by Offa and Ethelwolph; established by the Laws of Canate, Edward the Confessor, William the Conquerous, and Henry I. Twas collected by the Bishops, who employed the Rural Deans and Archdeacons to receive it. The whole Summ was by Pope Gregory stated at 200 l. 26 s. In the Year 1365, King Edward the Third first forbad the Payment of this Duty to the Pope; but the Custom some returned again, and continued till the Reign of Henry the Eighth, when Polydore Virgil was employed here as the Pope's Receiver-General. No Place nor Religious House was exempt from this Imposition, but only the Abby of St. Albans.

PETIT-Sergeanty: To hold Lands or Tenements in Petit-Sergeanty, is to hold them of the Crown, by yielding the Sovereign a Knife, Buckler, Arrow, or a Bow without a String, or other like Service at the Will of the first Feosfer; and there belongs neither Ward, Marriage nor Relief: No one can hold Land in Grand or Petit-Sergeanty, but of the Crown. See Stat. of Car. 2.

PHALANX, among the Macedonians, was an oblong square close Battle of Pikemen, consisting of 16 File, and 500 in Front, as Polybius saith; and the Soldiers stood so close together, that the Pikes of the 5th Rank extended 3 Foot beyond the Front of the Battle.

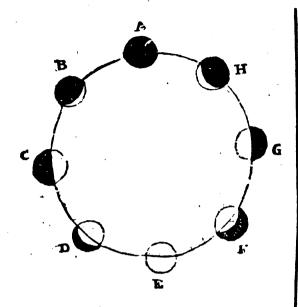
PHASES of the Planets: Since all the Planets as well as the Earth are spherical, orake, and scabrous Bodies, they must reflect every way the Sun's Rays which fall upon them; and it will follow also from hence, that one half of every Planet, or

that Hemisphere which is turned towards the Sun, will be illuminated by him, and the other Hemisphere at that Time must remain in Darkness. And further, since its that Hemisphere of any Planet, which is considered by any Observator:



The eight little Circles represent the different Phases of Venus, as they will appear to an Bye placed in T on the Earth, while she moves round in her Othir ACEG about the Sun. It will be plant then, that when Venus is in A, and the Earth at T; she being then most retrograde, (see the Word Direct in this Vol.) will least of all appear to us, because her obscure Hemisphere is entirely obverted towards us. And if she happen to be then in either of the Nodes, i. e. in the Plane of the Ecliptick, she will appear like a Spot in the Body of the Sun.

But when she gets surther to B (the Eye being still supposed to be in T) she will still be retrograde, but some small part of her illuminated Disk will be visible; and she will appear with illuminated Horns which will be turned from the Sun, of towards the West. When she comes to C, one half of her illuminated Disk will be visible to an Eye in T, and then she will appear like an Half-Moon; in D she will be gibbous, and in E at sull. And the same Phases she will put on as she moves in the other Semicircle from E to Alagain, only the illuminated Horns will be turned a contrary Way; as appears by the second Figure, where all the several Phases are delineated.



And the same kind of Phases must happen to Mercury in the several parts of the Orbit, Regard being had to the Figure of it, and the Time of his Periodical Revolution sound the Sun.

PHILTRATION. See Filtration.

PHOSPHORUS; by Order of, and before the Royal Society at London, Mr. Hawksbee made several Experiments on the Phosphorus, about its Production and Propagation of Light in vacue; and it plainly appeared from them, that the removing the common Air did very sensibly encrease its Light. And by the Experiments made by the same Person on the Mercurial Phosphorus, and mentioned in Phil. Trans. N. 303. it is also manifest, that the Mercury when strongly agitated in the common Air would exhibit in a darkned Room some Sparks of Light, yet that a very sensible and eminent De-gree of it might be produced by shaking it in proper Glasses in Vacuo.

Bernouli, Professor of Math. at Groningen, made an easy portable Mercurial Phosphorus after this Manner: In a clean neat Viol he included about five or fix Ounces of well purified clean Quickfilver; and then evacuating the Viol of Air by applying to an Air-Pump, it would, when shook strongly in the Dark, appear all bright and luminous, so as that one might distinguish the Faces of the Spe-

ctators.

PHYSICKS, or Natural Philosophy. The most eminent Books on this Subject which will give the Reader a true and useful Knowledge of Nature, are these:

Sir Is. Newson's Principia Philosoph. Naturalis Mąthematica.

Ejusdem Optice : sive de Lumine & Coloribus. Borellus de Motionibus & Gravitate pendentibus. -De vi percussionis.

Whilis Mechanicks, sive Liber de Motu Trastatus Geometricus.

Hon, Fabri Dialogi Physici. Lugd. Galliarum. 1669. 8vo. Mr. Boyle's Physical Pieces.

Keil's Introductio ad Veram Physicam. Ditton's Laws of Nature and Motion.

Cheyne's Philosophical Principles of Natural Re-

All Dr. Hook's Tracts printed while he was living, and his Opera Posthuma.

Philosoph, Transactions.

And Collections. A&a Eruditorum Lipfia.

Collegium Experimentale sive Curiosum, in quo primaria bujus seculi Inventa & Experimenta Phyfico-Mathematica inveniuntur 2 Vol. 450.

Essays of Natural Experiments made in the Academy del Cimento, English'd by Mr. Waller, 1684. 4to.

Ray's Wisdom of God in the Works of the Creation, Last Edit. with 3 Phys. Discourses.

Woodward's Natural History of the Earth.

Bobun, of Winds.

De Resistentia Solidorum, by Alex. Marchettus. Plorentiæ. 1665. 410.

Hypothesis Physico-Nova G. G. Leibnitz. Lond. 1671. 12mo. See N. 74. of Phil. Trans. Horologium Oscillatorium Christop. Hugenii, Paris,

Fol. 1673. Traite de la Percussion ou Choque de Corps per M.

Mariotte # Paris 1673. 12mo.

Traite de Mouvements des Eaux & des autres Corps Fluides par Feu. par M. Mariotte. Paris 1686. 800.

Pardies Local Mosion, Engl.

Exegesis Physico-Math. de momentis Gravium.

Whiston's Theory of the Earth. Gallilai Dialogi de Mechanica & Motu Locali. – de Systemate Mundi.

Sinclari Ars nova & magna Gravitatis & Levitatis.

Dee de Prastantioribus quibusdam Natura Virtutibus. 400 Lond. 1558.

Miscellanea Curiosa Germanica, in 8 Vol. 410. Physico-Mathesis de Lumine, Coloribus, & de Iridi. per Grimaldi.

PIAZZA's, or as our Vulgar frequently call them Piaches, are in the Italian the same as our Cloysters.

PICAGE, from the Latin Pica, was a Custom or Duty paid at Fairs and Markets for breaking the Ground and pitching up of Stalls and Standings; and this Profit of Picage was usually given or granted in Charters for holding a Fair or Market,

PIEDROIT, in Architecture, is a Square Pil-

PILÆ, in Architecture, and their Quadra's and Tables (as we yet see them in ancient Altars and Monuments) were imploy'd for Inscriptions; but if shorter and more massy, they serve for Arches of Bridges and for Buttresses to solid Work. Evelyn's Parallel.

PINK, is a Vessel used at Sea masted and rigged like other Ships, but only site is built with a round Stern, the Bends and Ribs compassing so as that her Sides buldge out very much; wherefore these Pinks are difficult to be boarded, and also are made to carry greater Burdens than others, They are often used for Store-Ships, and Hospital-Ships, in the Fleet.

PINNACE, is a small Vessel, with a Square Stern, going with Sails and Oars, and carrying three Masts; and is used as a Scout for Intelligence, and for Landing of Men, &c. also one of the Boats belonging to a great Man of War, which serves to carry the Officers to and from the Shoar, is called the Pinnace.

PISCI-

PISCIVOROUS Animals, are such as feed on See Birds

PITCH, is a Word used by Architects and Builders in these Senses. Sometime Paving is called Pitching: But usually they understand by it the Angle which a Gable-end, and consequently the whole Roof of a Building is set to. If the Length of each Rafter be? of the Breadth of the Building, then they say that Roof is of a True Pisch: But if the Rafters are longer, they say 'tis a bigb or sharp piech'd Roof; if shorter, they call it a low or flat pisch'd Roof.

PLACE Apparent of a Planet, is a point in the Starry Heaven which is found by a Right-Line passing from the Spectator's Eye on the Earth's Surface, and terminated at the other End amongst the fixed Stars. In the Figure under the Word Parallax in Vol. I. If A be the Centre of the Earth, and B a point on its Surface; let (represent the Moon, then will G be her true and H her appa-

rent Place in the Starry Heaven.

PLACE True of a Planet, in Astronomy, is that point amongst the fix'd Stars which is found by imagining a Right Line to be drawn from the Earth's Centre thro' the Planet, and terminated at

the other End in the Starry Heaven.
PLACE Geometrick. The Ancients called their Locus or Place, dranu wiro, i. e. Rosolutus, and the Order of their Writings about it, according to Pappus, is this, (1.) Euclidis Datorum, Lib. 1. (2.) Apollonii xó y v aralouñs, or de Rationis Sectione, Libri 2. (3.) The same Author's xosiv aralouñs, of the Section of a Space, 2 Books. (4.) His two Books of Tactiones (\$\times\alpha\operation{\text{col}}{\text{col}}\) (5.) Euclide his 3 Books of Porismata. (6.) Apollonius his revoceur, or of Inclinations, Book 2. (7.) The same Writer's two Books of Loca plana, Town omwider. (8.) His eight Books of Conicks. (9.) Aristaus his five Books Town segen, or of Solid Places. (10.) Euclide his two Books of Places ad Superficiem. (11.) Eratosthenes's two Books de Medietatibus. Of all which only Euclid's Data, and four Books of Apollonius his Conicks, are left now in Being.

See also 3. Craig's Tractatus Mathematicus de Fig. Curvilinearum Quadraturis; & de Locis Geometri-

Lond. 1693. 410.

PLANE, is an Instrument used in Joinery, to make Boards plane, try, and smooth, or in order to joint or frame them together, &c. These are of several Names and Sorts according to the several Uses; as, 1. The Pere-plane, which is a long Plane, and used first of all before either Smoothplane or Jointer. The Edge of the Iron of this Plane is not ground streight, but rising with a Convex Arch in the middle of it, that its Edge may bear to be set the Ranker, for its Use is to take off the Irregularities of the Scust as soon as may be, in order to prepare it for the Smoothing-plane, or Jointer. If the Stuff be free and from, that is, even tempered all over, you may then fet the Plane so rank as that you may take off a Shaving of the Thickness of an old Shilling; but if it be hard or curling, you can't take off one thicker than an old Groat. 2. The Smoothing-plane, is a short small Plane, whose Iron is set very fine, and its use is to take off the Irregularities of the Foreplane, or those which it hath left. 3. The Jointer is a Plane longer than the Fore-plane, and hath its Sole perfectly strait from End to End ; it comes after the Fore-plane and Smoothing-plane, and is defign'd to shoot an Edge of a Board perfectly

ftreight in order to jointing, as also Boards of any Thickness; for 'tis used to Try, as they call it, that is, smooth Tables with, whether large or small; wherefore its Iron must be set very fine, little above an Hair's breadth above the Sole of the Plane, and the length of the Edge of it exactly strait, or parallel to the Plane of the Sole or Bottom of the Plane. 4. The Strike-Block is a Plane made as true as the Jointer, and like it, only shorter; being used to shoot a short Joint, which it doth more handily and readily than the long Join-Tis used also for framing and fitting the oints of Misres and Bevels, but then the piece of Wood is drawn by Hand over the Plane several Times till tis shot true. 5. The Rabbet Plate is used to cut part of the upper Edge of a Board strait or square down into the Stuff, so that the Edge of another Board cut down after the same manner may fit and join in with it on the Square; and when two Boards are thus cut away, this lap-ping over is called Rabbering. The Rabber-plane is sometimes used also to strike a Pascia, in a piece of Moulding. The Iron of this Plane is full as broad as the Stock is thick (usually about an Inch) that the Angles of the Edge may cut down exactly strait; and it delivers its Shavings at the Side and not out of a Mouth at the Top, like other Planes.

6. The Plow, is a narrow Rabbet-plane, with the Addition of two Staves with Shoulders to them, and on the Bottom of the Shoulders a Fence: Its use is to plow a narrow square Groove on the Edge of any Board, of any proper Depth. 7. Mouldingplunes, of which are several kinds, as the Round Plane, the Hollow, the O-G-, the Snipes Bill, &c. and these of several Sizes, as from half an Inch to an Inch and half. When these Planes are used on soft Wood, as Deal, Pear-Tree, Maple; &c. the Iron is set to an Angle of 45 Degr. with the Sole or Base of the Plane; but if it be very hard Wood, as Box, Ebeny, Lignum Vitæ, &c. it is let to 80 Deg. and sometimes quite uprights There is also tome difference in the grinding of the Basil or the Slope of the Edge of the Iron of the Plane; for in working on hard Wood this is ground to an Angle of about 18 or 20 Deg. but in soft Wood, not to one above 12 Degrees; for the more acute the Basil is, the better and smoother the Iron cuts, but the more obtuse and thicker it is, the stronger is the Edge to cut upon hard Work.

PLANE of the Projection, in the Astronomical Perspective, or Stereographick Projection, is a Plane which passes thro' the Centre of the Sphere, the being supposed the Pole of or in a Point in the Axis of that Plane, and 90 Degr. above it or the Surface of the Sphere; thus, if the Eye be in the Zenith or Nadir Points, the Horizon will be a Plane on which the Circles of the Sphere may be projected Steteographically: And from hence it will follow, that all great Circles of the Sphere passing thro the Eye-point, must be at Right Angles to the Plane of the Projection, because they pass thro' its Poles. See Spherick Geometry, or Pro-

jection in Vol. I.

PI ANETS. The Motions of the fix Primary Square of the Times of their peroidical Revolutions are as the Cubes of their Distances from the Sun: And the same thing is found by all Astrono-

tners to be true, with Regard to the Motions of the Secondary Planets or Satellises round their primary bnes. Greg. Astron. p. 26, 27.

The

The Forces with which the Primary Planets are continually drawn from a Rectilineal Motion, and by that Means are retained in their Orbits, are reciprocally as the Squares of their Distances from the Centre of the Sun. Id. p. 33.

The Forces with which the Secondary Planets are retained in their Orbits, are reciprocally as the Squares of their Distances from the Centres of their

Primary Planets about whom they revolve. p. 34.

The Nodes and Apfides of all the Planetary Orbirs are at rest and do not move progressively.

P. 55.
The Planets and Comits are retained in their Orbits by the Force of Gravity; the same Law prevailing thro' all the Solar Sistem. p. 57.

If a Primary Planet revolving round the Sun as its Centre carry round with him a Sarellite which revolves also round the Planet; the Motion of this Satellite will be accelerated all the while it is moving from the Quadratures to the Syzygies, and retarded all the while it is moving from the Syzigies to the Quadratures: So that it will move faster near either its Conjunction or Opposition, and slower near the Quadratures. The Figure of its Orbit will al-so be more Curvilineal in the Quadratures than in the Syzygies, and consequently the Satellite will be or recede farther from the Primary Planer, in the Quadratures than in the Syzygies, so as that the Orbit will be an Ellipsis, whose Centre is the Primary Planer, and whose greater Axis lies at Right Angles to a Line drawn from the Sun; and the lesser Axis is coincident with that Line. This Dr. Gregory demonstrates in his Astron. p. 282, &c.

But if the Orbit of the Satellite Planer, inftead of being a Circle be an Ellipsis, in whose Focus the Primary Planet is supposed to be placed, then will the greater Axis of this Elliptical Orbit, twice advance forward, viz. in the 2 Quadratures, and twice recede backward, viz. in the 2 Syzygies, of every Revolution of the Satellite round the Pla-

net. p. 298.

In each Revolution of the Satellite round the Planet the Apsides will, for the most part, advance more forwards than they recede backwards, and by the Excess of this Progression, will move in

Consequentia.

PLASTICE, or the Plastick Art, is the Art of making Figures of Men, Birds, Beasts, Fishes, Planers, &c. in Clay, &c. The Workmen are called Plasta. It differs from Carving, because here the Figures are made by Addition usually, but in Carving always by Subtraction of what is super-It is now with us chiefly used in Fretwork Ceilings; but the Italians apply it to the Mantlings of Chimneys with great Figures.

PLAY. The Laws of Chance or the Proporti-

on of Hazard in Play or Gaming is a Thing Mathematically computable, &c. For the it be usually very uncertain in any Game depending on Chance, who shall win; yet it may, in most Cases, be determined who hath the better of the lay, and what Advantage one hath above the other; (which if Gentlemen knew and confidered, they would not, perhaps, venture their Money with Sharpers, and fuch Wretches as make it their whole Bufiness to know and remember the Odds in Gaming, as well as to practice most infamous Ways of Cheating by false. Dice, slight of Hand, &c. But, I proceed to an easy Instance; tho' whether a Man shall throw 6 with one Die the first time be uncertain, yet how much it is against him, or how impropable that he doth not, may easily be determined. So likewise if another and I play at Tables or Back-Gammon, 3 up, and I am the first one; tho' it be uncertain, and can't be determined Mathematically who shall win; yet by those Principles I can demonstrate what the Advantage is on . my Side, and how much the Value of my Expe-Charion or Chance exceeds his.

A vast Variety of Questions about these Things will arise in Play, amongst two or more Gamesters ; in Order to the Determination of which, this must

be premised as a Principle.

That the Value of any one's Chance or Expectation of Winning, is what would purchase the like Chance, Advantage or Expediation in a just or equal

Thus if a Person should, unknown to me, hide in one Hand 7's, and in the other 3's, tho it be impossible for me to be certain which Number is in which Hand; yet I'm sure 'tis an Advantage to me to have the Choice of which Hand I will take; and (as I shall shew below) this Advantage is worth five Shillings.

In order to which, I lay down this Propo-

Proposition I.

Where there is an equal Chance for a=3 s. and h=7 s. the Value of my Expectation is $\frac{a+b}{a+b}$; or half the Summ of a and b.,

To investigate the truth of which Proposition; suppose I would seek what the value of my Expechation is in this Case, let it in the Analytick way, of Enquiry, be called x.

Then, by the general Axiom or Principle, If I had x, I were able in a fair and equal Game to

purchase such an Expectation again.

Suppose therefore I play with another on these Terms, that each of us thall Stake down a, and, that the Winner shall give a to the Loser: I say this is just and fair, and that I have an equal Chance, either to get a, if I lose the Game, or to have 2x-a (that is, both the Stakes, inbducting 4) if I win. Now to make it an equal Game, this 2x-a must be =b, wherefore transposing aand dividing by 2, you will have this Equation x=a+b, which gives x fought.

Thus in Numbers, If I have an equal Chance of getting 3 s. or 7 s. then by this Proposition my Expectation or Interest is worth 5's. and 'ris certain, that having 5 s. I may have the same Chance ; for if I play with another, and each of us Stake 5 s. with this Condition, that the Gainer shall pay the Loser 3 s. This is an equal Way of Gaming; and tis plain, That I have an entire Chance to get or receive 3 s. if I lose, or 7 s. if I win.

That is, if a Man will give me the Choice of 7 s. in one of his Hands, and 3 s. in the other,

'tis as good as giving me 5 s.

Proposition II.

Where there it an equal Chance of a, b, or c, the value of my Expectation is $\frac{a+b+c}{3}$, or one third of the Sum of a, b, and c.

Let x (as before) be the Value of my Expectation; then must x be such, that I can purchase with it the same Expectation in a just and equal Game. Suppose the Conditions of the Game were, that of three Gamesters each of us stake down x, and I agree with one of them, to give him b if I win, and he doth the same by me; with the other I agree to give c, if I win; and he doth the same with me: I say, this is fair and equal Play; for here I have an equal Chance to get b, if the first win, c if the second win; or 3x-b-c (that is, all the Stakes, deducting b and c) if I win my self. Now to make the Game equal, 3x-b-c must be equal to a, wherefore x=a+b+c 3And so on; if there had been an equal Chance for four Things as a+b+c+d, the Value of my Expectation will a=a+b+c+d.

Proposition III.

Let the Number of Chances by which 13 (=a) may happen to me, be p=3, and the Number of Chances by which b=8, falls to me be q=2, and supposing all the Chances to happen with an equal Facility; then, I say, the Value of my Expectation is $\frac{pa+qb}{p+q}$; that is, in Words, The Quotient arising from the Summ of the Products of both the Numbers a and b, when multiply'd into their Respective Chances p and q, and then divided by the Summ of those two Chances. To prove which,

Suppose as before my Expectation to be x: If I have x, I shall be able to purchase with it the same Expectation again in an equal Game. For this I may take in as many Persons to play with me as make up the Number of p-1-q; of which every one must stake x, Therefore the whole Stake will be px+qx, and every one plays with equal hopes of wioning.

With as many of my Fellow-Gamesters as the Number q stands for, I bargain one by one, that which of them soever wins shall give me b; and if I win, I will do so by them. Then with the rest of the Gamesters, whose Number is p-1 (that is, all the remaining Gamesters but those express by q, and my self) I bargain, that whoever of them gains the Seakes shall give me a, and I agree to do so by them, if I win. 'Tis plain, that this is fair Play, no Man being injured. And in this Case I have q, Expectation to gain b; and p-1 Expectation to win a: And I Expectation (viz. If I win my self) to gain px+qx-bq-ap+a; for if I win I must give b to each of the q Gamesters, and a to each of the p-1 Players; which makes 6b+pa-a; if therefore qx-bx-ba-ap+a were equal to a, I should have p Expectations of a; since just now I had p-1 Expectations of it) and q Expectations of b; and so I should come just to my sirst Expectation; wherefore putting

px+qx-bq-ap+a=a. By Reduction x=ap+bqQ. E. 3.

In Numbers, If I have 3 Chances for 13, and 2 Chances for 8, I say by this Rule my Expectation is worth 11.

For $13 \times 3 = 39$. and $8 \times 2 = 16$. and 39 + 16 = 55, and 55 - 65 = 11.

And if I have 11, I can easily shew that I may come to this Expectation: For, suppose I play with 4 others, each of which, as well as I, stakes 11; with two of these I bargain, that whoever of us wins shall-give the others 8 a-piece; and then with the other 2, I agree, that the Winner shall give to the 2 Losets of us 13 a-piece. Then its plain, I have 2 Expectations to get 8, and 3 Expectations to get 13 (viz. if either I or any of the other two win) for in this Case I gain all the Stakes which make 55; out of which I must give the first two 8 a-piece, and the other two 18 a-piece, and so there remains 13 for my self.

To apply these things to the ordinary Cases of Play.

1. Suppose he that come first to Three be up, or wins the Stake between two Gamesters: And let me be swo and he but one; Query, What is my Advantage? Or, if we leave off Play, what is my just Share of the Stakes?

The first Consideration here is, how much each of us wants to be up; as suppose we play 3 up, and he be I and I 2; or if we play, first come to 20, and he be 18 and I 19 Games; in both these Cases he wants 2 of being up and I want but one; The Question is, what Advantage I have of the Lay? or what Proportion or the Stakes is due to me if we should now leave off.

To find which, let us see what would happen if the Game went on: If I get the next Game, or End, I am up, and win the Stakes; which suppose you call a=8, but if he win 2, then he will be up as well as I, and so both our Lots are equal; and if we should then divide, each of our Shares will be 4 or \frac{1}{3}a.

But before we play that Game, if I am two and he but one, the Hazard, which of us shall win that Game, being equal, I have an equal Chance to get the whole Stake or the half; that is, a or 4; for if I win the Game I have a, and if he win, my just share of the Stake is 14.

Since therefore, before I begin this Game, I have an equal Chance to gain a or ½a, the Value of my Expectation (by Prop. I.) is half the Sum of both

those Chances (i. e.) $\frac{a+\frac{1}{1}a}{2} = \frac{3}{4}a = 6$. Now if I have due to me as my Share, he can have but due to him as his Proportion, so that if we play'd for 8 Pieces, and would draw Stakes when I am two and he but one, and if three be up, I must have 6 Pieces and he but 2 Pieces, and the Odds on my side is Three to One.

Another way thus; in

Case 1. The Descriencies being 3; the Sett must be up in two Ends; wherefore take the Members of the 2d Power of a+b, and distribute them thus: Because A wants but one of up, let all the Members, where there is one a or more, with their Uncia be collected for A, and all where there's two b's (or bb and above) for B.

For

1 5 4	For B.	1
For A.	1 1 66 1	Wherefore A's odds to B
2 ab		is 3 to 1.
11 2 1	1 1	j

Or by simple Subtraction only, Let the Stake of each be 32 s. then if A wins the next Game he is up and hath the whole or 64 Shillings; but if B wins it, their Shares will be equal. A there might have said, If B will leave off let him give me the 32 Shillings. which I am fure of, tho he should win the next Game; and fince he will not venture for the other 32 s. let us divide it fairly between us; so A must have 16 s. more, which will make his Share in the whole 48 Shillings, and he must have only 16 Shillings.

Tis the same odds, i. e. 3 to 1, that a Man throws not Pile twice together with one Piece, as that he throws two Piles the first throw with two

Pieces. For reckoning each Face of the Piece of Money for a Chance, like the Face of a Dye, 'tis plain, of the 4 Chances on the two Pieces, there is only smo Piles for him, whereas there is 2 Crosses, one Pile and one Cross, and one Cross and one Pile against him; each Piece having two Faces) that is, there is one for him and 3 against him.

Case 2. Suppose I want but one Game of up,

and my Fellow-Player 3.

I consider the State of our Case, if either my self or he gain the next Game. If I win it I am up, and to have the Stake a; if he win it, he will then want two of being up, as I want but one. And then I shall be in the same State as was supposed in the Case before this; and my Share of the Stakes, if we should divide fairly, is a; wherefore before I threw I had an equal Chance for a or 14, and therefore (by Proposition I.) my Expectation

is worth $\frac{1}{4} = \frac{7}{4} = \frac{7}{4}$: But if my Proportion of

Expectation be 3a, his can be but 1a; and therefore my Odds is as 7 to 1.

Otherwise thus,

The Deficiencies being 4, the Sett must be up at 3 Games End: Then take the Members of the third Power of A+B and distribute them thus:

For
$$A$$
, For B , $1b^3$ Wherefore the Odds is as 7 to 1.

Here also by common Subtraction 'tis plain; That if A wins the Game he hath 64 s. but if B twins it, they are in the Condition mentioned in Case 1. That is, there is then 48 s. due to A; wherefore he might say, Give me that 48 s. that is due to me (for I'm sure of it whether I win or lose the next Game) and if you will leave off and not hazard the other 16 s. let us divide them equally; give me 8 s. more, which makes my Share 64 s. leaving yours but 8 s. wherefore A's Advantage was 7 to 1.

Case 3. By this Method of Calculation you will find, that if I want but one of being up and he 4, the Odds on my Side is 15 to 1;

Case 4. Suppose I want 2 and he 3 Games of bei

Then if I win the next, I shall want but one and he three. This State of the Sett is worth \(\frac{7}{4}a \) by the last Case; but if he win, then each of us will want 2, and io our Chance is equal, and there is 14 due to each of us; wherefore I have an equal Chance to gain 7 a or 1 a: But 2 a+1 a

wherefore, if we were to divide the Stakes justly, there is eleven 16ths due to me, and consequently but 5 Sixteenths due to him; wherefore I much have eleven parts of the Stake, and he but five.

Otherwise thus;

Let. A want 2 of up, and B want 3.

The Deficiencies 2+3 being 5, the Sett must

be up in one Game less; viz. 4.

1 take therefore the 4th Power of the Binomial

A+B, viz. a+ 4a3b+6a2b2+4b3a+b4, and distribute it thus;

Let all the Members where there are two a's be collected for A, and all those where there are three b's for B.

A. 1a ⁴ . 4a ³ b 6a ² b ²	B. 4b³a 1b4	in the fhe
11	5	as

Then adding all the Uncia each Collection together ey will give the Chances and ew the Odds of A's winning being up before B, to be 11 to 5.

And so on Universally.

As in Case the next, where A wants two and B wants four of up.

The Deficiencies being 6, the Sett will be up in one Game less, viz. 5. Taking therefore the Uncia of the 5th Power of a+b you will have

for A. 1a ⁵ 5a ⁴ b 10a ³ b 10a ² b	16' B on 5ab4	
in all 26.	in all 6.	

Wherefore the Odds is 26 to 6, or 13 to 3.

This Method by the Uncia of a Binomial was communicated to me by the Honourable Francis Roberts, Elq;

Case 5. Suppose I want 2 and he 4.

If I win next I shall want but one and he will still want four; but if I lose the nextGame, I shall want 2 and he 3; wherefore by Case 3, 4. I have an equal hazard of gaining 1/2 or 1/6, and this by Prop. I. is worth 1/3 ; wherefore his Share is but and therefore the Odds on my Side is 13 to 3.

N. B. Wherefore he that wants but 2 of up, when the other wants 4, is in a better State than he who wants but one when the other wants but two (as in Case 1. for his Expectation then is but 3 or 12a, whereas now tis 18a.

To carry this a little farther, Suppose 3 Men at play, and let the first and second want but one

Game of up; and the third want two.

To find the value of the Share of the first (in Case of a Division of the Stakes) you must consider what will happen if either he or any of the two other gain the first Game. If the first win he gets the Stake a, if the second win the first hath Nothing; but if the third win, each would want a Game; so that is each Man's Share:
Where

LA

Wherefore the first Man hath one Expectation to gain a, one to get nothing, and one for 1/4; which by Prop. II. is 4+0+3a =3a. But the second Man's Expectation was as good as that of the first, for he wanted also but one of up; wherefore his also is of 4: But 44+4=;a, and consequently the Third's Share can be but ; a; wherefore the Stakes being divided into 9 parts, the two first Men must have

4 a-piece, and the third must have one. And after this manner you may proceed with any Number of Players; of which some want more and some less of the Setts of Games. If you go about to investigate any one's Share, you must confider what would be due to him, if either he or any one Gamester should win the next Game; and then, adding all their Shares, and dividing the Sum by the Number of the Gamesters, the Quotient will be the Share you seek.

Proposition IV. Problem.

To find at how many Throws one may under-

take to throw 6 with one Dye?

Case 1. If I undertake to throw fix the first time tis plain there is but one Chance for me and 5 against me. Let the Stake therefore be a, then shall I have one Expectation to gain a, and 5 to gain a + 5 nothing,

Nothing; wherefore by Prop. II.-

(for 5 times Nothing is Nothing) = ta, is the Value of that Expectation, and consequently my Antagonist must have 'a; wherefore he ought to lay me 5 to 1.

Case 2. If I undertake to throw 6 at 2 Throws

with one Dye, my Chance may thus be found;
If I throw 6 the first time, I have my Stake; if I do not, I have but one throw remaining; which (by Case 1.) is $=\frac{1}{6}a$; wherefore there are five Chances for my gaining ta, and but one for a;

which (by Prop. II.) $\frac{=a+\frac{5}{6}a}{6} = \frac{1}{16}a$, the Chances

against me then give my Fellow Gamester 354, and consequently, that I don't throw 6 at two Throws, is 25 to 11.

Case 3. By the same Method of Calculation you will find that I don't throw 6 at three times is 125 to 91, a little more than 4 to 3.

Case 4. That I do throw it at 4 times is 671 to 625, a little more than an even Wager.

Case 5. That I do it at 5 times, is 4651 to 3125, viz. almost 3 to 2.

Case 6. That I do it at 6 times, is 31031 to

15625, almost 2 to 1.

The Solution of this Problem and of the following one I had also from the Honourable Fr.

Roberts, Eiq; Thus, In how many times, with a fingle Dye, may

one undertake to cast Six?

The Chances of one Dye being 6, I make 6 the Numerator of a Fraction, and the Chances against my throwing 6 being 5, I make that the Denominator; and by Consequence, the Denominator subducted from the Numerator leaves the Chances which are for me. Vol. II.

Now I say, that the Number of Throws required must be the Index of that Power of ; which makes the Numerator at least double to the Denominator; for by that Means the Chances a gainst me being subducted, a Majority will remain

Wherefore at 4 Throws I have something the Advantage: And so you may proceed on as far as you please.

Problems of this Nature are very expeditionfly folved by the Logarithms, as in this Example.

In how many times, with fix Dice, may one

undertake to throw all Sixes?

All the Chances on 6 Dice being the 6th Power of 6; that is, 46656, let x be the Number of Throws required.

Now without the Logarithms, (which folve this in a few Minutes) a Man's Life would scarce serve to go thro' the Operation; for $\frac{46656}{46655}$ must be raised up to the 32335th Power, which would make a Row of Figures almost a Quarter of a Mile in Length.

Proposition V. Problem.

To find at how many times one may throw 12 with only two Dice.

Case. 1. 'Tis plain, the first Throw, the Castor hath but one Way to throw it, and 35 Throws to miss it; wherefore by Prop. II. his Expectation is but 3 d.

Case 2. He that undertakes it at twice, if he throw 12 the first time gains a; if not, he hath but one Throw more for it; and that is worth but 164, by the former Case; wherefore there is but one Chance for him for 12 at the first Throw, and 35 Chances against him: So that he hath Chance for a and 35 for 16a, which by Prop. II.

is worth $\frac{71}{1296}a$, and there will be against him

 $\frac{22}{1296}$ which is above 16 to 1.

Omitting then the Chances of doing it at three Throws, let us find the Hazark or Odds of doing it at 4 Throws.

If he that undertakes to throw 12 at 4 Throws do it the first or second Throw, then he hath a; if not, there remains two other Throws against Rrr

him; which by the former Case are worth $\frac{1}{1296}a$.

But for the same Reason in his two first Throws, he hath 71 Chances for a, against 1225 Chances which will lose it; wherefore at first he hath 71

Chances for a, and 1225 which give him 1296 a;

which by the 2d Proposition is worth $\frac{1500625}{1679610}$ a.

And thus if you pursue all the Cases (saith the ingenious Author of the Laws of Chance, p. 38, 39.) you will find that he that undertakes to throw 12 with two Dice at 24 Throws, has some Disadvantage of the Lay, as he that engages to do it at 25, hath some Advantage.

Proposition VI.

After the same manner may be found, that you may undertake to throw two Sixes at ten Throws of one Dye, or with one Throw of ten Dice.

Proposition VII.

If I play with another but one Throw with two Dice, to that if 7 comes up I win the Stake, if 10 he gains it; what is the Odds, and how much of the Stakes would belong to me if we draw?

Of the 36 Chances on the two Dice, there are 6 which will give me 7, 3 which give me 10, and consequently 27 other Chances which give me neither, and which equals the Game; in which Case there is due to each of us 1 a; but if none of the 27 should happen, I have 6 Chances to gain a and 3 by which I may get Nothing; which, by Prop. II. is $\frac{3}{4}a$ in Value. So I have 27 Chances for half a and 9 Chances for $\frac{3}{4}a$, which (by Prop. II.) $=\frac{1}{2}\frac{1}{4}a$ for me, and $\frac{1}{2}\frac{1}{4}a$ for him.

Prop. VIII.

If I were playing with another, by turns, with two Dice, so that if I throw 7 I win, and if he throw 6 he wins, and he hath the first Throw; What is the Proportion of my Hazard to his?

Suppose I call the Value of my Hazard x, then

if the Stakes be a, his Hazard will be a-x.

Then whenever tis his Turn to throw, my Hazard is x; but when it is my Turn, the Value of

my Hazard is greater.

Suppose I then call it y. Now because of 36 Throws on two Dice, there are 5 which will give him 6, and 31 which bring it again to my turn to throw; I have 5 Chances for nothing and 31 for y, which (by Prop. III.) is worth \(\frac{3}{3}\tau_1\tau_2\). But at first I supposed my Hazzard to be x, where fore \(\frac{3}{3}\tau_2\) = x, wherefore $\frac{3}{3}$ $\dot{x} = y$. I supposed likewise when it was my Turn to throw, that the Value of my Hazard was y: But then I have 6 Chances which give me 7, and consequently the Stake; and 30 which give my Antagonist the Dice; that is, make my Hazard worth x. So I have 6 Chances for a, and 30 for x; which by Prop. 3. is worth but by the Supposition, that is $= 1 = \frac{1}{3} \frac{c}{4}x$, and $x=\frac{1}{6}i^{2}a$, which is the Value of my Hazard;

wherefore his must be 300, and consequently my Chance to his is as 31 to 30.

In the Book above-mentioned, called The Laws of Chance, you will find the Advantages and Difadvantages of the several Chances at Hazard, Raffling, Whist, &c. this Way computed.

Proposition IX. Probl.

To find in any Number of Games the Value of the First.

Suppose A and B play so that he that wins the first 9 Games shall have the Stakes, and A hath won one of the 9 already; if they leave off, how much of B's Money is due to A.

To find this, take the first 8 even Numbers, 2, 4, 6, 8, 10, 12, 14, 16, and multiply them continually, that is, the first by the second, and then the Product arising thence multiply by the third, &c. Take also the first 8 odd Numbers, and do so by them. The Product of the even Numbers will be a Denominator, and that of the odd ones a Numerator of a Fraction; which Fraction will express the Quantity of B's Money due to A on his winning the first of the 9 Games.

Suppose only 4 Games up, of which A is one: Take the three first even Numbers, as 2, 4, 6, and multiply them continually, they will make 48; the three first Numbers 1, 3, 5, so multiply'd make 15: Therefore there is due in this Case to A, 15, or 15 of B's Money; wherefore, if each had staked 16 Shillings, there would be a Crown due to A besides his own Stake of 16 Shillings.

Proposition X. Probl.

To find the Value of his Hazard who undertakes at the First Throw to cast Doublets with any assigned Number of Dice.

In two Dice, 'tis plain, that to avoid Doublets,' every one of the Six different Throws of the first Dye, can only be combined with Five of the Second; because one of the Six is of the same kind, and therefore will make Doublets.

For the same Reason, the 30 Throws of 2 Dice which are not Doublets, can only be combined with four Throws of a third Dye, and with but 3 Throws of a fourth Dye.

Wherefore in General this will be the Series. 6×5×4×3×2×1×0, &c. 6x6x6x6x6x6x6, &c.

The Under Series is the Summ of all the Chances; and the Upper, the Number of Changes against him who underrakes to throw Doublets.

Each Series must be continued to so many Terms, as are the Number of Dice. V. gr. If one should undertake to throw Doublets, the first Throw with four Dice, his Adversary's Hazard is $\frac{5\times5\times4\times3}{6\times6\times6\times6} = \frac{360}{1296} = \frac{5}{18}$, and he hath $\frac{1}{12}$: So that 'tis 13 to 5 that he throws Doublets the first time with 4 Dice.

In

In Seven Dice, 'tis easie to see the Chances against the Undertaker are nothing, because then there must necessarily be Doublets.

Proposition XI.

If I have p Chances for a; q Chances for b; and r Chances for c: I say, my Expectation is worth ap+bq-tcr $\frac{1}{p+q+r}$, that is, in Numbers, suppofing p=2. a=3. q=4. 5=b. 1=r. c=9; the Value of my Hazard is $\frac{2\times 3+4\times 5+1\times 9}{7}=5$. For call my Expectation x, then x must be such, having it, I am able to purchase as good a Hazard again, in a just and equal Game. Suppose the Law of the Play were this, that I playing with fo many others, as with my felf, make up the Number p+q+t; with as many of them as the Number p represents, I make this Bargain, that whoever wins shall give me a, and I will do so to each if I win: With those represented by the Number q, I bargain to have b if any of them win, and to give b to each of them if I win my felf; and with the rest of the Players, whose Number is r--1, I agree to give or to receive c after the same Manner. Now all being in an equal Probability to gain, I have p Chances to get a, q Chances for b, and r—1 Chances to get c, and one Chance, i. e. when I win my felf, to get px+qx+tx-ap-bq-rc+c. which if it be supposed as a Chances of a Chances equal to c then I have p Chances for a, q Chances for b, and r Chances for c (for just now I had r-1 Chances for it) therefore if px + qx - rx - ap - bqap+bq+cr as it ought -rc+c=c: Then is x: to be.

By this Theorem all the Chances at Hazzard may easily be calculated. Vid. Laws of Chance, p. 87.

PLEAS of the Sword. Placita ad Gladium. In 2 H. 3. Ranulph the 3d. Earl of Chefter granted to his Barons of Cheftire an ample Charter of Liberties; Exceptis Placitis ad Gladium suum pertinentibus. The Reason of which was, that William the Conqueror gave the Earldom of Chester to his Kinsman Hugh (commonly called Eupus) Ancestor to this Earl Ranulph, Tenere ita Libere per Gladium, sicut ipse Rex Willbelmus tenuit Angliam per Coronam. And consonant hereunto, in all Indictments for Felony, Murder, &c. in that Conty Palatine, the Form was anciently, Contra Pacem Domini Comitis, Gladium & Dignitates suas.

PLEBANIA, Ecclefia plebanianis, is a Mother-Church which hath one or more subordinate Cha-

pels.

PLEBANUS, was sometimes the Title of a Rural Dean, because the Deanaries were formerly affixed to the Plebanie, or chief Morber Churches within such a District, which at first was usually Ten Parishes: Sometimes it seems to have been used for a Parish-Priest of such a large Mother-Church as was exempt from the Jurisdiction of the Ordinary, and therefore he had the Authority of a Rural Dean committed to him by the Archbishop, to whom the Church was immediately subjects:

PLEBISCITUM, in the Roman Law, was whatever was enacted by the Common People, at the Request of the Tribune, or some other plebeian Magistrate.

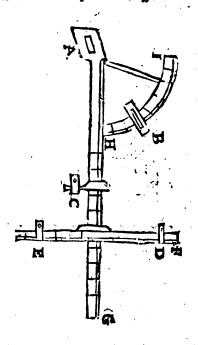
PLEURA, is a double Membrane, which covers all the inward Cavity of the Thorax; it arises from the Versebra of the Back, and ascends on each fide upon the Ribs, to the middle of the Sternum. It is fixed to the Periosteum of the Ribs, and to the internal intercostal Muscles, and it covers the Midriff. Its Side towards the Cavity is smooth and equal, but that which is fixed to the

Ribs is rough.

PLOW, an ancient Instrument, tho' now not much used at Sea, mentioned in the former Volume; and its Description is thus given by Sir 30-

nas Moor in his Navigation.

There is first, a Staff, as A L G, on which a small Arch, as H I, and a Cross, as E F, are fitted together with three Vanes, as A an Horizontal Vane, B a Shade Vane, and C a Sight Vane, which is moveable upon the Staff.



In order to make an Observation of the Sun's Altitude with this Instrument, you must fit on the Horizon-Vane, and then you may place the Shade Vane to any Degree of Altitude in the Divisions of the Arch, so it exceed not the Altitude to be observed, nor be above 10 Degrees (which a little Practice will soon enable you to guess readily at :) for in both these Cases the Divisions on the Staff are descient. Then put on the Sight-Vane, hold up the Instrument, and turn the Back of the Arch to the Sun, and move the Sight-Vane on the Staff backwards and forwards, till the Shade of the upper Edge of the Shade-Vane sall on the upper part of the Slit of the Horizon-Vane; and that at the same time, looking thro the Sight-Vane, you can see the Horizon thro the Horizon-Vane; for then will the Summ of the Degrees on the Arch and on the Staff be the Altitude, allowing for the Height above the Horizon and for Refraction, For the Height above the Horizon they usually allow 6 or 8 Inches.

PLOW-Land, Carucata, was formerly as much arable Land as one Plow could plough up in one R r r z

This in the Beginning of the Reign of Rich. I. was accounted at 60 Acres; and in the 9th of Rich. I. 100 Acres is allowed for a Plow-Land. And this Measure was very different ac-

cording to Time and Place.
PNEUMATICAL Experiments, are such as are made in the exhausted Receiver of the Air Pump, in order to discover the several Properties of the Air and its Influence on other Bodies. Of these you may find great Variety in Mr. Boyle's Works, and in the Philosophical Transactions; and those made with great Accuracy and Care.
PNEUMONICA Vena. See Vena Pneumonica,

in this Vol.

POCKET of Wooll, is the Quantity of half a

Sack. 3 Instit. Fol. 96.
POINTS of the Compass. See Compass and

POLEINE, was a kind of Shoe with a picked Point turned up at the Toe: These first came into Fashion in the Reign of William Rufus, and by degrees came to be of that excessive Length, that in Richard the Second's Time, they were ty'd up to the Knees with Silver or Gold Chains, according to the Dignity of the Wearer. They were forbidden by Edward the Fourth, in the fifth Year of his Reign, under a great Penalty, to be worn so very long; but they were not quite disu-fed till the Reign of Henry the Eighth.

POLITICAL Arithmetick, is the Application of Arithmetical Calculations to the Extent and Value of Lands, Number of People, Publick Revenues, Taxes, Trade, Commerce, Manufactures, or whatever relates to the Power, Strength, Riches, &c. of any Nation or Common-wealth. Of this Nature several Discourses have been published; as Sir William Petty's Political Arithmetick, Grant's Observations on the Bills of Mortality; Capt. Haley's on those of Breslaw in Silefia; Dr. Davenane's Discourses of Trade, &c. From these kinds of Inquiries and Computations, Sir William Petty hath advanced, that the Land of Holland and Zealand is not above 1000000 of Acres, whereas that of France is above 80,000000, and yet those Places are near a third part as rich and as strong. That the Rents of Lands in Holland to those of Prairie, are about 7 or 8 to 1. That the People of Amsterdam are 3 of those of Paris, or London, which don't differ, he faith, a-Bove a 20th part from one another. That the Value of the Shipping of Europe is about 2 Millions of Tuns; of which the English have 500000, the Dutch 9000000, the French 1000000, the Hamburghers, Dunes, Swedes, and Dantzickers, have 2500000, and Spain, Purtugal, and Italy, &c. about as much. The Value of the Goods exported from France into all the Parts is supposed Officially to what is feely into Burgland alone Quadruple to what is fent into England alone, and confequently in all about 5000000. What is exported out of Holland into England, is worth 2000000; and what is exported thence into all the World, is 18000000. The Money yearly raifed by the French King (in Peace) is about 6. Millions Sterling; and all Holland and Zealand pay about 2100000 l. and all the Provinces together about 3000000. That the People of England are about 6000000; their Expence at 71. in Butter, Cheese, and Milk, he thinks, is about per Annum 2 Head, 42000000. The Rent of the 2,500000. The Value of the Wooll yearly shorn, Lands about 8 Millions, and the Profits of the about 2,000000: Of Horses yearly bred, about Personal Estate as much. The Profits of all the 250000. Of the Flesh yearly spent as Food, a-

Labour of the People 26000000. In Ireland the People amount to about 12 Hundred Thousand. The Corn spent in England, at 5 s. per Bushel Wheat, and half a Crown Barley, is worth Ten Millions per Annum. The Navy of England (then) required 36000 Men to man it; other Trade of Shipping about 48000 Men to manage it. In France, to manage the Shipping Trade, he reckons then but 15000 Men. The whole People of France he accounts about 13000000 and an half; and those of England, Scotland, and Ireland, all together, to be 9 Millions and an half. In the King of England's Dominions are about 20000 Church-men; and in France above 270000. In our whole Dominions above 40000 Seamen, in France not above 10000. In England, Scotland, and Ireland, and all other Dominions belonging to us, there was then about 60000 Tun of Shipping; which is worth about 4 Millions and a half of Money. The Sea-Line round England, Scotland and Ireland, and the adjacent Islands, is about 3800 Miles

In the whole World about 300,000000 of People, and not above 80 Millions with whom the English and Dutch have Commerce. The Value of the Commodities traded for in the whole, nor above 45000000. The Manufactures of England in the whole, exported from England, amount to about 5000000 per Ann. Lead, I'm, and Coals, 500000 l. per Ann. The Value of the French Commodities (then) brought into England, did not ex-ceed 1200000 l. per Ann. The whole Cash of England in current Money was then about 6000000 la and at 6000000 of Souls, allowing each to spend 7 l. per Ann. the whole Expence will be 420000000, that is, about 800000 l. a Week. The Rent of Houses in England was then about 4000000 l. per

Annum.

Dr. Davenant also in his Discourses on the publick Revenues and Balance of Trade of England, shews the great Use of Political Arithmetick in all the Considerations about the Revenues and the Management of our Trade; he gives some good Reasons why Sir William Petty's Number abovementioned are not entirely to be rely'd upon, and therefore advanced others of his own, which are founded upon and supported by the Observations of the ingenious and industrious Mr. Gregery King. Some of the Particulars of which, that are most useful, are these: That the Land of England is 39 Millions of Acres. The Number of People, according to this Account, is now an bout 5545000 Souls, they increasing about 9000, every Year, Allowances being made for Plagues, Sc. Wars, Shipping, and the Plantations. The People of London he reckons at 530000. Those People of Landon he reckons at 530000. in the other Cities and Market Towns in England, at 870,000, and those in the Villages and Hamlets at 4100000. The yearly Rent-of the Land he accounts to be 10,000000. That of the Houses and Buildings:2,000000 l. per Ann. The Produce of all kinds of Grain he reckons to be worth 9,075000 l; in a Year of moderate Plenty. The Rent of the Corn Land annually 2,000000 l. and the neat Produce above 9,000000. The Rent of the Pasture Meadows, Woods, Forests, Commons, Heaths, &c. 7,000000. The Annual Produce by Cattle,

bout 3,350000. Of the Tallow and Hides about 600000. Of the Hay yearly confumed by Horfes, about 1,300000; of Hay confumed by other Cattle, 1,000000.

Of the Timber yearly felled for Building 500000 l. Of the Wood yearly spent in Firing. &c. about 500,000 l. The Land of England to its Inhabitants is now about 7. Acres per Head. The Value of the Wheat, Rye and Barley necessary for the Sustenance of England amounts to at least 6,000000 of Pounds Sterling per An. The Value of the Woollen Manufacture made here The is about 8,000000 l. per Ann. and our Exports of all Finds of the Wollen Manufacture do amount to above 2,000000 l. per An. The annual Income of England on which the whole People live and subsist, and out of which Taxes of all kinds are paid, is now fince the War about 43,000000l. That of France 81,000000, and that of Holland 18,250000 l. &c,

The Ingenious Capt. Halley, Geometry Profesfor in Oxon, hath made a very exact Estimate of the Degrees of the Mortality of Mankind, drawn from curious Tables of the Births and Burials at the City of Breslaw, the Capital of Silesia, with an Attempt to ascertain the Price of Annuities upon Lives from thence. This is Published in Philos. Trans. N. And in the Miscellanea Curiofa, Vol. I. From a Table which he hath there calculated he derives the following Uses. 1. To find the Proportion of Men able to bear Arms in any Multitude; which he reckons from 18 to 56 Years old; and accounts about 2 of the whole. 2. To shew the differing Degrees of Mortality (or rather of Vitality) in all Ages; by which Means he finds the Odds there is, that any Person of any Age dorh not die in a Year's Time, or before he attain such an Age. 3. Toshew at what Number of Years, itis an even Lay that a Person of any Age shall die ; and finds for Instance, that in an even Lay, that a Man of 30 Years of Age lives between 27 and 28 Years 4. To regulate the Price of Infurance upon Lives: And, 5. The Valuation of Annuities on Lives. 6. How to value two or three Lives after the same Manner. from the whole he makes two very good Observations. 1. How unjustly we complain of the Shortness of our Lives, for it appears, one Half of those that are born don't live above 17 Years. 2. That the Growth and Increase of Mankind is not so much stinted by any Thing in the Nature of the Species, as it is from the curious Difficulty most People make of venturing on the State of Marriage. And therefore Celibacy ought to be every Way discouraged by all wife Governments; and those who have numerous Families of Children, to be countenanced and encouraged by good Laws, (i. e.) such as the Jus Trium Liberorum, among the Romans, &c. See on this Subject also Grant's Observations on the Bills of Mortality; who reckons that there are 39000 fquare Miles of Land in England.

That in England and Wales there are 460000

That the People of London are about 640000; one fourteenth of the People of England.

That England and Wales are about 10,000 Parishes.

In Dublin (then) 30000 People.

That there are 25 Millions of Acres in England and Wales, viz. about 4 Acres to every Head.

That but 64 out of 100 of the Children born are living at 6 Years old.

That but 40 of 100 are alive at 16 Years End. But 25 out of 100 at 26 Years End. But 16 out of 100 at 36 Years End. But 6 out of 100 at 46 Years End. But 6 out of 100 at 56 Years End. But 3 out of 100 at 60 Years End. But I out of 100 at 76 Years End. That London doubles itself in about 64 Years.

Sir William Petty also in his Discourse about Duplicate Proportion, tells us, that 'tis found by Experience, That there are more Persons living between 16 and 26 than of any other Age : And laying down that as a Supposition: He infers, That the Square Roots of every Number of Mens Ages under 16, (whose Root is 4) shews the Proportion of the Probability of such Person's reaching the Age of 70 Years. v. gr. Tis 4 Times more likely that one of 16 Years of Age lives to be 70, than a Child of 1 Year old. Tis thrice as probable, That one of 9 Years lives to 70, as such a new-born Child,

That the Odds is 5 to 4, that one of 25 dies be-

fore one of 16 Years

That tis, 6 to 5 (still as the Square Roots of the Ages) that one of 36 Years old dies before one of but 25 Years of Age. And so on according to any declining Age to 70; compared with 4.6: Which is nearly the Root of 21, the Law Age.

The above-mentioned Mr. Halley, in his Observations on the Breslaw Bills of Mortality, saith; That 'tis 80 to 1, a Person of 25 Years of Age doth not die in a Year.

That 'tis 5 ½ to one, a Man of 40 lives 7 Years ; and that one of 30 may reasonably expect to live

27 or 28 Years.

And so great a Difference is there between the Life of Man at different Ages; that tis 100 to 1, one of 20 lives out a Year; and but 38 to 1, that one of 50 doth so. Whence, and from some other Observations, with great Pains he computed the following Table, shewing the Value of Annuities for every 5th Year of Life to the 70th.

A Table of the Value of Annuities

Age.	Years P	urchafe.
5	13	. 28 ⁻ . 40 · 44
15	13	· 33 · 78
25 30 35 40 45	12 11 11 10	27 72 12 57 91
50 55 60 65 70	9 · 8 · 7 · 6 ·	21 51 60 54 32

POLLARDS

POLLARDS, were formerly a kind of Spurious Com used in England, but these, as also Cro-tards, Staldings, Eagles, Leaonies, and Steepings have been long fince disused. See Matt. West. in Anno. 1299. p. 413. 2 Inft. fol. 577. and Plowden,

fol. 469.

PONTON: The late invented Ponton is a Boat of Tin or rather Latten, eight Yards long and two broad, having a large Ring at each Corner: When the Army marches it is laid on a Carriage, and drawn by five Horses. Each Boat hath an Anchor, and Cable, and Baulks, and Chefis belonging to it, The Baulks are seven Yards long and about five or fix Inches square: The Chefts are Boards joined together by Wooden Bars about a Yard broad and full there are given when these Pontons are to be used, they are slipp'd into the Water, and placed about two Yards asunder, having a strong Rope running through the Rings, which is fastened on each Side the River you would pass over, to a Tree, Stake, &c. The Baulks or Beams are laid across the Boats at a due Distance, and the Chests upon them; and these are joined close to make a Bridge, over which Foot, Horse, and even a Train of Artille-

ry may pass.
PORES. Sir If. Newton in his Opticks shews, that Bodies are much more rare and porous than is commonly believed. Water is 19 times lighter and consequently rarer than Gold; and Gold is so rare as very readily and without the last Opposition to transmit the Magnetick Effluvia, and easily to admit Quick-silver into its Pores, and to let Water pass through it; for a Concave Sphere of Gold hath, when filled with Water and solder'd up, upon pressing with great Force, let the Water squeeze through it, and stand all over its outfide in multitudes of small Drops like Dew, without bursting or cracking the Gold, as he was informed by an Eye-witness. Whence we may conclude, that Gold bath more Pores than folid Pares, and by Consequence, that Water hath above 40 Times more Pores than Parts. And he that shall find out an Hypothesis to solve how Water can be thus rare, and yet not be capable of Compression by Force, may doubtless by the same Hypothesis make Gold and Water, and all other Bodies, as

much rarer as he pleases.

So that Light may find a ready Passage thro' transparent Substances, there being open and free Space sufficient for such a Passage. We find that the Magnet transmits its Vertue without any senfible Diminution or Alteration, through all cold Bodies that are not Magnetick, as Gold, Silver, Brass, Glass, Water, &c. The gravitating Power of the Sun (if you will explain it Mechanically) is transmitted entire through all the vast Planetary Bodies, so that with an equable Force it acts thro' all their Parts, even to their very Centres; i.e. according to the Quantity of Matter in each Part. The Rays of Light, let'em be either Bodies actually coming to us from the Sun, or only Motions or Impressions upon the Medium, move in Right-Lines, and are hardly ever, unless by great Chance, reflected back again in the same Right-Line after their Impingence on Objects; and yet we see that Light is transmitted to the greatest Distances thro Pellucid Bodies, and that in Right-Lines. Now how Bodies should have Pores sufficient for these

of all Bodies arise from their Particles being of fuch a determinate Size or Magnitude: (See Cotours.) Wherefore if we conceive those Particles to be so disposed, as that there is as much of Porosity or Space interspersed between them as the Quantity of these Particles amounts to. And in like Manner, if you suppose these Particles to be composed of others much less, and that these have as much interspersed Vacuity as their Quantity amounts to; and so on till at last you come to solid Particles without any Pores: Then if in any Body there be 3 (for Instance) of these Sizes of Particles, and that the last be of the folid or least Sort; that Body will have 7 Times as much Vacuity as Solid Matter. If you suppose 4 such Degrees or Sizes of Particles, and that the last and least be solid; the Body will have 15 Times as much Pores as Solidity. If you imagine any Body to have 5 such Degrees or Sizes of Particles, it will have 31 Times as much Space as Solidity interspersed: And if it have 6 such Sizes of Particles as before, it will have 63 Times as much Vacuity as Solid Matter, and fo on. And perhaps in the wonderful Confirmation and Fabrick of Natural Bodies there may be other Proportions of Space to Matter to us wholly unknown, whence tis pofsible there may be yet far greater Quantities of Va-cuity interspersed in Bodies.

PORTA or Vena Porta: Dt. Keil in Animal Secretion, p. 36, 37, &c. thinks that he hath found out the true Use of this Vein, (of which you have a large Description in Vol. I. under Vena Porta) which is, that the Bile being to be mixed with the Chyle as it comes out of the Stomach into the Duo. denum, could no where be so conveniently secerned from the Blood, as where the Liver is placed: But if all the Branches of the Caliack Artery carried all the Blood to the Liver, from which the Gall was to be separated; it is evident, considering the nearness of the Liver to the Heart, and the intestine Motion of the Blood, that so viscid a Secretion as the Gall is, could never have been formed in the Blood, and confequently could never have been secreted by any Gland in that Place. In this Case Nature is forced to alter her constant Method of sending the Blood to all the Parts of the Body by the Arteries. Here she forms a Vein, (which is no Branch of the Cava, as all the others are) and by it she sends the Blood from the Branches of the Mesenterick and Cæliack Arteries, (after it hath passed thro' all the Intestines, Stomach, Spleen, Call, and Pancreas) to the Liver. By this extraordinary Contrivance the Blood is brought a great way about before it arrives at the Liver; and its Celerity is extremely diminished; so that all the Corpuscles which are to form the Bile, may have sufficient Time to attract one another, and unite before they come to the secerning Vessel.
And thus, saith he, have we found out the true
Use of the Porta; which he confirms afterwards,
by shewing what Nature doth further in Prosecution of the same Design; in increasing the Cavities of all the Arteries as they divide, and that as the Trunk of the Mesenterick Artery bears a lesser Proportion to its Branches than the Aorea does to its Branches; so the Branches of the Mesentericke Artery are likewise less in Proportion to their Conjugate Veins than the Aorta is to the Vena Cavd. Essects is hard to conceive, but yet not impossible. The descending Trunk of the Aorta below the E-For Sir Is. Newton hath shewn, That the Colours mulgents is to the Vena Cava at the same Place,

as 324 1s to 441. But a Branch of the Mesenterick Artery is to its corresponding Branch of the Porta as 9 to 25: And therefore the Blood in the Branches of the Porta moves above 177 Times Slower than it does in the Trunk of the Mesenterick Artery, and then only upon the Account of the Increase of the Diameters of the Vessels. So necessary is it to abate the Rapid Intestine Motion of the Blood, which would otherwise hinder the Coalescence of the Particles for the Formation of the Ball,

PORTABLE Barometer. See Barometer,

PORTFIRE, is a Composition of Meal, Powder, Sulphur and Salt-Petre drove into a Case of Paper, but not very hard; 'tis about 9 or to Inches long, and is used to fire Guns and Mor-

tars instead of Match.

PORTREVE, is the Title for the Chief Magistrate in some Sea-Coast Towns: And Cambden in his Bris. faith, the Chief Magistrate of London was so called in William the Conqueror's Time, as appears by a Charter of his to this City. In Richard the First's Time, the City was governed by two Bailiss appointed by the King; but presently after King John granted them a Mayor for their yearly Magistrate.

PORTIFORIUM, was formerly an Enfign or Banner, which was provided in all Cathedral and most Parochial Churches, to be solemnly carried

in the Front of any Procession.

PORTMANNIMOTE, sometimes hath been nsed for Portmote, which see

PORTMOTE, is a Convention or Meeting of the Inhabitants of a Port or Burgh, in which some Customary Duties were anciently paid to the Lord of the Fee.

PORT-NAILS, are such Nails as are used to

fasten the Hinges to the Ports of Ships.

PORTOISE, aboard a Ship, is the same with Portlast, or the Gunwale; and as they say the Yard is down a Portlast, when it lies down on the Deck, so for a Ship to ride a Portoise, is to ride with her Tards a Portlast, or struck down on the Deck.

PORTRAITS, is the Painters Word for Pictures of Men and Women (either Heads, or greater Lengths) drawn from the Life; and the Word is used to distinguish this kind of Face-Painting (as it is often called) from History-Painting.

PORTSOKNE, the Soke or Liberties of any Port; i. e. City or Town.
POST, in the Art Military, is used for any sort of Ground or Place, whether fortified or not, where aBody of Men can make aStand, fortify themselves, or be in a Condition to fight an Enemy; and therefore they say the Post was relieved, the Post was quitted, the Post was taken Sword in Hand, Sc. A Spot of Ground seized by a Party to secure the Front of an Army and to cover the Posts that are behind, they call an Advanced Post: And the Advance Guard or the Right of the 2 Lines of an Arniy, &c. they call the Post of Honour.

POSTNATI, are such as were born in Scotland after the Descent of that Crown to K. James 1. And it was resolved in the 7th Year of that King's Reign by all the Judges, that such Persons are no Aliens in England. But the Ante-Nati or such as were born in Scotland before that Time, were

Aliens as to the Time of their Birth.

POUND, Libra, contains 12 Ounces; and tho' now it fignify 20 s. when applied to Money, which is but the 3d part of a Pound in Weight, yet it is

because 20 s. did heretofore (with us) weigh a full PoundTroy or 12 Ounces, each of these Ounces contained so many Solidi or Shillings, and so many Denarii or Pence, as they who govern'd the Money Matters thought fit, sometimes more, sometimes fewer. The old Saxon Pound did contain 48 Shillings, and each Shilling contained 5 d. so that the Libra Anglo-Saxonica contained 240 d. When the Pound was reduced tis hard to tell exactly, but in W.the Conqueror's time it contained 20s. sometimes the Pound was composed of 12 Ounces or Orx, and then the Ora was 20 d. and sometimes of 15 Ounces or Ora, and then the Ora was 16d. But tho' either of these may be taken for the Shilling, yet generally it was 20 d. and this was the Value of the Ounce in the Libra Denariorum and the Libra Sterlingorum, which are the same. See Chro. Presciosum.

POWER of the County, See Posse Comitatus in

Vol. 1.

POWERS Mechanick, of these there are 5 usually accounted, the Lever, the Balance, the Wedge, or inclined Plane, Screen and the Pulley. About these Powers (the Nature of which you will see under those Words, or the Latin Names) there are some Universal Laws agreed on, which it would be well for Mechanicks, Engine-Makers, &c. to have in Readiness in their Minds, lest some such impossible Whims as the Perpetual Motion, &c. should get Possession of their Heads.

RULE I.

The Moving Forces or Powers are to the Weight to be moved, reciprocally, as the Space passed by the Weight, is to that passed by the Power.

Thus in the Windlace Axis in Peritrochio, &c. the Circle or Part of fuch a Periphery, which the Power moves, is to the Periphery of the Axis of the Cy-linder reciprocally as the Weight to the Power.

And in Pulleys tis plain that the Ropes are shortened in Proportion to the Elevation of the Weights.

RULE II.

The Power or moving Force, and the Weight are reciprocally proportional to their Velocities.

RULE III.

The same Force which can lift (ex. gr.) 100 lb. the height of 2 Feet; will raise 200 lb. the height but of one Foot,

PRAGMATICK Sandion, is a Term in the Civil Law for a Letter written to a Corporation, or any Publick Body, by the Emperour, in answer to their Request to enquire or know the Law of him. But if this Letter be sent only to particular Persons who have consulted him in the like Case,

tis called a Rescript.
PRÆAMBLE, Proæmium, in the Law-sense, is the Beginning of an Act of Parliament, &c. and as it were a Key, to open the Intent of the Makers of the Acts, and the Mischies design'd to be pre-

vented or remedied by the same.

PREBEND. See Prebend, in Vol. 1. PREMUNIENTES, are Writs sent to every particular Bishop to come to Parliament, Pramunientes, or warning him to bring with him the Deans and Arch-Deacons within his Diocess, one Proctor for each Chapter, and two for the Clergy of his Diocess. PRE:

PRECARIA, the same which Bedrep, Binddagg or bidendag, a days Work; which the Tenants of some Manners are bound by their Tenure to do for their Lord in Harvest: See the great Book of the Customs of the Abbey of Battel, Tit. Apeldarbam. fol. 60.

PRECEPTORIE, or Commanderie. As the larger Monasteries had formerly their remote Country Cells which were Subordinate to the Motherhouse of Religion; so the Knights Templars and Hospitalars sent part of their Fraternity to some country Cell, which was govern'd by a Person whom they called a Praceptor or Commander: And thence the Place was called a Praceptorie or Commandrie: and all these were Subject to the Prime Body, who had their Principal Seats in London. Kennet's Paroch. Antiqu. Sixteen of these Præceptories we have the Names of; viz. Creffing Temple, Balshall, Shengay, Newland, Yevely, Wicham, Temple-Brue, Wallington, Rothely, Ovennington, Temple-Combe, Trebigh, Ribstan, Mount St. John, Temple-New Sum, and Temple-Church.

PRECIPE quod Reddat, is a Writ of a great Diversity-both in its form and use: For which See Ingressus and Entry. This form is extended as well to a Writ of Right as to other Writs of Entry or Possession. Tis called sometimes a Writ of Right

Close as a

PRECIPE in Capite, where it issueth for the Tenants holding of the King in Chief as of his Crown, and not of him, as of any Honour, Castle or Mannor. Sometimes also 'ris called a Writ of Right Patent, as when it issues out of the Chancery Patent; i.e. open to any Lords Court for any of his Tenants deforc'd against the Deforcer, and must be determined there.

PRECONTRACT, is a Contract (usually understood of Marriage) which was made before a-nother Contract, and consequently as far as 'tis contrary to and inconfistent with, annuls the latter.

PRE-EMPTION, was formerly allowed to the Crowns Purveyor, to have the first buying of all Corn, other Provisions, &c. before others. See 12 Car. c. 24

paid on Suing out the Writ of Covenant.

PREMUNIRE. See PRÆMUNIRE.

PREPOSITUS Viue, some will have to be the Constable of a Town, or Petit Constable. Tisalso sometimes used for a Reeve: For others say in our Old Records, it fignifies the Reeve or Bailiff of the Lord of the Mannor who is sometimes called Serviens Ville. But by the Laws of K. Henry. I. the Lord answered for the Town where he was Resident: Where he was not present his Deputy or Seneschal was responsible if he were a Baron. But if neither of them could be present, then the Prapositus & quatuor de unaqua; villa, the Reeve and 4 of the most Substantial Inhabitants were

Summoned in.
PRESBYTERIUM, the Presbytery; The Choir or Chancel of a Church; so called because that Place was appropriated to the Bishops and Priests; and other Clergy, while the Laity were confined to the Nave and Body of the Church, Cowel's In-

PRESIDENT, in a Legal Sense, is the Crowns Lieutenant in a Province or Function: As the president of Wales, York, Berwick; of the King's Council, &c.

PRESSURE; by this Word some Philosophers,

addicted to the Cartelian Hypothelis, mean a kind of Motion which is impressed upon and propagated through a Fluid Medium. And by this they would explain all the Phænomena of Light and Colours, as well as of many other Effects; by certain new Modifications which do there happen to the Rays of Light, as they are usually called. But as our Excellent Sir If. Newton shews, (p. 307 of the Latin Edition of his Opticks) this is a Mistake.

For if Light (for Instance) consisted only in Pressure, propagated without Actual Motion, it could not therefore agitate and warm such Bodies as Reflect and Refract it: And if it consisted in an Instantaneous Motion, or one propagated to all Distances in an Instant; as some have advanced; there would be required an Infinite vis or Force, to produce that Motion, every Moment, in every Lucent Particle. And if Light confifted either in Pressure, or in Motion propagated in a Fluid Medium, whether instantaneously or in Time, it must from thence come to pass, that it should inflect itself in umbram. For Pressure or Motion in a Fluid Medium cannot be propagated in Right Lines, beyond any Obstacle which shall hinder any Part of the Motion; but will inflect and diffuse it self every Way into those Parts of the Quiescent Medium which lie beyond the said Obstacle.

Thus the Force of Gravity tends downward, but the Pressure, which arises from that Force of Gravity tends every Way with an Equable Force: And with equal Ease and Force, is propagated in Crooked Lines as in Straight. Waves on the Surface of Water while they slide by the Sides of any Large Obstacle, do inflect, dilate and diffuse themselves by Degrees, into the Quiescent Water lying beyond the Obstacle. The Waves, Pulses, or Vibrations of our Air in which Sounds confift, do manifestly inflect themselves, tho' not so much as the Waves of Water; for the Sound of a Bell or of a Cannon. can be heard over a Hill, which intercepts the Sonorous Object from our Sight: And Sounds will be propagated as easily thro' Crooked Tubes, as thro'. Straight: But Light is never observed to go in Curve Lines nor to inslect it self in Umbram. For PRE-FINE, (in Law) is that Fine which is the fixed Stars do immediately disappear on the Interpolition of any of the Planets, as well as some Parts of the Suns Body, by the Interposition of the Moon, Venus or Mercury.

PREST Money, from the French Prest, ready; is Money given to Soldiers when they are Prest: And binds such as receive it to be ready at Com-

mand at all Times appointed by their Officers.

PREST Sail: A Ship at Sea is faid to carry a Prest Sail, when she carries all that she can possibly Croud: Which is sometimes done in giving Chase to an Enemy: But 'tis a dangerous Experiment and ought not to be tryed often, lest a Ship should over-set, or bring her Masts by the Board, in which latter Case she will become a Prey to the Enemy

PRESTATION Money, was according to some, a Sum of Money paid by the Arch-Deacons to the Bishops annually pro Exteriori Jurisdictione:. But others say it was a Subsidium Charitativum, which in reasonable Causes a Bishop might require

of his Clergy

PRETENSED Right or Title: Jus Pratensum; where one is in Possession of Lands or Tenements, and another who is out, claims it and sues for it. Here the Pretensed Right or Title, is said to be in: him who doth thus Claim or Sue.

PREVA-

where an Informer colludes with the Defendant,

and so makes only a seigned Prosecution.

PREVENTER Rope, in a Ship, is a small Rope used to secure the Ties, so that if one Part should break, the other may not run thro' the Ram-head.

See Ropes in Vol. I.
PRICK-Posts, in a Building, are such as are framed into the Breast-Summers between the principal Posts for strengthning the Carcale of the

PRIDIAL Services. See Services.

PRIMAGE, is a Duty due to the Mariners and Sailors for the loading of any Ship at the letting forth from any Haven. Anno 32. H. 8. c. 14. which in some Places is a Penny in the Pound: In others Sixpence for every Pack or Bayl, &c. according to the Custom of the Place.

PRIMES, are the first larger Divisions of the fingle Number on Gunter's Line of Proportion, whose next Subdivisions are called Tenths, &c.

See Line of Proportion.
PRIMÆ VIÆ. See Viæ Primæ.

PRIMITIÆ, First-Fruits: In our Law, the Profits, after Avoidance, of every spiritual Living as rated in the King's Books, for one Year,

PRINCIPAL Posts, in any wooden Building, are the Corner Posts, which are tennanted into the Ground Plates below, and the raising Plates above,

i. e. into the Beams of the Roof.
PRINTING. There is a Dispute between the Towns of Harlem in Holland, and Mentz in Germany, about the Invention of this noble Art.

The Harlemers say, that Laurenzs Janzs Koster of Harlem, was the first Inventer of Printing, A. D. 1430. But that at first he used only wooden Blocks or Plates, (like those used in China and some other Eastern Countries, where that kind of Printing hath been much longer in Use, and perhaps gave the first Hint to our Manner of Printing now in Use;) tho after some Time he lest those off, and cut single Letters in Steel, which he sunk into Copper Matrices, and fitting them into Iron Molds, cast single Letters of Metal in these Matrices.

They say also, that his Companion 3chn Guttenburgh Role his Tools away while he was at Church, and with them went to Mentz in Germany; where setting his stolen Instruments to work, he claim'd the first Invention of this Art before Koster did his.

To prove this, they say that one Rabbi Joseph, a Jew, in his Chronicle, mentions a printed Book that he saw at Venice in the Year 5288, according to the Jewish Account, and of ours, 1428, as may

be feen in Pet. Scriverius.

But notwithstanding all this, and also what they say further of a Book entituled De Spiegel, which they shew printed at Harlem in Dutch and Latin, tho without Date; but they pretend it to be the first that ever was printed: Notwithstanding this, says Moxon, Guttenburgh of Mentz is more generally taken for the Inventer of Printing, than Koster of Harlem.

Dr. Wallis saith, this Are was first invented about the Year 1450, and was practifed in Germany immediately, but whether first at Mentz or Harlem, he determines not. He saith the Book which bears the Repute of being the first that ever was printed, is Tully's Offices; which was printed in the Year 1465 or 1466; for the Copy of it in the Bodleian Library in Oxon, difagrees a Year with that in the

PREVARICATION, In the Civil Law, is the Bodleian Library, is a Note written which mentions one Johannes Faustus, as Coadjutor to Guttenburgh, as also Peter Scheffer, on the same-Account ; and this Scheffer, Job. Arnoldus in Libello de Chalcographia Inventione, makes the Inven-ter of the Matrices. These three work'd together a while, and then parted.

There is also another Note written in a later.

Hand, in the said Look, which refers the first Inven-Year above-mentioned by Dr. Wallis, viz. 1460.

Next to these two Places of Ment? and Harlem,

it seems to have been practifed first ar our Univerfity of Oxon in England: For K. H. 6, and Thomas-Bouchier, then A. B. of Canterbury, fent Wm. Turner, Master of the Robe, and Wm. Caxton, Merchant of London, over to Harlem to learn this Art. who privately prevailed with one Frederic Corfeles, (an Under Workman) for a Sum of Money to come over hither; who did so, and at Oxford set up the Art of Printing, before it was used any where else, except in Mentz and Harlem. And there is a Treatise, said to be of S. Ferom, (because found in his Works) but in Reality of Ruffinus on the Creed, printed at Oxon in a broad Octavo, in the Year 1468, which is but 3 Years after the Edition of Tully's Offices at Menez; and perhaps is one of the first Books printed on Paper, for that of Tully was on Vellum. Soon after this, Caxton (who first brought ir, as is supposed, to Oxford) promoted it to London; which Baker in his Chronicle saith was about 1471: But Moxon in his Art of Printing saith, he had not seen any Books printed at London before 1480; about which Time ir was received in Italy, Germany, Gc.

In Philof. Transactions, N. 288, and 310, there is this further Account of the Rife and Progress of

the Art of Printing.

Boxhornius Schrevelius, and other Authors fay, That Koster could not, nor did he in Fact print so large a Book as the Speculum Salutis, without gradual Improvements; and his first Essays were on small and loose Leaves of Paper before he attempted whole Books.

In the Bodleian Library at Oxford, are two Books, and in that of Bennes Coll. in Cambridge is another very ancient printed Book, printed only on one Side of the Paper; the whole wrought, or cast on Wood, nor set or composed with Printing Letter, and printed with Writing-Ink; which do sufficiently shew that they were done when this Art was in its Infancy, and are very probably the Work of Koster; but they are without Date or Printer's Name.

Koster had an Assistant whose Name was John Fust, or as some write him Faust or Faustus; from whom he took an Oath of Secrecy, as Schrevelius rells us, but Fust ran away with Kofter's Tools and Materials, and in some time fet up a Printing- Press at Ment 7. where he was affifted by his Servant John Scheffer, a young Man of a good Genius, and who after-wards married his Daughter, and became his Part-They rell a Story also of Fust's going to Paris, but whether before or after he settled at Menez, is uncertain, and offering there a great number of printed Bibles to Sale, as if they were Manuscripts: But the French considering the Number of these Books, and their exact Conformity one to another throughout the whole, to a Line, a Word, a Letter, nay even to a Point, and that the best of Book-wri-Library of C. C. College there. In that Book in rers could not be thus exact, forc'd the Secret out of Vol. II.

S f f him.

him, by either actually indicting him for a Magician, or threatning him at least so to do; and this 'tis said gave Rise to the Story of Dr. Fau-

And 'tis probable about this Time many printed Books were fold up and down for Manuscripes.

Tis not certain in what Year Fust and Scheffer began first to work at Menez. But Schrevelius saith, Faustus (as he calls him) printed Alexandri Doctrinale eum Petri Hispani Tractatibus, A. D. And Lamberius in Comment. de Biblioth. Caf. Lib. 2. p. 988. saith, that he brought from Inspruck to the Imperial Library at Vienna, 2 Psalser printed on Parchment by Fust and Scheffer, 1457. And soon after this Date many Books were printed, which are still in Being: as the Durandus in the Library of Basil, printed 1458. Johannis Johannensis Catholicon, in his Majesty's Library, printed 1460. The Latin Bible of 1462 in the French King's Library, all before the Tully's Offices abovementioned; which was not printed till 1465 or 1466. The first Book printed here in England, was the Ruffinus, printed at Oxford 1468, as was faid before. But they practifed the Art earlier in other Countries; and in particular, it was used at Rome in the Palace of Maximi, A. D. 1455, by Conrad. Sweynheim, and Arnold Pannartz, both Germans, and who continued Printers there many Years after, as Martellinus in his Roma Sacra affirms.

Some think that Paper, (made of Linnen Rags) was first made at Basil, by some Greeks, who sled out of their Country after Constantinople was sackt, A. D. 1452; and this in Imitation of the Cotton Paper used in the Levant. Certain it is the Cotton Paper hath been of very ancient use in the East; there being in the Bodleian Library an Arabick Manuscript (among those the University bought of Dr. Huntingdon) written in the 427th year of the Hegira, which is A. D. 1049, on this Paper; and some there are without Dates, which seem older.
And as for the Linnen-Rag-Paper, it must be

much older than 1452; for in the Archives of the Library of the Dean and Chapter of Canterbury, there is an Inventory, on our Paper, of the Goods of Henry Prior of Christ's Church there, that is in the 20th Year of Edw. 3. which is A. D. 1346. and in the Cotton Library are several Writings, on our Pa-

per, as high at least as the 15th of Edw. 3.

Some think the Rolling-Press was invented by Lipsius; but there is a printed Book in the Bod-leian Library, (placed Laud. p. 138.) being a Misfale secundum usum Eccles. Herbipolensis, (i. e. Wurezburgh) in Germany. At the Beginning of this Book is an Instrument of Rodulfusthe A.B. of this Church, containing the Reasons of the Publication of this Missale, and instead of a Seal, there is annexed a Print engraven of the Arms of the See, &c. very finely done (for that Time, for twas before Durer) and on which are evident Marks of the Pressure by the Plate, with some Touches of Ink at the Edges, &c. which all that have seen it judge to be plain Marks of its being done or wrought off in a Rolling-Prefs. And there are sufficient Reasons to prove that this Book is as ancient as 1481.

Mr. Bagford thinks we had not the first Hint of Printing from the Chineles, of whom we had no Knowledge hardly, when this Art was invented:

to be, that Caids are as old as H. 6. nothing feems to give a better Hint to the Invention of Printing than Card-making, as is evident by the first Specimen of Printing at Harlem; and by those Books above-mentioned in the Bodleian Library, and

that of Bennet-College in Cambridge.

The cutting of the Molds or Blocks for making our Playing Cards, is after the same Manner as that of the old Books first printed at Harlem. They lay a Sheet of wet or moift Paper on the Form or Block, being first lightly brushed over with Inkmade of Lamp-Black mixt with Starch and Water. Then they rub it off with a round List with their Hand, which is done with great Expedition. They colour the Court Cards by the help of several Patterns or Stanefiles, as they call them; being Card-Paper cut thro' with a Penknise for every Colour, as Red, &c. (for at the first Printing, the Card hath only a meer Out-line.) These Patterns are painted with Oil-Colours to keep them from wearing out by the Brushes; for they lay it upon the Pi-Aure, and by sliding a Brush that is full and loose over the Pattern, it fixes the Colour into the cut Holes, and leaves it on the Print that is to be a Card; and so they go thro' with all the Colours on the Cards: This very probably was the Way of their first printing at Harlem, as might have been discovered before this, if they had consider'd that the Great Letters in our old MSS. (of 900 Years old) are done by the Illuminators, after this

of Card-making.

The next Form of Printing in Harlem was by cutting whole Forms in Wood from MSS. exactly written, and without Pictures. Such perhaps was the Donatus, which might bear Date about 1450; some say, 1440. This appears plain, saith Mr. Bagford, from Copy Books which we have seen printed at Rome, Venice, Switzerland, and England,

as high as 1500.

The third way of Printing was with fingle Types made of Wood; but who invented this is not known; it was at first esteemed so great a Rarity, that the Printers carried about their Lettets in Bags at their Backs, and got Money at great Mens Houses by printing the Names of the Family, Epitaphs, Songs, and other small Pamphlets.

The fourth Improvement of this noble Art was the Invention of Single Types made of Metal: which is owing to Peter Scheffer, above-mentioned, first Servant, and then Son-in-law to Faustus, who work'd at Mentz. Sometimes you have the Names of these two Men printed at the End of their Books, and sometimes not; sometimes with Dates as high as the Year 1457, and as low as 1490.

As for John Guttenburgh, who by many Authors is said to be the first Inventor of Printing, we cannot find one Book with his Name and Printing.

As the first Harlem Printing was only a Book with Pictures, and the Impression taken off with a List coiled up, as our Card-makers do now use; so when they came to use single Types, they made use of stronger Paper, with Vellum and Parchment, and then the Press was first used; tho afterwards much improved; as was their Printing-Ink.

Rolling-Press-Printing was not used in England till K. James I. and then brought hither from Ant-

werp by our industrious John Speed.
As to the Art or Practice of Printing it self, its so useful to the Common-wealth of Learning, to But rather from Old Medals, Seals, &c. and the have it better understood by Authors and Editors Letters on them. But if it be certain, as it seems of Books than it usually is, that I shall here give a full but succinct Account of the whole Matter from M1. Moxon's Mechanick Exercises of Printing; and from what I could collect from my own Observation, or get by Information.

The principal Officer in this Affair is called the

Master Printer: Who contrives or finds a Room or Rooms, for setting up what they call a Printing House; or who furnishes a proper Place, with all Tools and Instruments used in Printing.

And first he must consider what Number of Preffes and Cafes he shall want that his Room may be proportionate to his Number. They usually allow about 7 Foot square on the Floor, for each Press : And for every Frame of Cases, which holds 2 pair of Cases, viz. a pair of Roman and a pair of Italick, five Foot in Length and 41 in Breadth; tho they contain but 2 Foot and 9 Inches: But then Room enough will be left to pass freely between the Frames.

The Cases, must be so placed that the Light may fall to the left Hand of the Compositor; or else his Hand will interpose between the Light and his Eyes, and so shadow or obscure the Letter he is to take up.

The Presses also must be so placed as that the Light may fall from a Window right before the

Form and Tympan.

The Correcting Stone, or Stones must also stand against a good Light; and as near as can be in the Middle of the Room, if there be but one, that the several Compositors, may come the better to it.

In some Corner of the Room with a Sink under it, must the Lee Trough and Rinsing Trough be placed; or in some other Place if there be Room

The Distributing Frame, stands also pretty near the Middle of the Room; and round about the Sides Nest Frames may be placed to hold the Cases, that lie out of present Use; and the Letter Boards, with Forms fet on them; that both the Cases and the Forms, may be the better secured from running

Having thus contrived his Room or Rooms to the best Advantage; it is to be next furnished with its proper Materials as Letter, Cases, Presses, Chases,

&c. of which next in Order.

The Printer must be provided with a good Fount as they call it, or Found of Letter, and of all Bodies: For most Printing Houses have all these that Fellow, except the two first: And the Dutch (and I believe the French of late) have several other Bodies, and we have one more, which is sometimes used in England which they call a Small Pica: But this differs but little from the Pica.

These Bodies, are commonly cast with a Roman, Italick, and sometimes an English Face: But the Printer hath also some Bodies with Hebrew, Syriack, Greek, and with the Musick Face: As also Changes Markensical Chamical Alexandrical Characters Mathematical, Chymical, Algebraical, &c. The following Table shews the Names and Sizes of these several Bodies: Or what Number of each Body is contained in a Foot.

Pearl	[148]	Ì
Nompareil	150	ł
Brevier	112	Ĭ
Long Primer	92	
Pica	75	> contain'd in a Foot.
English	66	
Great Primer	5a	İ
Double Pica	38	}
Two Lined English	33	
Great Cannon	L 175	ر ال

In the Choice of his Letter, a Printer hath great Scope to shew his Judgment and Skill as to their Shape, &c. and I think in the whole, the Preference must be given to the Dutch Types or Letters: But be their Shape what it will, the Letters must be deep cut, that they may print clear, last longer, and be less subject to entertain Picks. They must also be deep sunk in the Matrices, lest the Bottom Line of a Page should Beard; and the Beard must also be well cut off by the Letter Founder.

There must be provided also Brass Rules of about 16 Inches long; for the Compositor to cut into such Lengths as his Work requires: These Rules must be exactly Letter bigh; for if they are much to high they cut thro the Paper, Tympans, and Blankers: And if but a little so, their Shoulder or Beard will print black; and they will also bear the Platten off the Letters that stand near them, so that those Letters will not Print at all; and if they be too Low, then the Rules themselves will not Print. These Rules must also be straight all their whole Length: Their Edges of equal Breadth and neither too thick nor too thin: and the Brass should be very well Planished, that it may be Stiff and Strong.

Of Cases.

What they call a pair of Cases is an Upper and Lower one: They are usually both of equal Length, Breadth and Depth: viz. 2 Foot 9 Inches long, one Foot 4 Inches; broad, and about one Inch deep besides the bottom Board. These Cases are encompassed about with a Frame about 4 of an Inch broad; that the Ends of the several Partitions may be let into the Substance of the Frame: but the hithermost Side of the Frame is about 1 Inch higher than the other Sides, that when either the Galley, or another pair of Cases are set upon them, the Bottom edge of the Galley, or of these Cases may stop against that higher Frame and not slide off. Both upper and Lower Case have a thick Partition about fof an Inch broad; but the Divisions for the several Boxes of the Upper and Lower Cases are not alike: For each half of the length of the Upper Case is divided into 7 equal Parts, and its Breadth into 7 also; so that the whole makes 49 Boxes. But the 2 half Lengths of the Lower Case are divided each into 8 equal Parts, and its Breadth into 7: And yet not throughout so neither, but the Lower Case hath 4 several Sizes of Boxes.

These Cases should be placed in good substantial Frames; which should be so placed with an easy Declivity, that the Compositor may the better

see and come at his Letters.

Of the Galley.

These Galleys are of different Sizes according to the Page to be composed. They are commonly made of 2 Flat wainscot Boards each of ; or ; of an Inch in Thickness: The uppermost to slide in Groovesof the Frame close down to the undermost. The 3 Sides of the Frame are fixed fast and square down on the upper Plain of the undermost Board, to stand about i of the height of the Letter above the Superficies of the Slice.

The Sides of the Frame must be broad enough to admit of a pretty many good strong Oaken Pins along the Sides, to be drove hard into the bottom Board, and almost quite through the Sides of the Frame, that the Frame may be firmly fixt to it;

but they must not be glewed; because the Compositor may have formetimes Occasion to wer the Page in the Galley.

Of the Correcting Stone.

This Stone is made of Marble, Parbeck, or any other Stone that may be made flat and smooth: It should be capacious enough to hold two Chases or more; that the Compositor on Occasion, may set some Pages by on it ready to Impose, the two Chases lie on the Stone: So that it may be about 2 Foot broad and 4½ Feet long. It must be placed on a strong Frame like a Table about 3 Foot one Inch from the Ground or Floor.

Of Letter Boards and Paper Boards.

1 etter Boards, are to lay the Letters on, and are oblong Squares; about 2 Foot long, 18 Inch. broad and 1 an ‡ Inch thick: These should be madestrong, and clampt on the under side within about 4 Inches of either Bnd with Pieces of about 2 Inches square as well to keep them from warping, as that the Compositors may easily take them to remove them. Paper Boards are only to set Heaps of Paper on, and to press the Paper with.

Of Furniture, Such as

Head flicks, &c. must be made of dry Wainscot that they may not shrink when the Form stand by; they are Quadrate High, Straight, and of an even Thickness all their Length: and both these and Side flicks are called Rigles, if they are not at ove an Inch in Thickness.

Side-flicks, and Foot-flicks, are of the same height with the Head-slicks; the latter serving to determine the Breadth, at Bottom and Top; as the Side-slicks do the length of each Page.

Gutter-sticks, are used to set between Pages, on either Side the Crosses, as in 8205. 12mos. 16mos. and Forms upwards.

There are Quoins also used to lock up the Forms, or wedge them so close together (with a Mallet and Shooting-stick) both on the Sides and Head and Foot of the Page, that every Letter bearing hard against every other Letter, the whole Form may Rise, as you will see hereafter. The Shooting-stick, should be of Box, and is of a wedge-like Shape and of about 6 Inches long.

There is also a Dressing-block, usually made of Pear Tree, about 3 Inches square and an Inch high; its use is by being run over the Face of the Form, and gently knockt there with the Head of the Shooting-stick, to press down such Letters, as may happen to stand higher than the rest.

Of the Composing Stick.

This is made of a thin Iron Plate, about to Inches longand doubledup square so as that the bottommay be; Inch and; broad, and the Back about an entire Inch broad. At the further End of the Iron Plate so doubled up, is soldered on an Iron Head which must stand square to the Bottom, about the thickness of a Long-Primmer: But all its outer Edges are basil'd and filed away into a moulding. About 2 Inches from this Head and in the Bottom, is begun a Row of round Holes about an Inch as funder to receive the Shank of the Male Scr. w, that Screws the

fliding Measures fast down to the Bottom: So as these sliding Measures may be set nearer or further from the Head, as the measure of the Page requires.



In the Figure annexed a is the Head of the Composing Stick, bb the Bottom, cc the Back, d the Lower Sliding Measure or Check, e the Upper Sliding Measure or Check, ff the Male Screw, g the Female Screw.

The Lower sliding Measure is a pretty thick Iron Plate, as broad as the Inside of the Bottom; about 4 Inches in length: And in its Middle is a Groove, quite thro' it, within about half an Inch of each End, to receive the Shank of the Screw.

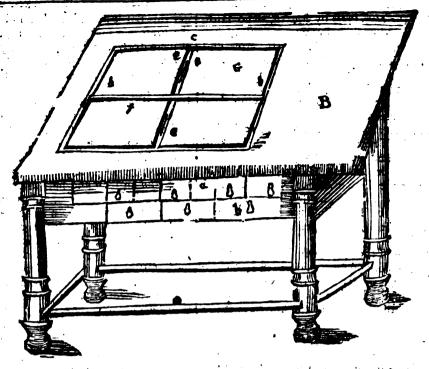
On the fore End of this Plate stands square another Iron Head about a Brevier thick, and reaching as high as the Top of the Back. The Upper sliding Measure is made just like the Lower, only tof an Inch Shorter. Between these 2 sliding Measures, they can compose Marginal Notes to any Breadth.

The Compositor uses a Bodkin of Steel of about 2 Inches in length from the Shauk of the Handle: the Handle is of soft Wood; that when 'tis knockt on the Face of any single Letter, which happens to stand too high, it may not batter it.

Of Chases.

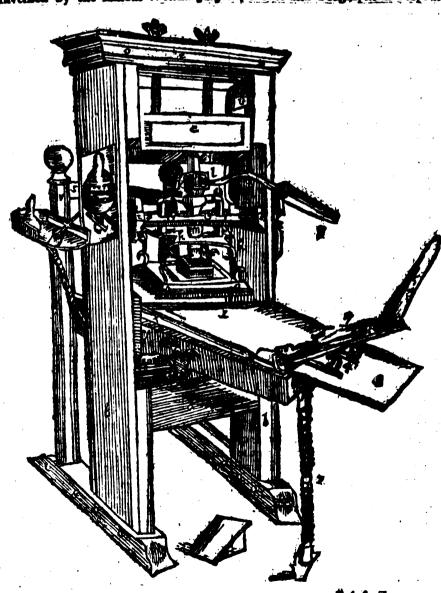
These are Iron Frames about 22 Inches long, 18 broad, and I Inch and I thick, and the breadth of the Iron on every Side is I of an Inch usually, but it should be an entire Inch: All the Sidesmust be truly square to one another; that when 'tis laid on the Correding Stone, it may lie truly flat, and the out and inside must be filed straight and smooth. Each Chase hath 2 Crosses belonging to it: One Shorter than the other; they are square to one another and are called the Short and the Long Cross. They have at each End a male Dove-tail filed bevil-way from the under to the upperfide of the Cross, so that the underside of the Dove-tail is narrower than the upper: These Male-dove-tails, are fitted into Female ones, filed in the Infide of the Chase; and which are also wider on the upper Side of the Chase, than on the under, that the upper Side of the Cross may not fall thro' the lower Side. The Short-Cross is thus dove-tailed into the Middle of the 2 long Sides of the Chase; and the Long Cross into the Middle of the 2 other Sides. The Shore Cross is moveable also in the Chase about 3 Inches from the Middle. The Middle of these 2 Cross ses, are filed or notched half Way thro, one on its upper, the other on its under Side, that they may be let into one another, and in the Middle between the 2 Edges of the upper Side of the Short Cross are made 2 Grooves parallel to the 2 Sides of the Crofs, beginning at about 2 Inches from each End: They are i an Inch deep all the Way, and about ; of an Inch broad, that the Points may fall into them. The Short Cross is about 3 of an Inch thick; and the Long about half as much.

See their Figure as they lie on the Correcting-stone.



Of the Press.

The Princing Press, whose Figure is here annexfor his good and great Printing, but also for his ed, was invented by the famous Willem James Globes and Geographical Maps and Charts.



Tie

Tis called the New Press by Moxon, who saith, it was (in 1683) but little known in England, but generally used in Holland, and is much better and more commodious than the common Printing-Press.

an, Represent its Feet, which are 2 Feet 9 Inches 1 long, 5 deep, and 6 broad, having their Outsides truly square.

bb. Are the Cheeks, which are 5 Foot to Inches long besides the Tenons of the Top and Bottom, 8 Inches broad, and 4 and a half thick.

d, Is a Plank called the Winter, which is in Length besides the Tenons, a Foot 9 Inches 1, in Breadth 8 Inches, and its Depth 9 Inches.

c, Is the Cap, or Top of all the Press, being 3 Foot and 1 Inch long, 41 Inches deep, and 91 In-

ches broad.

e, Is the Head of the Press; whose length, besides the Tenons, is 1 Foot 9\frac{1}{4} Inches, Breadth 8\frac{1}{4} Inches, and Depth 8 Inches. Its Top, Bottom, and hind Sides are all square; but the Foresides of the an Inch over the Range of the Foresides of the Cheeks: In which Projecture is cut a Table with an hollow Moulding, about it 2 Inches distant from all the Sides of the Foreside of the Head; its Tcnons are 3 Inches broad, and are cut down at eie dand made fit to Mortices in the Cheeks, that may flide right, and yet play in them.

In the Under-side of the Head is cut a Hole about 4 Inches square, and 31 deep, into which a Brass Nut is fitted, for the Worm to play in.

i, Is Part of the Worm below the Head; the

upper Part being hid in the Brass Nut.

f, k, l, m, n, Is the whole Spindle.

f, Is the Till, a Board about an Inch thick, one
Foot 94 long besides the Tenons, its Breadth 8 Inches; in its middle is a round Hole for the Shank. of the Spindle, and at 74 Inches from each End is a square Hole for the Hose to pass thro'

gg, Are the Hofe, being upright Irons of 3 of an Inch square, and at each End have male Schews on Their lower Ends are fastened into the Hose-books, and their upper Ends into the Garters or Curts, which is a round Hoo placed over the flat Neck of the Shank of the Spinke.

bbbb, are the Hose-books, or the Hooks on the Hose the Platten hangs on; they proceed from 2 Branches of an Iron Hoop encompassing the lower End of the Spindle, on either Corner of the Branch.

k, l, Is the Eye of the Spindle, as m is its Shank, and n its Toe; the Spindle's Length in all is 16. Inches, the Length of the Cylinder the Worm is cut

on is 34 Inches, and its Diameter 24. Hose; this is usually made of bearen Plank 2 Inches and a half thick, 14 long, and 9 broad; its Sides are tied square; and its under side exactly

plain and smooth.

In the middle of its upper side is let in and fastned an Iron Plate called the Platten-Plate, & of an Inch thick, 6 Inches long, and 4 broad; in the middle of this Plate is made a square Iron Frame of about halfan Inch high, and as much broad; into which is fitted the Stud of the Platten-pan, so as it may stand steddy. This Stud is about an Inch thick, and then spreads wider and wider to the Top, where 'tis two Inches and a half.

Is the Bar, in length about 2 foot 8 Inches, 'tis faitned strongly with a Nut and Screw into the Bye of the Spindle. About 4 Inches from the Shoulder this Bar is bowed with an obtuse Angle, that the Press-man may the more easily and readily catch at it, to draw its wooden Handle q within its reach.

rr, Are the Hink-posts, which stand at a Foot Distance from the hind sides of the Cheeks; they are 3 Foot 4 Inches long besides the Tenons, and 4 Inches thick, and square every way. These hind Posts have lix Rails sitted to them, and marked sta and called the Hind-Rails.

t, Are the Wedges of the Till f uu, The Mortices of the Cheeks bb.

xxxx, y, Express the Carriage; whose Plank is of Elm an Inch and half thick, 4 Foot long, and I Foot 8 Inches & broad. On this Plank at its fore end is firmly nailed down a square Frame 2 Foot 4 Inches long, I Foot to Inches broad, and the Thickness of its sides 2. Inches square. This is called the Coffin, and is marked with the Figure (1) in the Plate, and in it the Scone is bedded.

(1) On each of the 4 Corners of the Coffin is let in and fastned down a square Iron Plate, with return-sides about 6 Inches long, each side 1 8th of

an Inch thich, and 2 1 qr. broad.

Behind this Coffin is nailed on to its Outside a Quarter, of about 3 Inches longer than the Breadth of the Coffin; it hath all its sides 2 Inches over, and 3 of them square: But its upper side is hollowed round to a Groove or Gutter (2) an inch and half oyer. This Gutter is so nail'd on, that its hitlier End standing about an inch higher than its further End the Water that descends from the Tympan (5) falling into ir, is carried on the further fide of the Coffin by the Declivity of the further End of the Gutter (2,) and so keeps the Plank of the Carriage near and clean, and preserves it from rotting. Parallel to the outward sides of the hinder part of the Plank of the Carriage at 3 inches distant on either side, is nailed two Female Dove-tail Grooves, into which is fitted so as to slide two Male Dovetails made on the two Feet of the Gallows (4) on which the Tympan rests.

At 3 inches from the hinder Rail of the Coffin in the middle of the Plank is cut a Hole of 4 inches square, and on the hither and further side of this Hole is fastned down a Stud of Wood, one on each side, and in the middle of these two Studs is a round Hole of about an Inch over, to receive the two Iron Pins of a wooden Rowler, or Barrel, with a Shoulder on each fide of it to contain so much of

the Girt as shall be rolled upon it.

The Tympan (5) is a square Frame having 3 of its Sides Wood and one of Iron. 'Tis 2 foot 8 Inches wide, 2 foot 2 inches long, and the Breadth of the wooden sides an Inch and half, and the depth one inch on its hinder end; at the 2 Corners is rivited an iron Match Joint, to be pinned on to another half Joint, fastned on the hind Rail of the Coffin. The fore end of the Tympan is of Iron, with a square Socket at either End for the wooden Ends of the Tympan to fit and fasten into; on the outer Edge of this Iron about an inch and half from its Ends are made 2 iron half Joints, to contain a Pin, which entring this, and a Match balf Joint, made on the Frisket, (6,) serves for a Frisket to move truly upon. In the middle of each long Rail of the Tympan is a Hole half an Inch square, for the square Shanks of the Point Screws, (7,8) to fit into. Within this Tympan, which may be called the Outer, is another called the Inner Tympan, which is fitted exactly to it, and gaged by an iron Pin, and an iron Turning-Clasp.

I hope

Figure a little Intelligible, and to give a general Idea of the Printing Press; but no words can postic a very surprizing thing to see how very quick sibly explain it so well, as once seeing of it work is performed; and how in an instant he will do.

I shall omit describing the manner of making the Types or several sorts of Letters, used in Printing but wholoever hath a mind to fatisfy himself further may consult Mr. Moxon's book of Printing, where he will find the whole affair very largely and

plainly described.

I shall only add something further about the Rules and Methods of Distributing and Composing. After the Press-man hath wrought off as many Sheets from a Form, as he is appointed; he first washes the Form, and brings it to a place which they call the Rinfing Trough, and rears it a little assope on one end of the Chase; for when 'tis so placed the Face of the Letter is less liable to damage, and the Form stands in a proper position for the Compositor to rear a Letter Board against the Back- let, placing the first line close and upright against side of it; by which he raises it up, and then sets the lower Ledge of the Galley. Letter Board, and Form both a little assope in the Rinfing Trough. Next with his Mallet and Shooting-flick he opens or Uplocks (as they call it) the Quoins and Form: and then the Furniture; viz. the Head sticks, the Inner Side sticks, and Gutter-sticks, if the Form have any, that he may have the more Room to open the Letter in order to its receiving the water the more plentifully: which is thrown on it by dish fulls to Rinse and Clean it, and the Face of the letter is rubbed with the Fingers, and shook so that the water may get between the Letters to clean them; and this is done till the water thrown and rubbed on, runs away quite clear and colourless. Then he thrusts the Letter and Furniture close up together again that the letter may not Squabble, as they call it, that is, break and fall atunder: after it hath flood a while to dry; he carries Letter Board, Form and all to the Diffributing frame: and there he strips it of its Furniture, Quarter by Quarter, taking out the Quoins, &c. and then with his Distributing stick or Riglet, he takes up out of the Form as many Lines of Letter as he be folded into an orderly Succession. And the can, and turning their Face towards him, he carries them to his Case, and taking out the Letters &c. one by one, but very quick and nimbly, he distributes each of them to its proper Box in the Case. Then he proceeds to take off and Distribute another parcel, and so goes on till he hath done, or till his Case is full.

They usually choose to distribute their Letter over Night, that they may have a Dry Case to work on in the morning, for wet Letters are less easy to take up, and beades the Lye makes their fin-

gers fore.

The Compositor next sets himself to the Composing work: and here he must first Determine his Meafure; to which he fits his Composing stick (above

Having fitted bis Measure, he Places the Galley on his upper Case on the Right hand, and placing in it may lie in the same Range with the Head-line his Copy before him, he reads 5 or fix words or of the Metal, &c. so that all the lines in the Proof such a part of it as he can keep in his mind, and coincide or range right with the respective ones then spells it over Letter by Letter, taking up the in the Metal; by running his eye along easily the proper Letters out of their respective Boxes in the several Places, or Lines in the Proof, where the Case: he sets a Space between every word till they come to the end of the Line; but there none. He holds his stick in his left hand, and with his Thumb gently presses the Letters close to the cheek, keeping Vol. II.

I hope this Description may serve to make the it secure, tight and close together, as with his righthand he puts them into the Stick successively. And ipells, resolves upon, and takes out the several let-

ters which compose his work, and supply his stick. Having composed one Line; it it ends with a word, or a Syllable and a Division, and just fill the Moafure, then it needs no more Justifying as they call it, the Stick being duly filled; but if the Line conclude not so, then he puts a Space more between every word, or at least so many as will fill up the measure pretty Stiff, or justify the Line. And here he takes care that his Letter don't Hang, as they call it, i. e. Stand a Skew.

After he hath thus composed one Line, he begins another, and so goes on till his Stick be full: and when it is so, he empties it, laying it down on his Lower Case, and by means of a Rigles of just the length of the Line, he claps it down into the Gal-

As he Sets or compoles this first stick of Letter, so he goes on till his page is out, remembring after the last line of every Page to set a Direction; that is, he sets a Line of Quadrats and at the End of it the first word of the next Page, or if the word be very long and the Line very short, two Syllables, or sometimes but one, of that word. And when 'tis the first Page of a Sheet, he sets a Signature as 'they call it (i.e.) A for the first Sheet, B for the Second, &c. And so successively till he come to W which is always skipt, because the Larin Alphabet hath no fuch Letter.

When our Compositor hath got a full Page in his Galley, he next ties it up fast together with a Packthread, or Gord, according to the bigness of his Letter and Page, and then carries it to the Correcting stone, and here all the Pages which belong to a sheer, with the Chase and Furniture about them, are duly placed, or Imposed as they call it: that is, so disposed or ordered, as that when the Sheet comes to be wrought off at the Press, all the Pages may different volumes of Folios, Quartos, Octavos, and Twelves, are all diverfly Imposed.

Correction.

In Correcting Faults, if there be but a few of them, and these East ones, the Compositor gathers the Corrections in his Srick, beginning at the bottom of every Page and so scending: because when he is Correcting, the corrections of the Top of the Page stand the first in the Stick, and therefore are readiest to his hand.

But if there be many and considerable Faults, he brings the Lower Case to the Correcting Stone, and takes his Corrections as he uses them. described) by loosening the screw, and Sliding the he unlocks the Form, but keeps the Quoins pretty Cheeks nearer to or further from its head. tight up, least his Letter should hang or squabble: and there folding the Proof, so that the Head-line of the Metal, &c. so that all the lines in the Proof

If there be a Long word or more than one left Ttt

Smile

3

out, the Compositor is usually forced to over-run, here he marks Scoff out thus Sanga as they call it: i. e. he must put so much of the forepart of the Line, into the Line above it; or so much of the hinder part of the line into the next Line under it, as will make Room for what is left mark A, where it is Left out, for a

If much be left out, he must over-run many lines either backwards or forwards, or both, till he come to a Break; and when he comes thither if it be not Gotten in, as their word is, then he is forced to Drive out a Line: and sometimes to get in that Line, he is forced to over run the next Page backwards or forwards, till that Line can come in.

The Quite contrary Process must be take, if he happen instead of Leaving out, to set any thing swice over: for if it be but little he must take it out, then Drive out his Matter: But if it be as much as two or three Lines, &c. Then he must over-run as two or three Lines, &c. Then he must over-run the next Page, or more, and sometimes the whole Lest Hand Margin of the Page: Sheet, till it be Driven out.

After all this Correcting there is, or always should be a Revise, to see that the Faults are truly mended; and if not, to have them Re Correlled, by unlocking either the whole Form, or only that Quarter of it where the faults are, &c.

And because 'tis a Thing very useful for all Authors, and Correctors of Printing presses to be acquainted with, I shall conclude this Account of Printing with proper directions for both.

And first the Author should well examine his Copy before it go to the Press; and Point and Mark it so, as that the Compession may know what words to Set in English, Italick, Capitals, &c. For his Italick words, he should draw a line under them Thus: for English words two Lines Thus: and for

Capitals a Line of Points Thus, or else a Line with Red Ink. If there are no Proper Breaks made in the Copy; the Author must supply them by a Crotchet [Thus, before the word he would have begin his new Paragraph.

And every Author, if he can possibly, our of a due regard to his own Reputation, which else may much suffer, or at least as much as he can, will cor rect the Sheets of his Book himself; that is, look them over, after the Printers Corrector hath mended the Common Typographick Faults: And whether it be the Author himself, or some other Corrector, that hath this Care upon him, the way of correcting Faults so as they may be mended by the Compositor is after this manner.

When one Letter is put instead of another, as in this word The for The; he dashes out the wrong

Letter thus the, and Writes the Letser it should be on the Right Hand Margin of the Page, right against the same Line, and makes a Dash behind it, as you may see in the Mar-

If two or three, or more Words in the same Line have Faults in them as in these Words, Potienge a c peg førce; where first an o is See instead of a, e instead of c, t instead of r, and c instead of o. These he marks in an orderly succession towards the Right Hand, against the same Line, as you may see in the Margin.

But if one word be set instead of another, as Scoff instead of Smile, Smile,

and writes Smile, as in the Margin.

If a Word or Words, or Letter or Point be Left out, he makes this mark of Infertion, and Writes in the Margin what must come in.

If a Space be Left out, he makes the former mark of Infertion where it should come in, and makes this mark # in the Margin.

If a whole Sentence be Left out, too long to be Writ in the Margin, he makes the mark of Insertion where it is Left out, and only Writes (Out) in the Margin. If the Sen-(Out) tence Left out be not very long, he But if it be too large to be Writ in the Margin, or under the Page, he Writes in the Margin, See the Co-(See the Copy)

If a Word or Sentence be See twice, as Him Him, he marks out one Him thus Him, and makes this mark & in the Margin, for Dele, to take out.

If a Letter be turned thus & he dashes it out as you see, and makes this mark in the Margin.

If Words are Transposed, that is, if one Word fland in another Words place, as, no I love Swearing, and it should be, I love no Swearing; he marks this Fauls thus, no I love Swearing, and makes this mark & in the Margin. The like mark he makes in Matter and Mergin if two Letters are Transpos'd.

If a Space or an m or n Quadrate, Gc. flick up and Prine Black, as tween these words, he marks in the

Margin thus, If a Word be Set in Roman Letter

instead of Italick or English Letter, he dashes the Word underneath thus, and Writes Ital. or Eng. in Ital | Eng | the Margin.

In like manner, if a fingle Letter or more Letters be Set in Roman Letter, and it should be Italick or English Letter; or if in English or Ita-lick, and it should be Roman Letter, he dashes the Letter or Letters thus underneath, and writes Ital. Rom. Ital | Rom | Eng or Eng. in the Margin: Or if Lower Case Letters be Set instead of Capitals, he dashes them underneath, Capt |

and Writes Capt. in the Margin. Having Read the Matter of the Proof he examines again if the Form be right Impos'd, for though he before turn'd the Pages in the Proof as he read them according to their orderly places, yet he will scarce trust to that alone, but again examines them on purpose, and distinctly, which he does not only by the Direction Word, but by examining the whole Sentence the Direction comes in, both at the end of the Page, and the beginning of the next Page.

He examines that all the Signatures are right, and all the Titles and Folio's.

If the Work be large Forms and small Letter, he has a second, and sometimes a third Proof, which he Reads as the first,

After the Second or Third Proof he has a Revise which is also a Proof sheet: He examines in this Revise Fault by Fault, if all the Faults he markt in the last Proof were carefully mended by the Compositor; if not, he marks them in the Revise,

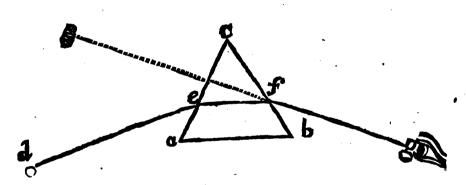
PRINTS. The Original of Prints or Cutts, as we sometimes call them, was this; in the Year 1460, one Maso Finiguerra, a Goldsmith of Flo rence, graved his Plate; and then casting some of Colours you have a great variety of Experiments it in melted Brimstone, he perceived, that what made with such Glasses, by the Incomparable Sir came out of the Mold was markt with the same Is. Newton; and from whence, in a good measure, Prints as his Plate, by the Black which the Sulphur he hath established his Demonstrative Theory of came out of the Mold was markt with the same had taken from the Graving: after this he tried to Light and Colours; a large account of which you do as much on Silver Plates with wet paper, by may find in his Opeicks. rolling it smoothly with a Roller, and this succeeded. This Novelty tempted Baccio Baldini, passing thro such a Pris a Goldsmith of the same City, to attempt the fame thing, which he did with Success; ingraving made by a Plane passing transversely to three paseveral Plates of Sandro Boticello's Invention and rallel Lines or Edges, then when the Light passeth was then at Rome, ser about engraving some of first side of the Prism a c, where the Light goes his own Pieces. This knowledge getting into Flan-into the Glass: Then by putting the Line of Inciders, Martin of Antwerp, a famous Painter, graved abundance of Plates of his own Invention, and sent several Prints into Italy, which were markt in this Volume) of the first refracted Ray; then thus, M.C. After him the Famous Albert Durer taking this Ray for the Incident Ray on the second appear'd and gave the world a vast number of side of the Glass be, where the Light goes out, Prints, both in wood, and copper. About this find the next refracted Ray fg; by putting the time one Hugo de Carpi, an Italian Painter of no great Capacity, but of a ready Invention, found the next refracted Ray fg; by putting the great Capacity, but of a ready Invention, found the next refracted Ray fg; by putting the great Capacity, but of a ready Invention, found the next refracted Ray; then taking this Ray for the Incident Ray on the second second Ray fg; by putting the second Ray fg; by putting th great Capacity, but of a ready Invention, found ction as 11 to 17; for if the Line of Incidence out a way, by means of several Plates of wood, out of Air into Glass be to that of Refraction as to make Prints resemble Designs of Claro-Obscuro: and some Years after the Invention of Etching was discovered, which was soon made use of by Parmeggiano.

PRISAGE, is the Custom or Share that belongs to the Queen, out of such Merchandice as is taken at Sea by way of lawful Prize,

PRISM: A Glass bounded with two equal and parallel Triangular Ends, and three plane and well-polished Sides, which meet in 3 Parallel Lines. running from the 3 Angles of one End, to those of the other, is called a Prism; and is used in Opticks to make many noble and curious Experiments about Light and Colours; for the Rays of the Sun falling upon it at a certain Angle, do transmit thro it a Spectrum or Appearance, colour'd like the Iris or Rain bow in the Heavens. Under the word

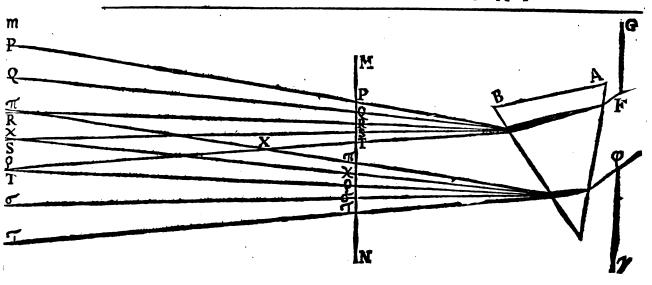
How to find the Refraction of a Ray of Light passing thro' such a Prism, the same Author shews thus: Let a b c represent the Section of this Prism Design; and upon this Andrew Mantegna, who thro' it; and let de be the Ray incident on the dence to the Line of Refraction as 17 to 11: Find (by the Direction given under the word Incidence 17 to 11, the Line of Incidence back again, out of

Glass into Air, must be as 11 to 17,



The same admirable Author, Opicks, p. 121, by his most accurate Experiments, to explain the shows, how by the Properties of Light discovered Phanomena of Colours made by Prisms; thus,

Let



brought into a darkned Room, by the Hole Fo, almost as broad as the Prism; and let m n be a White Paper on which the refracted Light is cast: And These Colours ought to appear were the Sun's suppose the most refrangible or deepest Violet Rays to fall on the Space P , the left refrangible or deepest Red Ray on the Space T7; the middle fort, between the Indico and Blue Rays, on the Space $Q\chi$; the middle fort of the Green Rays on the Space R_g ; the middle fort between the Yellow and Orange Rays on the Space Se; and the other intermediate forts on intermediate Spaces. For so the Spaces on which the several sorts adequately fall, will, by reason of the different Refrangibility of these sorts be one lower than the other. Now if the Paper mn be so near the Prism that the Spaces P t and A do not interfere with one another, the distance be tween them T will be illuminated by all the forts of Rays in that Proportion to one another which they have at their very first coming out of the Prilm, and consequently, will be White. But the Spaces PT and 20 on either hand, will not be illuminated by them at all, and therefore will appear coloured; and particularly at P, where the outmost Violet Rays fall alone, the Colour must be the deepest Violet. At Q where the Violet and Indico Rays are mix'd, it must be a Violet inclining much to Indico. At R, where the Violet, Indico, Blue, and one half of the Green Raysare mix'd, their Colours must by the Constitution Colours, ought, by the same Rule, to compound a faint Blue, verging more to Green than Indico. And in the progress from S to T this Blue will grow more and more faint and dilute; till at T, where all the Colours begin to be mix'd, it ends in Whiteness.

So again on the other fide of the White at T, where the least refrangible or utmost Red Rays are alone, the Colour must be the deepest Red. At σ , the Mixture of Red and Orange will compound a Red inclining to Orange. At e, the Mixture of Red, Orange, Yellow, and one half of the Green, must compound a middle Colour be tween Yellow and Orange. At x, the mixture of all Colours but Violet and Indico, will compound a faint Yellow, verging more to Green than Orange: and this Yellow will grow more faint uncovered may be confidered, as a kind of Cuneus

Let a b c be a Prism refracting the Sun's Light, and dilute continually, in its progress from x to a

Light persectly White; but because it inclines to Yellow, the excess of the Yellow Rays, wherewith it is tinged, being mix'd with the faint Blue between S and T, will draw it to a faint Green. And so the Colours in order from P to Tought to be Violet, Indico, Blue, very faint Green, White, faint Yellow, Orange, Red: Thus it is by computation, and they that please to view the Colours made by a Prilm will find it so in Nature

These are the Colours on both sides the White, when the Paper is held between the Prism and the Point & where the Colours meet, the Interjacent White vanishes: For if the Paper be held still farther off from the Prism, the most refrangible and least refrangible Rays will be least in the middle of the Light, and the rest of the Rays which are found there, will by mixture, produce a fuller Green than before; also the Yellow and the Blue will now become less compounded, and by conse-

quence, more intense than before.

And if thro a Prism you view a White Object encompassed with Black or Darkness, the reason of the Colours appearing on the Edges is much the same. If a Black Object be encompassed with a White one, the Colours arising from seeing it thro a Prism, are to be derived from the Light of the on of Problem 2. in pag. 114) compound a middle White one, spreading into the Regions of the Colour between Indico and Blue. At S, where Black; and therefore they will appear in a conall the Rays are mix'd, the Red and Orange, thin trary order. And its the same when an Object is viewed, whose Parts are some of them less or more luminous than others: For in the Borders of the more or less luminous parts, Colours ought always, on the same Principles, to arise from the excels of the Light of the more luminous, and to be of the some kind as if the darker parts were Black, but yet to be more faint and dilute.

And what is thus faid of the Colours which are exhibited by Prisms, may easily be applied to those Colours which the Glasses of Telescopes and Microscopes, or even the Humours of the Eye produce: For if the Object Glass of a Telescope be thicker in one part than another; or if one half of the Glass, or one half of the Pupil of the Eye, be covered by any Opake Body, then that Object Glass, or its half; or the half of the Eye which is

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with curved Sides. And every Glass, or Pellucid Cuneus (or Wedge) will produce the same effect as a Prism, by refracting the Rays of Light as they are transmitted thro' it.

PROCURATIONS, are a Pecuniary Sum or Composition paid by the Parish Priest to an Ordinary or some other Ecclesiastical Judge, as an Archdescon, &c. to commute for the Provision or Entertainment which was otherwise to have been procured for him; which Entertainment was called a Procuration

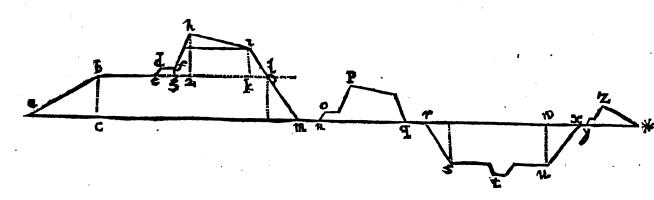
PROCURATOR, is used for one that gathereth the Fruits of a Benefice for another man; 3 R.2 Stat. 1. cap. 3. as Procuracy was the word for the Inftrument impowering him to do it. In the West of England, such Persons are called Proctors to Faussebray, Foss, Covert-way and Esplenade. this day. Cowel.

PRODES Homes: This is a Title often given in our old Books to the Barons or other Military Tenants, who were called to the King's Council; and was no more than Homines discreti & fideles.

PROFER, Profrum vel Proferum; is the Time appointed for the Accounts of Sheriffs, and other Officers in the Exchequer; which is twice a Year.

An. 51 H. 3. 5. In another Sense Profer also signifies the Officer or Endeavourer to proceed in any Action by any Man concerned so to do.

PROFILE, in Fortification, is the Representa-tion of the Height, Depth and Thickness of any Work; and suppose the Work cut perpendicularly down from Top to Bottom; as in the Figure annexed, where you have the Profile of a Rampart,



a b 1 m is the Solidity of the Rampart, a m its Lines, Furniture of Dials, &c. on any kind of Bale; b 1 its Top; b c its perpendicular Height; a b its inward Talus or Slope; I m its outward Talus or Slope; be is the Terre-plain; el is the Bale of the Paraper, e d its Banques; fb is the in ward Talus of the Parapet, il the outward one, bi its upper one; b2 is the inward Height of the Parapet, ik the ontward Height; I the Cordon; nopq represents a Faussebray with its Banquet, Sc. q r is Liziere or Berm; r s t u x is the Fois or Ditch; rs the Scarp; uy the Counterscarp; t the Lunette; wu the Depth of the Ditch; x, the Covert-way; x 7 * the Parapet and Glacis of the Covert-way; 7 the Height of the Barnquet and Parapet of the Covert-way; * the Basis of the Glacis; * the Slope of the from the middle Point in the Arch, to the Diame-Glacis

PROFRE Vicecomitis. Tho' the certain Debet of the Sheriff could not be known before the finishing his Accounts, yet it seems there was anciently an Estimate what this constant Charge of the Annual Revenue amounted to, and what the confrant Allowances amounted to according to a Medium; and those Summs were paid into the Exchequer at the Return of the Writ of Summons of the Pipe; and they were and are to this day cal led by this Name Profre Vicecomitis. But altho thele Profess are paid, yet if on conclusion of the Sheriffs Accounts, and after the Allowances and Discharges had by him, it appears that he be in Surplusage, or that he be charged with more than if you hold the Edge of the Ruler to the fix'd indeed he could receive, he hath his Profess paid Point, and also apply the Point of the Edge of the or allowed to him again.

PROJECTIVE Dialling, is the way of Draw-

Surface whatfoever, without any regard had to the Situation of those Surfaces, either as to Declination, Re- or Inclination. This curious and in many Cases most useful manner of Dialling, seems to have been the Invention of our Mr. Sam. Foster, formerly Astronomy Professor in Gresham College. Something of this was printed in his Posthumous Miscellanies 1659, and more added by Mr. Leybourn (in his Dialling) from a Manuscript which Mr. Foster left behind him.

In order to perform this manner of Projective Dialling after Mr. Foster's way, there is necessary a Semicircle divided into two Quadrants, whose Divisions must begin, and be numbred both ways ter; which Diameter must be made to receive a Ruler into a Grove made in it, so as that the Semicircle may slide easily along it, and be fastened by a Scrue any where upon it: It will be convenient to have two or more of these Rulers of different Lengths. You may see the Fig. of this Semicircle and Ruler in Leybourn's Diading, p. 198. But there is no difficulty in understanding the use of it at all; and a Quadrant, divided on both fides, may very well supply the place of the Semicircle.

The General Use of this Instrument is; Upon a

Line drawn any where, to project an Altitude or De-pression, above or below the Horizon, from a fix'd Point placed at a distance from that Line.

The manner of doing which is very easie; For Ruler to the Line given, removing it higher or lower (as occasion requires) till the Thread and Plummet of the Semicircle or Quadrant fall on the ing, by a method of Projection, the true Hour- degr. of Altitude or Depression intended; for then the Ruler lies at the Altitude or Depth, and so right Line : this right Line so drawn, shall repreprojects it from the fix'd Point into a Line, as was defigned.

Two General and Easie ways to project Hour Lines on all Surfaces, Concave, Convex, &c. Inclining, Reclining or Declining.

1. Let a Gnomon, being first sharpened into a Point, be shaped and fastued in such wise, that it no way hinder either the draught of the Horizonral Line, or the Point of the Shadow from having free accels to the Dial at all times of the Year.

2. Draw an Horizontal Line, by help of your Semicircle in a true Level both in regard of it felf, and also to the Point of the Gnomon, through the whole Superficies on which the Dial is to be de-Or having two Points in the same Level with the Point of the Gnomon, project it upon your Superficies, if it be a rugged one. And it the Superficies be more than one, or if any of them be very much inclined toward the Horizon, or else be very rugged, or far remote from the Gnomon to that it will not at all, or not to well, receive an Horizontal Line upon it, you may Either fet up some Board, or such like Object, upon which for a rime you are to inscribe the Horizontal Line, and by help of which the Hours were to be projected upon the Superficies; Or else (which perhaps will be better) you may extend a Thred in the Air (it matters por which way, nor whether from the Gnomon towards the Sun, or from the Sun: whether stretcht out in one length, or with returns, so long as it lieth justly parallel, in every Point of it, to the Horizon, and in the same Level with the Point of the Gnomon:) which being fixed in this manner, will very well supply the use of the Horizontal Line: or the Horizontal Line may be partly Thred, and partly drawn upon the Superficies, as occasion shall be. And upon it may any Point be transferred, and figned out by flip-ping knots of Thred tied upon it.

3. Upon the Superficies of the Dial, observe the Point of the Shadow of the Gnomon (making a mark at it) and the Sun's Altitude, both of them

at the same instant of time.

4. By the Altitude observed, compute the Azi

muth of the Sun from the Meridian.

5. The same Azimuth must be transferred unto or projected upon, the Horizontal Line by help of a Perpendicular Thred, covering to your fight (as it hangeth down) the Points of the Gnomon and Shadow both together; and at the same view cut-ting through the Horizontal Line: observe then punctually where it cuts through the same Line, for that same Section being signed thereon, shall be the Azimuth projected into the Horizontal Line.

6. Let any kind of Board or Past-board be now applied to the Point of the Gnomon; io, as that it may be staid, either upon the Horizontal Line (where it may to be conveniently) or at least to placed toward the Horizontal Line, that it may have a just respect unto it, and in that posture may have some stay for the edge of it to rest upon, that after it is furnished with such necessary Lines as must be drawn upon it, it may be placed in its former just posture without any Impeachment Upon this plain so placed, let the Point of the Gno mon be figned, which may be called the Center; and from this Center to the Sign of the Azimuth

sent upon the Board or Past board; the same Azimuth which was before computed.

7. Then taking away the same Plain, draw upon it the Meridian or Line of 12; extending it from the Center besore noted, at the true Angle that it hath from the Azimuth before computed and described, and also toward the true Coast of the World. And let it be extended on both sides the Center if need be.

8. To the Meridian so pitched upon the Patt-board, draw (from the Center) the Lines of an Horizontal Dial made to the Latitude wherein

you are.

9. Then again, let the plain Board or Pastboard be applied to its former situation, the Center of the Horizontal Dial resting upon the Point of the Gnomon, and every thing else answering to the same just posture that it had at the sirst. Which done, let a Thred be fixed in the Center of the Horizontal Dial, by help whereof you may transfer every Hour from the Past-board into the Horizontal Line. Let every Hour be therein noted (by fixing marks upon the Horizontal Line where it is drawn, or by flipping Knois upon the Thred, where a Thred Horizontal Line is used) especially mark out the Hour of 12: For which (if it chance to run belides the Superficies) some kind of Object (whereon the Horizontal Line is also to be drawn) or an Horizontal Thred must be fastned, that may receive it, till such time as your Dial be finished.

10. After all this, take your Plain away (for there will now be no more need of it) and conje-Cture whereabout the Axis of the World would pass from the Point of the Gnomon to the Poles of the World, for into that place is the Meridian to be projected. Which that it may be done more commodiously, if no object stand in the way that will receive it, you must place one there, it matters not whether above or below the Gnomon, chuse that which is most convenient: Or, a Thred laid assope in the Meridian justly as it ought, will serve as well as may be. If then you hold up a perpendicular Thred, so that by your Eye you may see the Point of the Gnomon, and also the Point of 13 in the Horizontal Line, both together, the same Thred so hanging, shall shew where the Meridian is to be drawn. Or, you may extend a Thred from the Point of the Gnomon to the Point of 12 in the Horizontal Line, which Thred shall represent the Line of 12: And staying your Thred there, close to it, hang up two perpendicular Threds at a good distance, so shall the same two Threds, give you the track of the Meridian Line.

11. The next Work will be to project one of the Poles of the World (that namely, which lies the same way that this projected Meridian doth from the Point of the Gnomon) into this Meridian. And this is done by elevating or depressing your Semicircle, from the Point of the Gnomon towards the Meridian Line, according to the Latitude of your Place; for so will the Ruler of the Semicircle, or a Thred extended along by it, Sign out the very Pole Point. If now you extend a Thred from this Pole Point, to the Point of the Gnomon, the same shall represent the Axis of the World.

12. Last of all; by these helps, all the Hours may easily be projected. For if the Eye do lay, or project, this Thred or Axis upon each Point of before prejected into the Horizontal Line, draw a those Hours that were inserted before into the Horizontal

Point upon the Axis, each one of those Projections shall represent upon your Dial, each of the Hours required, and will shew upon every Object that stands in the way, where the Hours are to be drawn. Or, where convenient room is wanting to place the Eye, so as it may make this Projection; there may two Threds be used for the same purpose, one whereof must be fastned to the Point of the Gnomon, the other to the Pole defigned in the Meridian Line. Then stretching one of the Threds to any of the Points noted in the Horizontal Line, and holding it there, you may take the other, and extend it to the Superficies, so as it may closely pass by the first Thred, by which Work you may make as many Points upon your Superficies as you please, thro' which each Hour is to be drawn. Having thus traced the way before hand, you may afterward draw the Hour without any difficulty, be the Superficies never so irregular. Among which Lines, the Shadow of the Point of the Gnomon, as it creepeth along, will shew the Time of the Day.

If a Point be affigned upon any Superficies Flat or Curved, one, or more, wherein the Hour-Lines ftyle, and measure from it the elevation of the Axis and Axis shall concur, how to project the Hours above the Plain. But if the Dial be described upto that Point, and to set up an Axis after the ordinary manner to give Shadow to them without any knowledge how the Dial standeth, in respect either of the Declination or Inclination.

1. To the Point affigned (upon any fide of it)

by direction of your Semicircle or other Level, firetch out an Horizontal Thred, serving for the Horizontal Line: this Horizontal Line need not be one direct Line, but may be turned at one or more Angles, provided that it lie totally in the Superficies of the Horizon.

- 2. With a perpendicular Thred held up, project the Sun into the affigned Point, and into the Horizontal Thred, and tie a little mark of Thred upon the same Horizontal, through which the Shadow cutteth. At the same instant also, take the Sun's Altitude.
- 3. By the Altitude taken, find out the Azimuth; This Azimuth, what ever it be, is represented by the knot.
- 4. Apply a Past-board to the Assigned Point, and hold it stat that it may answer to the Horizontal Thred also, and upon this Past-board, protract your Azimuth by a Thred extended from the Point affigned for the Center, to the mark upon the Horizontal Thred. This done,

5. By help of that Azimuth upon your Paftboard, protract the Meridian Line, observing the true Coast, and quantity of the Angle from the A-2imuth: and to the Meridian describe an Horizontal Dial.

- 6. Applying the Past board to its place again, all things standing right as before, project all the Hours in the Horizontal Thred from off the Pastboard, and set marks upon the same for the Points of each several Hour, which marks may be little ject to an Apex. moveable Knots to slip to and fro upon the same Thred.
- 7. Project the Meridian Point by a perpendicular Thred upon some object into that place whereabouts you imagine the Axis of the World would pass, above or below from the Point assigned for the Center.
- 8. With your Semicircle elevated or depressed

rizontal Line, the Axis upon an Hour Point, or agthe Center, according to your Latitude project the Pole of the World.

9. Extend a Thred from the Point affigned for the Center to the Poles of the World, which shall

represent the Axis.

101 By the Point upon the Horizontal Thred, and this Axis (either by your Eye, laying the Axis to the Hour points, or laying the Hour knots to the Axis) you may project all the Hours and draw them; Or else you may let the Axis alone, and content your self with the Pole point projected into the Meridian, for if from the Point assigned to be the Center or meeting of the Hours and Axis, you extend a Thred to each Hours-point in the Horizontal Line, and do repose (with your Eye) the same Thred upon the Pole-point, then shall the Shadow of the Thred give you that Hour-line, and do so in all the rest.

11. Your Thred or Axis lying in its true fituation, you may eafily fit an Axis to the same po-sture. If your Dial be described upon a plain Superficies, you may then (by one fide of a Nominal Square, applied to a Thred or Axis, and the other fide lying upon the Plain) find out the subon a curved Superficies, you must be content to fet up your Axis by the direction of the Thred

12. This Point assigned for the Center, being a Point of the Axis, is as it were the Apex of the Gnomon, unto which all the Work is projected. But if it be required to set up an Axis to such & Superficies, upon which the Axis and Hours will not meet in any tolerable manner, because perhaps the Axis may be but of very small elevation above the Superficies, and yet an Axis is required: in this cale, ser up any Point (of Wire, or such like) of such distance from the Superficies, as that the Axis and Hours may be distinct: And through that Point let it be required to make the Axis pais, you have no more to do but only to project to this Point, as before, by letting the Shadow of a perpendicular Thred pass through that Point, and no ting the same upon your Horizontal Thred, and counting that end of the Wire as your Center, proceed as before, for the Thred that lies to project the Hours is a pattern for the Axis.

This way is as general as the former, serving to project the Hours upon many Superficies, be they plain or curved, and however situate whether contiguous, or separate, and that without any laborious inquisition of any of their Situations, in respect of Inclination or Declination. If you will put in that Furniture which is usual, you must make some Mark (Notch, or Button) upon your Axis, unto which (as representing the Center of the World) by help of your Semicircle you are to project the Altitudes of such great or lesser Circles as you intend to insert; as hereafter shall be taught.

The 12 Propositions in the first way were to pro-

These 12 Propositions answerable in the second

way are to project to an Axis.

And after this method it will be easie, and often very useful and curious, to Project a Dial from a small Hole made in a Pane or Quarry of Glass; (the rest of the Glass being covered) or which is better, a Plate of Tin with a round Hole of † of 8. With your Semicircle elevated or depressed an Inch in Diameter, being put in the room of a (as it shall be required) from the Point assigned for Pane of Glass) for the Sun thining thro' that Hole.

(1) Apply an Horizontal Dial in a true Horizontal Position, so that its Centre lie in that of the Aure, was a Rank or Row of 4 Columns only, Hole in the Pane; and then by a Thred fixed at and whole Station was in the Front of a Temple, one end of the Centre of the Dial, and laid over fuccessively, every Hour, Half Hour, Quarter, Gc. find corresponding Points in the Sides of the Room a Country without the Limits of Italy, and gained where thole Hour-Lines intersect them: Then to their Subjection by the Sword. But with us (2) The Twelve a Clock Line being an Azimuth the word is most commonly used for the Circuit also as well as an Hour Line, you may by a String of an Archbishop's Juridiction; and in some of and Plummet brought just to touch that Thred our Statutes 'tis used for a County.
when strained over the 12 2 Clock Hour Line, PROVISION, in the Canon Law, is used for transfer that Meridian Line up to the Ceiling or down on the Floor, as you shall find occasion. Ecclesiastical Living. by the Pope, before the In(3.) Next in this Meridian Line find another cumbent be dead. Tis called also Gracia Expessa-Point, (by help of a Thred elevation to a proper tiva, and Mandatum de Providendo.

Height (in degrees) by means of a Quadrant) PROVISIONS: The Acts to restrain the exor-Height (in degrees) by means of a Quadrant) Reversed) Axis of the Earth; and therefore if you fix a Thred in one or both of these Points (or rather Poles) and extend it or move it along by the fide of the other Thred, as it is brought succeffively over every Hour Line on the Horizontal Dial (in whose Centre, as well as in that of the Hole it is fixed) and as it is extended to the corresponding Hour Points before found in the Room: I fay, that moveable String shall any where on the Ceiling or on the Floor, trace out any Hour Line which the Horizontal Thred shall successively represent.

And this Method of Projective Dialling, will And this excellent Mechanick way of Dialling or drawing Hour Lines on any Plane how lates the Weights and Measures, and the Price of integular soever as to Surface or Situation. Under the Plane where you intend to make a Dial, draw a true Level or Horizontal Line, and then to it set the Weights and Measures, and the Price of PROVOST Ma shal in the Royal Navy, who a true Level or Horizontal Line, and then to it set the Weights and Measures, and the Price of PROVOST Ma shal in the Royal Navy, who have the content of the Prisoners taken at Sea. 13 Care direct us into this excellent Mechanick way of horizontally, a Scaffold or Frame of Boards, greater or lesser, according to the designed Bigness of the Dial. Next, by some good Dial, Clock, E-quinoctial Ring. &c. get exactly the true Hour of the Day, and set your Minute Watch to it Then place a good Horizontal Dial for the Latitude of the Place and which hath a fine String fastened in its Centre, on your Level Plane or Scaffold, and the Sun fhining, turn it about till it shew the true Hour of the Day there. Then fix it; and by the motion of your Thred over every Hour, Half, Quarter, &c. you may eafily project them all into your Plane or Place defigned for the Dial.

PROLATE Spheroid, is a Solid produced by the Revolution of a Semi Ellipsis about its longer Diameter; but if a Solid be formed by the Rethis Figure is the Earth we inhabit, and perhaps all the Planets are so too, having their Equatorial

Diameter longer than their Polar.

PROMONTORY, is an Hill or High Land running out into the Sea: The Extremity of which towards the Sea, is usually called a Cape or an Headland.

PROPORTIONAL Scales, sometimes also called Logarithmetical; are only the Artificial Num-

will cast a bright Spot of Light into the Room, and advantage of Multiplying, Dividing, Extrace-Suppose then such a Hose to be the Nodus, or Point ing Roots, &c. by the means of Compasses, or by of the Top of the Perpendicular Style of any Dial, Sliding Rules; and they are only so many Lines of you may draw one or more Dials, (each side or Numbers, as they are called by Mr. Gunter. (See part of the Room being a different Plane) after Gunter's Line.) But make Single, Double, Triple, or Quadruple; beyond which they seldom go. PROSTYLE, in the ancient Greek Archite-

or other great Building.
PROVINCE, was used among the Remans for

the providing of a Bishop or any other Person, an

from which, a Line or Thred extended to the Hole bitant abuse of Arbitrary Power, made in the Parin the Window may represent either the Direct (or liament at Oxford, 1258, were called Provisions; because they provided against the King's Absolute Will and Pleasure.

PROVISO, in the Sea Phrase, for a Ship to Moor a Proviso, is for her to have one Anchor out, and also a Hawser ashore, and so she is moored with her Head to the Shore with two Cables.

PROVISOR, is he that sues to Rome for a Pro-

vision; which fee.

PROVOST Marshal, of an Army, is one appointed to secure Deserters, and all other Criminals: He is to go often abroad round the Army, to hinder the Soldiers from Pillaging: 'Tis part of his Office to indite Offenders, and to execute the

PRUDENCE, is by the Writers of Ethicks defined to be a Habit of the Mind, by which a Man-judges and determines truly how he should act and proceed, what he should do or avoid, in all things relating to his Temporal or Eternal Advan-

tage, to as to render himself happy here and here-

PRYAN Tin, is a fort of Tin that is found mix'd with a Gravelly Earth, sometimes White, but usually Red; 'tis not half so good as the other

which is made out of Stone.

PTOLEMAICK System of the Heavens, was that invented by Ptolemy; in which he supposes. the Earth immoveable any way in the Centre of the Universe, round about which the Moon first moves in a Circle; next her Mercury, then Venus: volution of a Semi-Ellipsis about its shorter Dia-meter; 'tis then called an Oblate Spheroid: And of this Figure is the Earth we inhabit, and perhaps diack from West to East. Above Saturn he places the Sphere of the fix'd Stars, which he supposes to move flowly also from East to West, on the Poles of the Ecliptick. While the fix'd Stars themselves, and all the Planets, move from East to West on the Poles of the Equator, in the space of a Natural Day or 24 Hours. This Vulgar System of Astronomy, (in which I omit to mention the Epi-cycles and Deferents, &c. with which they enbers or Logarithms placed on Lines, for the ease deavoured to solve the Phanomena which did al-

most all of them contradict this Scheme) was plainly overturned and refuted as foon as ever the use of the Telescope acquainted us with the Pha fes of Venus and Mercury; for from thence it was apparent, that their Orbits included the Sun, and therefore by degrees it came to be quite disused, Rope must and consequently I shall say no more of it.

PULLET, in a Ship, is a little Room within her Hold, in which the Piggs of Lead, or such like weighty things are put, that the Ship may be well

ballasted in a little Room.

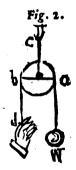
PULLEY, is a compounded Mechanick Power, confisting of one or more Shivers or Rundles with proper Blocks, &c. to raise up any Weight, &c. and this Instrument so fitted is called Trochlea or the Pulley; and at Sea with Ropes, &c. fitted so to it, it is called a Tackle.

Fig. 1.

In every Pulley, from the Position and Number of the Shivers, you may know how much the Weight W is diminished, by making the V. Motrix, or Power, to be to the Weight: as 1 to the Number of the parts of the Rope going up and down.

Only this you must ob-ferve, that it is the lower Pulleys, or Blocks with Shivers, that give any Force to the Motion; for if a Weight hang on any upper Pulley or Shiver. it will require a Power to sustain it that shall be fully equal

to the Weight.



Thus if a Weight hang as in the Position a W, it would certainly fall, if a Force or Power equal to it did not hold the Rope b d.

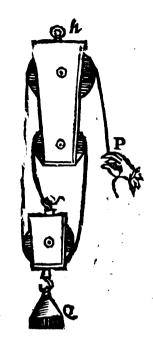
And all upper Shivers being every where of the same Nature, none of them can conduce any thing towards easing the Power or lightening the Weight; but they only ferve for the Convenience of the Motion.

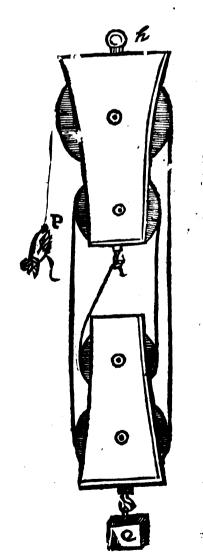
But if you suppose the Weight W (as in Fig. 1.) to be sustained by the Hook b, above the Block a b, then 'tis plain that the Hook b will sustain just half the Weight, and therefore the Power at P need be but equal to half the Weight W; for 'tis all one as if the Weight were hung to the middle of a Balance or Libra a b, whole equal Arms were upheld by two several Strings, as ba and Pb.

Tis also apparent in Fig. 1. That in order to raise the Weight W, the Height of one Foot, each part of the Rope, viz. h a and Pp; (accounting downwards from the Hook b) must be made a Foot shorter, i. e. the Power must move two Feer, in order to raile the Weight but one: Wherefore in this Engine, the way of the Power is double to that of the Weight; and therefore their Celericies will also be in the same Ratio; wherefore if the Power he to the Weight as 1: to 2, its Moment will be equal to that of the Weight, one fourth of the Weight, &c. and so will sustain the Weight. Vol. II.

If the Weight be sustained by 3 surns of the Rope, and be made to ascend one Foot (as in

Fig. 3.) then each Part, or Turn, or Fall of the shortened 1 Foot (reckoning as before from the Hook at b) and this cannot done unless the Power in P move three Feet: Here therefore the way of the Power is triple to that of the Weight, as is also its Celerity; wherefore if the Power be to the Weight as 1 to 3, or one third of it, it will sustain the Weight.





And so on in the 4th Fig. the Power P must be

The

The Pully is a Wheel not only turning round its Axis, but made to, that at the same time tis drawn up by a Rope or Cord that goes round it: This may be considered as a perpetual Homodro-mous Lever or Vedis; for the Cord which is put over the Wheel AFC being fattned at one End at D, and the other End at E being drawn or beld by some Power, so that the Weight suspended

from the middle of the Wheel AFC, be kept in Equilibrio; 'is then plain, that the moving Force is apply'd to the lower Pulley or Shiver in A, one of the Extremes of the Lever A C, the other Extreme C rising on the fix'd Rope or Chord DC as on an Hypomochlion Tis plain also, that the Weight F is suspended from the middle Point B, and consequently as A C, the distance of the moving Force from the Hypomochlion, to BC, the distance of the Point of Suspension of the Weight from the same

(that is, as 2 to 1): : so is reciprocally (from the Nature of the Lever) the Weight F to the Force fustaining it in E; and consequently one under-Pulley takes off always half the Weight, or raises double the Weight with the same Power or

But if the Pulley be fix'd above only, it affords no help towards lifting up the Weight more easily;

for here the moving Force in E must be equal to the Weight in W, because the Hypomochlion in this case is in the middle at B; and consequently the Weight and Power equidiftant from it, as in the Balance.

The upper Pulleys or Shivers then are of no other use but to facilitate the Motion of this Rope by their Volubility and apt Position.

So that to estimate the Power of the Combination of never so many Shivers or Pulleys put to-

Number of the lower Shivers, or of the Cords which pass over them without considering the upper ones, and they will give you the Multiple of the Weight to be raised this way; in comparison of what could be raised without any such help by the same Power.

So the Force of 50lb. in a Pulley with two lower Shivers will raile four times as much, viz

If the Force of 50 lb. and the Weight 200 lb be both given, and the Number of Shivers be required, 'tis plain you must divide 200 by 50; that is, the Weight by the Power, and the Quotient will be 4, the Number of Ropes, and the half of that is the Number of lower Shivers,

If the Weight, suppose 1000 lb. be given, and the Number of Pulleys or Ropes, suppose 4; then divide the Weight by the Pulleys, and the Quotient is the Power of Force required; viz. 250 lb. And this Method of proceeding will give you the Desiderata in any Combination of Pulleys, and in any Conjugation of many Combinarions.

PULMONES. See Lungs in Vol. II.

PULVINATA, in Architecture, is the Term

for a Freeze, which swells out like a Pillow.
PUMPS, in a Ship are of several sorts, as the Chain Pumps which are used in great Ships; and thele go with more ease than others, yield more Water, and are easily mended. Bare Pumps, are small ones made of a Cane or a piece of Wood bored thro, and are used to pump Beer or Water out of the Caske. Bur-Pumps, are used by the Dutch, who have them by their Ships fides. In these there is a long Staff with a Bur at the end like a Gunner's Spunge, to pump up the Bildgewater: Thele are also called Bildge Pumps.

PUNCHINS, in Architecture, are short pieces of Timber, placed to support some considerable Weight: They commonly stand upright between the Posts, and are shorter and slighter than either the Principal Posts or Prick Posts. Those that stand on each side of a Door are called Door Pun-

PUNCTATED Hyperbola, is an Hyperbola whose Oval Conjugate is infinitely small, that is, a See Curves.

PUNCTUM. See Point.
PUNCTUM Formatum seu Generatum; in Conicks, is a Point determined by the Intersection of a Right-Line drawn thro the Vertex of a Cone to a point in the Plane of the Base, with the Plane that constitutes the Conick Section. See De la Hire's

Latin Conicks, p. 15. 16. PUNCTUM ex Comparatione, is either Focus in an Ellipsis and Hyperbola; and it was so called by Apollonius, because the Rectangles under the Segment of the Transverse Diameter in the Ellipfis, and under that and the Distance between the Vertex and Focus in the Hyperbola, are equal to part of what he calls the Figure.

PUNCTUM Lineans; is that point of the generating Circle, which in the Formation of either Simple Cycloids or Epicycloids, produces any pare of a Cycloidal Line. See Epicycloid.

PUNITORY Interest, is a Term in the Civil Law, for such Interest of Money as is given for

Delay, or Breach of Trust.
PURE Hyperbola, is one which by the Impossibility of its 2 Roots is without any Oval, Node, Spike, or Conjugate Point. See Curves ...

PURGATIVE Medicines; the manner of their Operation is very well accounted for by Dr. Cheyne in his Book of Fevers, thus: Purgative Medicines being received into the Stomach by the Mouth, their Particles do there vellicate or stimulate the Fibres of the Stomach, and thereby encrease the Digestive Faculty; i. e. bring the Muscular Fibres of the Stomach, and the Muscles of the Abdomen and Diaphragm into more frequent Contractions than ordinary, till they are admitted into the Inte-fines; the Fibres and Glands of which being more sensible than those of the Stomach (whose Parts, by the frequent rough Contacts of one against another, and of the gross Bodies which are often thrown into it, are as it were deadned) they eafily move and bring them into frequent forcible Contractions; whereby these Glands are squeezed, and so emit a Fluid which lubricates the Passages: And this mixing with the Fæculent Matter of the Intestines (which is rendred stuid by the same active and stimulating Quality of the Purgative Medicine) renders it more fluid; by which, and

by the uncommon Contractions of the Intestines, it pattes more easily and plentifully into the Re-Elum Intestinum, and is thence ejected by Stool. Thus gentle and easie Purges act, and do only cleanse the Intestines, sew of their Particles entring in by the Lacteal Veins and so affecting the Blood: But in violent Purgatives, the stimulating Particles are mixed with the Blood, and produce there many times very great effects by occasioning unnatural Fermentations, by separating the natural Cohe fions of the Liquors of the Body; and also by vellicating the Spiral Fibres of the Veins and Arteries, bring those into more forcible Contractions, and thereby accelerate the Motion of the Blood; all which may sometimes have a good and sometimes a bad effect.

PURLINS, in Architecture, are those Pieces of Timber which lie across the Rasters on the Inside, to keep them from finking in the middle of their

PURPARS, a Purparty, is that part or share of

an Estate, which being held in Common by Copartners, is by Partition allotted to any one of them

PUTLOGS, are short pieces of Timber (about 7 Foot long) used in Building Scaffolds; they lie at Right-Angles to the Wall with one of their Ends resting upon the Ledgers or Poles which lie parallel to the side of the Wall of the Building.

PYRAMIDALES Papilla. See Papilla Pyra-

PYRAMIDOID, is what is fometimes called a Parabolick Spindle; and is a solid Figure formed by the Revolution of a Parabola round its Base or greatest Ordinate; and if you consider it according to the method of Indivisibles, you may conceive its Solidity to confift of an infinite series of Circles whose Diameters are all parallel to the Axis of the Revolving Parabola

PYTHAGORICK Tetrattys, was a Point, a Line, a Surface, and a Solid.

QUA

QUADRAGATA Terra; a Team of Land: or which may be tilled with 4 Horses.

QUADRAGESIMA, is the first Sunday in Lent, and so called, because 'tis about the fortieth Day before Eafter; and on the same account the three preceding Sundays are called Quinquagesima, Sexa-

gesima, and Septuagesima

QUADRAGESIMALS: In Popish Times 'twas the Custom for People to visit their Mother Church on Midlent Sunday, and to make their Offerings ar the High Altar. And the like kind of Superstitions Devotion was also used in Wnitson week: But as the Processions and Oblations at Whitsonside were sometimes commuted for a rated Payment of Pentecostals or Whitson Farthings; so these were changed into a Customary Payment, and were called Quadragesimals, Denarii Quadragesimales; and sometimes Letare Jerusalem, because that Hymn was sung on Midlent Sunday. The Custom of Mothering, as 'cis called in many places in England, is still retained, being that of vifiting Parents on Midlent Sunday; and it feems to be called Mothering from the Respect thus in old Time paid to the Mother Church. And the Epistle of Ga lat. 4. 21. is still retained on Midlent Sunday, which began Jerusalem mater omnium, &c. tho' the occasion of it is forgotten.

QUADRANS, the fourth part of a Penny, or a Farthing; for before the Reign of Edw. 1. our smallest Coin was a Penny, called then Steeling; and it was stamp'd with a Cross or Traverse Stroke, so that it might on occasion be cut easily or broken into Halves or Quarters: But to avoid the Fraud of unequal division of the Penny, this King Edw. 1. coined Half-pence and Farthings in round distinct

Pieces.

eces. Matt. West. in Anno 1279. QUADRANT of Davis. See Back staff. QUADRANTATA Terra, the sounth part of an Acre.

QUADRAT: To Quadrat a Piece of Ordnance, is to see whether it is duly placed in its Carriage, and that the Wheels be of an equal Height. composed of Parts extreamly small, but as generated Vol. II.

QUA

QUADRATRIX of the Hyperbola: There is a new Curve lately invented by Mr. J. Perks of Great Swinford in Worcester shire, for the Quadrature of the Hyperbola; of which see an Account in Phil. Trans. N. 306.

QUADRATURE Lines, or Lines of Quadrature; are two Lines placed usually, or at least sometimes, on Mr. Gunter's Sector, and eafily known there, by being mark'd with the Letter Q, and the Figures 5, 6, 7, 8, 9, 10; of which Q fignifies the fide of a Square, and the other Figures the fides of Polygons of 5; 6, 7, &c. Sides. S. there stands for the Semi-diameter of a Circle, and 90 for a Line equal to 90 Degr. in the Circumference

Their Uses are readily (tho' not exactly) These:

1. To make a Square equal to a given Circle.

Open the Sector to the Radius of the given Circle by applying it over in the Point S, S, and then the Parallel Diffance between the Points Q Q. is the fide of the Square required.

2. To make a Circle equal to a given Square.

Apply the fide of the Square over in Q.Q. so will the Parallel Distance between S, S. be the Radius of the Circle fought.

3. To reduce a Square, or a Circle, into a Pentagon or other regular Polygon equal to it.

Take the Side of the Square, or Radius of the Circle given, and apply it over in its proper Points, and then the Parallel Distances between the Points of any of the other Polygons, shall be the Sides of thole Regular Figures.

QUADRATURE of Curves, by Sir If. New-

I don't here consider Mathematical Quantities as 3 U 3

of Parts, but by a continual motion of Points. Surfaces are generated by the motion of Lines, Solids by the motion of Surfaces, Angles by the Rotation of their Legs, Time by a continual flux, and so in the rest. These Geneses are founded upon Nature, and are every Day seen in the motion

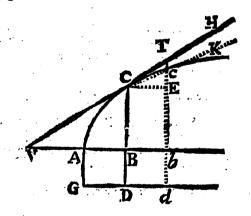
And after this manner the Ancients by carrying moveable right Lines along immoveable ones in a Normal Polition or Situation, have taught us the

Geneles of Rectangles.

Therefore considering that Quantities, encreafing, in equal times, and generated by this encreafing, are greater or less, according as their Velocity by which they encrease, and are generated, is greater or less; I endeavoured after a Method of determining the Quantities from the Velocities of their Motions, or Increments, by which they are generated; and by calling the Velocities of the Motions, or of the Augments, by the Name of Fuxions, and the generated Quantities Fluents, I (in the Year 1665 and 1666) did, by degrees, the generated Solid ABC will be as the generated Soli light upon the Method of Fuxions, which I here make use of in the Quadrature of Curves.

Fluxions are very nearly as the Augments of the Fluents, generated in equal, but infinitely small parts of Time; and to speak exactly, are in the Prime Ratio of the naicent Augments: but they may be expounded by any Lines that are proportional to em. As if the Areas ABC, ABDG be described by the Ordinates BC, BD, moving with an uniform motion along the Base AB, the Fluxions of these Areas will be to one another as the describent Ordinates BC and BD, and may be expounded by those Ordinates; for those Ordinates are in the same Proportion as the Nascent

Augments of the Areas.



Let the Ordinare B.C move out of its place BC into any new one bc: Compleat the Parallelogram BCEb, and let the right Line VTH be drawn which may touch the Curve C and meet bc and B A produced in T and V; and then the just now generated Augments of the Abscissa AB, the Ordinate BC, and the Curve Line ACc, will be Bb, Ec, and Cc; and the Sides of the Triangle CET, are in the Prime Ratio of these Nascent Augments, and therefore the Fluxions of AB, BC and AC are as the Sides CE, ET, and CT of the Triangle CET, and may be expounded by those Sides, or, which is much at one, by the Sides of the Triangle VBC similar to it.

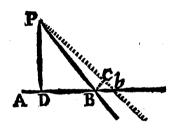
'Tis the same thing if the Fluxions be taken in the ultimate Ratio of the Evanescent Parts. Draw

by a continual motion. Lines are described, and the Right Line Cc, and produce the same to K. by describing are generated, not by any apposition Let the Ordinate bc return into its former place BC, and the Points C and c coming together, the Right Line C K co-incides with the Tangent C H, and the Evanescent Triangle C E a in its ultimate form becomes fimilar to the Triangle C ET, and its Evanescent Sides C E, E c and C c will be ultimately to one another as are C E, E T and C T the Sides of the other Triangle CET, and therefore the Fluxions of the Lines AB, BC and AC are in the same Ratio. If the Points C and c be at any small distance from one another, then will CK be at a small distance from the Tangent cH. At soon as the Right Line CK coincides with the Tangent CH, and the ultimate Ratio's of the Lines CE, Ec and Cd be found, the Points C and c ought to come together and exactly to coincide. For Errours, tho' never so small, are not to be neglected in Mathematicks.

> By the same way of arguing, if a Circle described on the Centre B with the Radius BC, be drawn with an uniform motion along the Abscissa AB, and at Right Angles to it, the Fluxion of ting Circle, and the Fluxion of its Surface will be as the Perimeter of that Circle and the Fluxion of the Curve Line AC conjointly. For in what time the Solid ABC is generated by drawing the Circle along the Abscissa AB, in the same time its Surface is generated by drawing the Perimeter of that Circle along the Curve A C.

Of this Method take the following Examples.

Let the Right Line PB revolving about the given Pole P cut the Right Line A B given in Position; the Proportions of the Fluxions of the Right Line A B and P B is required.



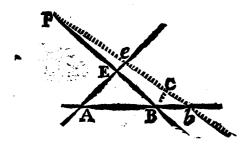
Let the Right Line P B go out of its place P B into a new one Pb: In the Line Pb take PC equal to PB, and draw PD to AB for that the Angle bPD may be equal to the Angle bPC; and then from the Similarity of the Triangles bBC, bPD, the Augment Bb, will be to the Augment Cb as Pb is to Db.

Now let P b return into its former place P B, that those Augments may vanish, and the ultimate Ratio of the Evanescent Augments, that is, the ultimate Ratio of Pb to Db will be the same as that of PB to DB, the Angle being right; and therefore the Fluxion of AB is to the Fluxion of

PB in this Ratio.

Let the Right Line PB revolving about the given P Pole cut AB and AE two other Right Lines given in Position in B and E; 'tis required to find the Proportion of the Fluxions of those Right Lines AB and AE.

Let



Let the revolving Line P B move out of its place PB into a new one Pb, cutting AB, AE into the Points b and E, and draw BC parallel to AE, meeting Pb in C; then Bb will be to BC as Ab is to Ae; and BC to Ee as $Ab \times PB$, to $Ae \times PE$. Now let the Right Line Pb return the sum of th into its former place P B, and the Evanescent Augment Bb will be to the Evanescent Augment Be as $AB \times PB$ is to $AE \times PE$, and therefore in this Ratio is the Fluxion of the Right Line AB to the Fluxion of the Right Line A E.

Hence if the revolving Right Line PB cut any Curve Lines given in polition in the Points B and E, and the moveable Right Lines AB, AE touch those Curves in B and E, the Points of Section; the Fluxion of the Curve which the Right Line AB touches, will be to the Fluxion of the Curve which the Right Line A E touches, as A B×P B is to A E×P E. The fame thing will happen if the Right Line P B always touch any Curve given in Polition in the moveable Point P.

Let the Quantity x from uniformly, and let the Fluxion of x^n be to be found. In the same time that the Quantity x by flowing becomes x + o, the Quantity x^n with become $x + o \mid n$, that is, by the Method of Infinite Series's $x^n + no$ $x^{n-1}+\frac{nn-n}{2}$ 00 $x^{n-2}+\mathcal{G}c$. and the Augments o and 2 00x1-2 +, Scare to one another as 1

and $nz^{n-1} + \frac{nn-n}{2} \circ ox^{n-2} +$, c. Now let those Augments vanish, and their ultimate Ratio will be the Ratio of 1 to nxn-1; and therefore the Fluxion of the Quantity x is to the Fluxion of the Quan-

tity xn as I to nxn-1.

By like ways of arguing, and by the method of Prime and Ultimate Ratio's, may be gathered the Fluxions of Lines, whether Right or Crooked in all cases whatsoever, as also the Fluxions of Surfaces, Angles and other Quantities. In Finite Quantities so to frame a Calculus, and thus to investigate the Prime and Ultimate Ratio's of Nascent or Evanescent Finite Quantities, is agreeable to the Geometry of the Ancients; and I was willing to shew, that in the Method of Fluxions there's no need of introducing Figures infinitely small into Geometry. For this Analysis may be performed in any Figures whatsoever, whether finite or infinitely small, so they are but imagined to be similar to the Evanescent Figures; as also in Figures which may be reckoned as infinitely small, if you

do but proceed cautiously.

From the Fluxions to find the Fluents is the more difficult Problem, and the 1st step of the So-Intion of it is equivalent to the Quadrature of Curves; concerning which I have formerly written the following Tract.

A Treatise of the Quadrature of Curves.

I consider indetermined Quantities as encreasing or decreasing by a perpetual motion, that is, as flowing encreasingly or decreasingly; and I reprelent em by the Letters 2, 7, x, v, and I mark their Fluxions or their Celerities by which they encrease by the same Letters with Points over 'em thus, z, y, x, v. There are likewise Fluxions of Fluxions, or Mutations more or less swift, which may be called the Second Fluxions of z, y, x, v, and may be marked thus, z, y, z, v; and the First Fluxions of these, or the Third Fluxions of z, y, z, v, thus, z, y, z, v; the Fourth thus z, y, z, v, &c. And as z, y, z, v, and these are Fluxions of the Quantities z, z, z, z, z, and these Fluxions of the Quantities x_1, y_2, x_3, v_4 , and these Fluxions of the Quantities, x_2, y_3, x_4, v_5 . So these Quantities may be considered as Fluxions of others, which I shall mark thus, z, y, x, v; and these as Fluxions of others z, z, z, v, and these as Fluxions of others 7, 7, x, v. Wherefore 7, 7, 7, 7, 7, 7, 7, &c. represent a Series of Quantities, in which every subsequent one is the Fluxion of the precedent, and any preceding one is a flowing Quantity or a Fluent, which has for its Fluxion that which follows it.

Of the like nature is this Seties Jaz "77, $\sqrt{a\chi}$ — $z\chi$; as also this Series, 42 + 22 42 + 23 42 + 22 42 + 23 42 + 23 42 + 24

And it is to be observed, that any preceding Quantity in these Series's is as the Area of a Curvilineal Figure, whose Ordinate Applicate apply'd at Right Angles is the flowing Quantity; and

its Abscissa z: as √ az - zz is the Area of a Curve whose Ordinate Applicate is $\sqrt{az-zz}$ and the Abscissa z.

The defign of all this will be apparent from the following Propositions.

Prop. 1. Prob. 1.

Having given an Equation involving any number of fluent or flowing Quantities, to find their Fluxions.

Solution

Multiply every Term of the Equation by the Index of the Power of each flowing Quantity contained in that Term, and in each Multiplication change the Root of the Power into its Fluxion; and then the Aggregate of all the Products' under their proper Signs will be the new Equation.

Expli-

Explication.

Let a, b, c, d, &c. be determined and immutable Quantities, and let any Equation be proposed containing the fluid or flowing Quantities z, y, &c. as $x^2 - xyy + aaz - b^2 = 0$. First let the Terms be multiply d by the Indexes of the Powers of x, and in each Multiplication, instead of the Root or Side of the Power, or instead of x of one dimension only, write x, and the Summ of the Products will be $3xx^2 - xyy$. Let the same be done by y, and you will have -2xyy: Do the same by z, and there will be produced aaz. Let the Summ of the Products be put equal to z and you will have the Equation z be z and z be z and z be z and z be z and z be z and z be z and z be z be z and z be z and z be z be z and z be z be z and z be z be z and z be z be z be z be z and z be z be z be z by z and z be z be z be z by z and z be z be z by

Demonstration.

For let o be a Quantity extreamly small, and let 0.7, 0.7, 0.8, be the Moments of the Quantities 2.7, 3.7, 3.7; that is, the momentaneous synchronal Increments. And if the flowing Quantities are now 3.7, and 3.7, these after a moment of time being augmented by their Increments 3.7, 3.7, 3.7, which being substituted in the first Equation instead of 3.7, and 3.7, give this Equation, 3.7 and 3.7 and 3.7 give this Equation, 3.7 and

A more full Explication of the same thing.

After the same manner, if the Equation were $x^2 - xyy + aa \sqrt{ax - yy} - b^2 = 0$, there would be produced $3x^2x - xyy - 2xyy + aa \sqrt{ax - y} = 0$; where, if you wou'd take away the Fluxion $\sqrt{ax - yy}$, put $\sqrt{ax - yy} = z$, and then will ax - xyy =

And by the same Operation, you may proceed to Second Fluxions, Third Fluxions, and so on: Let the Equation $\chi y^2 - \chi^4 + a^4$ be o, then it will be made by the first Operation, $zy: +3zyy^2 - 4\zeta z^3 - c$, by the Second Operatation $zy: +6\zeta yy_2 + 3zyy_2 + 6\zeta y^2 - 4\zeta z^3 - c$; and by the Third, $zy: +9zyy: +9z: +2\zeta z^2z^2 - c$; and by the Third, $zy: +9zyy: +9z: +2\zeta z^2z^2 - c$; and zy: +3zyy: +

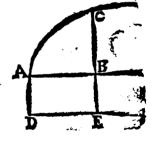
But when we thus proceed to Second and Third Fluxions, 3c. it is convenient to confider some Quantity as flowing uniformly; and for its first Fluxion to write 1; but for the second and following ones o. Let the Equation be $z^{j2} - z^{j} + a^{j} = 0$, as above; and let z flow uniformly, and let its Fluxion be Unity; and then by the first Operation it will become $y^{j2} + 3zy^{j2} - 4z^{j2} = 0$, by the Second $6y^{j2} + 3zy^{j2} + 6zy^{j2} - 12z^{j2} = 0$, by the Third $9y^{j2} + 18y^{j2} + 3zy^{j2} + 18z^{j2} + 6z^{j2} - 24z = 0$. But in Equations of this kind we must conceive,

But in Equations of this kind we must conceive, that the Fluxions in each of the Terms are of the same Order, that is, that they are all either of the first Order j, χ , or all of the Second γ , γ^2 , γ^2 , γ^2 , γ^2 , or all of the Third, γ , γ^2 , γ^2 , γ^2 , γ^2 , γ^2 , γ^2 , γ^2 , γ^2 , γ^2 , &c. And when the thing happens otherwise, the Order is to be compleated by the supposed Fluxions of a Quantity flowing uniformly; and then the last Equation, by compleating the third Order, becomes $9\chi \gamma \gamma^2 + 18\chi \gamma^2 \gamma + 3\chi \gamma \gamma^2 + 18\chi \gamma \gamma \gamma + 6\chi \gamma^2 - 24\chi \chi^2 = 0$.

Prop. 2. Prob. 3.

To find the Curves that are Quadrable.

Let ABC be the Figure, whose Area is to be found; BC an Ordinate apply'd at Right Angles, and AB the Abscissa. Produce CB to E that BE may be—I, and compleat the Parallelogram ABED; and the Fluxions of the Areas ABC,



ABED will be as BC and BE: Therefore take any Equation by which the Relation of the Areas may be determined, and thence will be given the relation of the Ordinates BC and BE, (by Proposition 1.) Q. E. D.

position 1.) Q. E. D.

We shall give Examples of this thing in the two following Propositions.

Prop. 3. Theor. 1.

Demonstration.

For if z^{θ} $R^{\lambda} = v$, then by the first Prop. will $\theta z z^{\theta-1}$ $R^{\lambda} + \lambda z^{\theta}$ R $R^{\lambda-1} = v$. Instead of R^{λ} in the first term of the Equation, and z^{θ} in the second, write R $R^{\lambda-1}$ and $z^{\theta-1}$, and then the Equation will become $\theta z R + \lambda z R$ into $z^{\theta-1}$ $R^{\lambda-1} = v$. But R was taken equal to $E + fz n + gz^{-1} + fz z^{\eta} + fz z^{\eta}$. Sc. and consequently (by Prop. 1.) $R = nfz z^{\eta-1} + 2ngz z^{2\eta-1} + fz z^{\eta} + fz z^$

then will θ , $+\theta$ $+f\chi^n$ $+\theta$ $+2\lambda_n e^{\chi^n}$ $+3\lambda_n b^{\chi^n}$ +Sc. into zen Rhal be wBC. Q. E. D.

Prop. 4. Theor. 2.

If for the Abscissa AB be put z, for $e+fz^n+gz^{2n}+$, &c. be put R, and S for $k+lz^n+mz^{2n}+$ &c. Let the Area of the Curve be $z^0R^\lambda S^\mu$; then the Ordinate Applicate B C will be =

This is demonstrated after the same manner as the former Proposition.

Prop. 5. Theor. 3.

into $a+bz^n+cz^{2n}+dz^{2n}+8c$. and let $a+bz^n+cz^{2n}+dz^{2n}+8c$. and let $a+bz^n+cz^{2n}+dz^{2n}+8c$. Then $a+bz^n+cz^{2n}+dz^{2n}+8c$. Then $a+bz^n+cz^{2n}+dz^{2n}+8c$. Then $a+bz^n+cz^{2n}+dz^{2n}+8c$. Then $a+bz^n+cz^{2n}+dz^{2n}+8c$. In the latter Case =r. and r+x=S. S+x=1.1+x=v, &c. Then the Area will be 28 R multiply'd into $\frac{1}{re}$ $\frac{\frac{1}{n}b \cdot SfA}{r+1,e} z_0 + \frac{\frac{1}{n}C - \frac{e}{r}fB - \frac{e}{r}A}{r+2,e} z_2 + \frac{\frac{1}{n}d - \frac{e}{r}fC - \frac{e}{r}ZB - \frac{e}{r}A}{r-3,e}$ $73^{3} + \frac{-\frac{1}{2}fD - \frac{1}{2}gC - \frac{1}{2}hB}{r+4}$, &c. where A, B, r+4, e. c. denote the whole given Co-efficients of each Term in the Series with their Signs + and -, viz. A denotes the Co-efficient of the first Term 34, B the Co-efficient of the second Term -SfA, C the Co-efficient of the third Term $\frac{-\frac{1}{1}fB-igA}{r+2, e}$, and so on.

Demonstration.

According to Prop. Third.

Let the Ordinates of the Curves be, and their AZO RA 2. ... $\theta + \eta$, $eBz_{1} + \frac{1}{4} \frac{\partial + \eta}{\partial \eta} fBz_{2}$ +0+n 1 N B 234, &c. 3: + 0+2n, eCz²ⁿ +0 +2nfCz³ⁿ, &c. C70+2, RX D78+3"R eDz3*, &c.

ply'd into $\chi^{\theta-1} R^{\lambda-1}$, the Sum of the Areas $z^{\theta} R_{\lambda}$ into $A + Bz^{\eta} + C\chi^{2\eta} + D\chi^{3\eta} + &c.$ will be equal to the Area of a Curve which has that for an Ordinate. Therefore let the Corresponding Terms of the Ordinate be equal; and then a will become = 0:A, $\frac{0}{\lambda n} \int_{-\lambda n}^{\lambda} \int_{-\lambda n}^{0} \int_{-\lambda n}^{0} \int_{-\lambda n}^{\lambda} \int_{-\lambda n}^{0} \int_{-\lambda$ e C, &c. and thence $\frac{a}{\theta e} = A$. $\frac{b - \theta + 2\lambda n}{\theta + n}$. - 10 + 2 x 11 8 A - 10 + 11 + x 11 FB

Now put $\frac{\theta}{n}$ r. $r+\lambda=S$. $S,+\lambda=t$, &c. and in the Area z^0 $R^{\lambda} \times A + Bz^{\mu} + Cz^{2\mu} + Dz^{3\mu}$, &c. write the values of ABC found above, and there will come out the propos'd Series. Q. E. D.

And it is to be observed, that every Ordinate is resolved into a Series two ways: For the Index m may either be Affirmative or Negative. Let an Ordinate be proposed 3k-133

77/k7-123-mz4 this may If z be put for the Abscissa of the Curve AB, and R be put for $\frac{1}{2} + \frac{1}{$ a=-1. b=0. C=3k. e=m. f=-1, g=0. b=1. =_1.0-1=/.0=2,r=-2.S=__1¹: -1. Each of these Cases must be try'd; and if either of the Series be broken off and terminated, the Terms at length growing different, the Area of the Curve will be had in Finite Terms. So in the former Case of this Example, by writing in the Series the Values of a, b, c, e, f, g, b, a, b, r, s, e, v, all the Terms except the first vanish. ad infinitum, and the Area of the Curve becomes 2 k-122 1-m23. And this Area, by reason of the negative Sign, adjoyns to the Abscissa produced beyond the Ordinate. For every Affirmative Area adjoyns to both the Abscissa and Ordinate, but a Negative one falls on the contrary parts of the Ordinate, and adjoyns to the Abscissa produced, the Sign of the Ordinate remaining. By this means one of the Series, and sometimes both, is always terminated and finite; if the Curve can be squared Geometrically.

But if the Curve don't admit of such a Quadrature, both Series will be continued in infinitum, and one of 'em will converge and give the Area by approximation, except where r (by reason of the infinite Area) is either nothing or an Integer Number and Negative, or where $\frac{7}{e}$ is equal to Unity. If $\frac{7}{e}$ be less than Unity, that Series will converge in which the Index , is affirmative; but if greater than Unity, the other Series will converge. In one Case the Area adjoyns to the Abscissa drawn as far as the Ordinate, in the other Case it adjoyns to it produced beyond the Ordinate.

Note farther, that if the Ordinate be a Rectangle under the Rational Factor Q and the Surd irreducible Factor Rr, and the Side R of the Surd Fa-ctor does not divide the Rational Factor Q; then A-I will be = ; and R = I=R*: but if the Side R of the Surd Factor divide the Rational Factor And if the Sum of the Ordinates be put equal once, $\lambda = 1$ will be +1 and -1 and -1 to the Ordinate -1 by -1 cz²ⁿ -1 de -1 kc. multi- if it divide it twice, -1 will be -1 and $R^{\lambda} = R^{\pi+2}$: If thrice, $\lambda = 1$ will be $= \pi + 3$ and $R^{\lambda-1} = R^{\pi+3}$, and so on, $\mathfrak{C}c$.

If the Ordinate be a rational irreducible Fraction whole Denominator is composed of two or more Terms; the Denominator is to be resolved into all its first Divisors. And if there be any Divisor which has never another equal to it, the Curve is not Quadrable. But if there be two or more Divisors equal, one of them must be thrown away, and ftill there will be two others or more, which are equal amongst themselves and unequal to the former; one of these also must be rejected, and so of all others that are equal, if there still be more; then the Divisor that is lest, or the Product under all the Divisors which are lest, if there be more, must be put instead of R and Rthe reciprocal of the Square of R for Ra-', except where that Product is a Square, or a Cube, or a Biquadrate, &c. in which case the Side of it is to be put instead of R. and the Index of the Power 2, 3, of 4, taken negatively instead of A; and the Ordinate must be reduced to the Denominator R', R', R', or R', &c.

Let the Ordinate be 25 + 24 - 823 because this Fraction is irreducible, and the Divifors of the Denominator are equal, viz. z-1, z-1, z-1, z-1, z+2, & z+2, 1 reject one Divisor of either magnitude, and the product of the remaining $\chi = 1, \chi = 1$, $\chi = 2$, which is $\chi^3 = 2\pi + 2$. I put instead of R; and the Reciprocal of the Square of R which is $\frac{1}{R^2}$ or R^{-2} instead of Rx.1. Afterwards I reduce the Ordinate to the Denominator R2 or R1-A, and it becomes -921+823 $\frac{z^{2}-9z^{4}+8z^{3}}{z^{3}-3z^{4}+2|z^{2}}$, that is, $\frac{z^{3}\times8\cdot9z^{4}+z^{3}\times2\cdot3z+z^{3}|\cdot\cdot2}{z^{4}-3z^{4}+2|z^{4}}$. And thence is a=8. b=-9. C=0. d=-1, &c. B=2. f=-3. g=0. b=1. A=1=-2. A=1. a=1. b=1. a=1. b=1. a=1. b=1. a=1. b=1. a=these being put in the Series, the Area comes out 34+2; all the Terms in the Series, except the first, vanishing.

If lastly, the Ordinate be an irreducible Fraction, whose Denominator is a Product under the Rational Factor Q, and the Surd irreducible Factor R, you must find all the first Divisors of the Side R, and reject one Divisor of each magnitude; and by those Divisors that remain, if there be any, multiply the Rational Factor Q; and if that Product be equal to the Side R, or any

Power of that Side whose Index is an Integer Number; let that Index be m, and a-I will be $-\pi$ -m and $R^{\lambda} = R^{\pi-m}$, so that if the Ordinare be $\frac{3q^3-q^4x+9q^2xx-qqx^3-6gx^4}{qq-xx^3}$, because the Side R of the Surd Factor or $q3+qqx-qxx-x^3$ has the Divisors q+x, q+x, q-x, which are of two Magnitudes, I reject one Divisor of each Magnitude, and multiply the rational Factor q+x by the Divisor that is left q+x. And beqq - xx by the Divisor that is left q + x. And because the Product $q_3 + qqx - qxx - x_3$ is equal to the Side R, I put m = 1. and thence, since π is $\frac{1}{2}$, A-1 becomes = 4. Therefore I reduce the Ordinate to the Denominator R-4, and tis made $z_0 \times 2q^6 + 2q^5x + 8q^4xx + 8q^3x^3 \cdot 7qqx^4 \cdot 6qx^5 \times q^3 + qq$ $x - x^4 = \frac{4}{3}$. from whence a is $= 3q^6$. $b = 2q^5$, &c. $e=q^3 \cdot f = qq$, &c. $\theta = 1 = 0$. $\theta = 1 = 1$. $\lambda = -\frac{1}{4}$. r=1. $S=\frac{1}{4}.$ s=0. and these Values be. ing put in the Series, the Area comes out $\sqrt{43+aax-axx-x^2}$, all the Terms in the whole Series after the third, vanishing,

Prop. 6 Theor A.

If the Abscissa A B of a Curve be z, and R be be put in the room of $e + fz^n + gz^{2n} + bz^{2n} + bc$, &c. and S in the room of $k + lz^n + mz^{2n} + nz^{2n}$, &c. then let the Ordinate Applicate be $z^{\theta \cdot 1} R^{\lambda \cdot 1} S^{\mu \cdot 1}$ multiply'd into $a + bz^{\mu} + Cz^{2\mu} + dz^{3\mu}$, &c. if there be the Rectangles of the Terms e, f, g, b, &c. and k, l,

And if the numeral Co-efficients of thole Reckangles be respectively,

$$\vec{r} = \vec{r}$$
, $\vec{r} + \lambda = S$. $\vec{S} + \lambda = t$. $t + \lambda = v$. &c. $\vec{r} + \mu = \dot{S}$. $\vec{S} + = \dot{t}$. $t + \mu = \dot{v}$. $v + \mu = \ddot{w}$. &c. $\vec{S} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{w}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$. $\vec{v} + \mu = \ddot{v}$.

The Area of the Curve will be

$$z^{0} R^{\lambda} S^{\mu} \text{ into } \frac{\frac{1}{r}a}{\frac{1}{r+1}} + \frac{\frac{1}{r}b}{\frac{1}{r+1}} \cdot \frac{s}{e^{i}} - \frac{1}{r+1} \cdot \frac{f}{e^{i}} + \frac{g}{r+2} \cdot \frac{e^{i}}{r+2} \cdot \frac{g}{r+2} \cdot \frac{e^{i}}{r+2} \cdot \frac{g}{r+2}$$

first Term, with its Sign | or -, B the given Terms 4, b, c, &c. e, f, g, &c. k. l, m, &c. one or

Where A denotes the given Co-efficient of the Co efficient of the fecond Term, C the given

more may be wanting. This Proposition is demonstrated after the manner of the former, and what was observed there takes place here also. But the Series of such Propositions as these run on ad infinitum, and the Progression of the Series is evident.

Prop. 7. Thear. 5.

If R be put instead of $e + /\chi_0 + g\chi^{2n}$, &cc. as above, and in the Ordinate of any Curve $\chi \theta + m\sigma R^{n} + \tau$ there remain the given Quantities θ , n, e, f, g, &cc. and instead of σ and τ be put any Integer Numbers successively, and if the Area of the G curves be given which are defined. one of these Curves be given, which are denoted by innumerable Ordinates coming out in these forms, if the Ordinates be Binomials in the Vinculum of the Root, or if the Areas of two of those Curves be given; if the Ordinates be Trinomials in the Vinculum of the Root, or the Areas of three of those Curves; if the Ordinates are Quadrinomials in the Vinculum of the Root, and so on infinitely: I say, that the Areas of all these Curves will be given. For Nomes I here take all the Terms in the Vinculum of the Root, as well defi-cient as entire, the Indexes of whose Powers are in an Arithmetical Progression. So the Ordinate 44-4x3+x4 by reason of the two different Terms between 44 and ax3 ought to be reckoned a Quinquenomial. But $\sqrt{44+x4}$ is a Binomial, and a Trinomial, seeing the Progression now proceeds by greater differences. This Proposition is thus demonstrated.

Cafe 1:

Let the Ordinates of two Curves be pzg-1Rx-1

Let the Ordinates of two Curves be $p\chi^{6+1}R^{3-1}$ and $q\chi^{6+1}R^{3-1}$, and their Areas $p\Lambda$ and qR, R being the Trinomial Quantity $e+f\chi^{n}+g\chi^{2n}$. And by Prop. 3. fince $\chi^{6}R^{3}$ is the Area of a Curve whose Ordinate is $\theta:\frac{1}{2}\frac{1}{N}\frac{1}{N}f\chi^{n}+\frac{1}{2}\frac{1}{N}\frac{1}{N}g\chi^{2n}$ multiply'd into $\chi^{6-1}R^{3-1}$, subduct the former Ordinates and Areas from this latter Ordinate and Area, and there will remain 0 + 0 + 0 = 0 there will remain 0 + 0 + 0 = 0 there will remain 0 + 0 + 0 = 0 multiply'd into $z^{\theta-1}$ $R^{\lambda-1}$ the new Ordinate of the Curve; and z^{θ} R^{μ} —pA—qB its Area. Put θe —p, and $\theta + \lambda u f$ = q and the Ordinate will be found +2An 87²ⁿ multiply'd into 28-1 RA-1, and the Area 30 Rh—0eA— f B—A n f B. Divide both by 05+2 Ang, and call the Area that will come out C, and taking r at pleasure, r C will be the Area of a Curve whose Ordinate is $r \neq 0$ + $a^{n-1} R^{n-1}$. And after the same manner that from the Areas p A and q B we find the Area r C agreeing to the Ordinate rzo x 21-1 R. 1, we may from the Areas q B and rC find a fourth Area, as S D, agreeing to the Ordinate $S_{\zeta_0}^{0+3n-1}$ $R^{\lambda-1}$, and so on infinitely. And from the Areas B and A there is a like Ratio of Progression towards a contrary part. If any of the Tetms θ , $\theta + \lambda u$, and $\theta + \lambda x u$ be wanting, and break off the Series, assume the Area p A in the beginning of one Progression, and the Area q B in the beginning of the other and from the forms A the beginning of the other, and from these two Areas will be given all the Areas in both Progressions. Vol. II.

And on the contrary, from any two other Areas affumed, one may go back by an Analysis to the Areas A and B, so that from these two Areas given, all the rest may be given likewise. Q. E. D. This is the case of those Curves where 0 the Index of z is encreased or diminished by a perpetual addition or subduction of the Quantity n. The other is the case of those Curves where the Index a is encreased or diminished by Unites.

Cafe 2.

If the Ordinates $p\chi^{0-1}$ R^{λ} and $q\chi^{0}+r^{-1}$ R^{λ} , whose corresponding Areas are p A and q B, be multiply d by R, or $e+f\chi r-f\chi r^{2}$, and afterwards be a gain divided by R, they become $pe + pfz^n + pg\chi^{2n}$ $\chi \zeta^{\theta-1}$ R^{\lambda-1}, and $qe\chi^n + qf\chi^{2n} + qg\chi^{2n}\chi \chi^{2+1}$ R^{\lambda-1}. And by the 3d **Prop.** $a\chi^{\theta}$ R^{\lambda} is the Area of a Curve whose Ordinate is 0 so + 0 afz" + 0 agz" multiply'd into ze-1 Rx-1, and bze-1-Rx is the Area of a

Curve whose Ordinate is the bfz-1-1 bfz-1-1 bgz-3" 十22月 + >1 multiply'd into $z^{\theta-1} R^{\lambda-1}$. The Summ of these 4 Areas is $pA+qB+az^{\theta}R+bz^{\theta}+aR^{\lambda}$, and the Summ of their corresponding Ordinates.

If the First, Third and Fourth Term be separ rately put equal to nothing; by the first Term, $\theta = -pe$ will be made 0 = 0 = -pe, by the Fourth $-\theta = -pe$ and by the Third (striking out p and q) $\frac{2ag}{f}$ = b. From whence the fecond Term becomes Anaff—4Anage, and therefore the Summ of the four Ordinates is Anaff-4Anage 23++1 RA-1, and the Summ of fo many corresponding Areas is az 0 Rh + 245 z 0 + 1 Rh 0 $aA = \frac{2b+2u+4\lambda n}{f} agB$. Divide these Summs by $\frac{\lambda n eff - 4\lambda n ege}{\lambda n}$, and if the latter Quote be called D; D will be the Area of a Curve whose Ordinate is the first Quote 20+1-1R. And after the same way by putting all the Terms of the Ordinate except the first equal to nothing, the Area of a Curve may be found whose Ordinate is ze-1RA-1. Let that Area be called C, the same way that the Areas C and D are found from the Areas A and B, two other E and F may be found from C and D, agreeing to the Ordinates x6-1 RA-2 and x6+x-1RA-2, and so on in infinitum: And by a contrary Analysis one may proceed back again from the Areas E and F to the Areas C and D, and thence to

the Areas A and B, and others which follow in $[x^{\theta-1}]$ into $e+fx^{n}+gx^{2n}+8cc$, by affurning any Therefore if the Index a be onthe Progression. created or diminished by a continual addition or Quantity for s, and putting = S and z = x, change subduction of Unities; and of the Areas, corresponding to the Ordinates coming out in these be $\frac{y}{y} = \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y\theta - y}{y}$ into $\frac{y}{y} = \frac{y}{y} + \frac{y}{$ thers are given in infinitum. Q. E. D.

Cafe 3.

And by these two Cases conjoined, if both the Index 8 be any how increased or diminished by the continual addition or subduction of n; and the Index A, by the perpetual addition or sub-duction of Unity, the Areas corresponding to the several arising Ordinates, will be given.

And by a like encrease, if the Ordinate be expressed by 4 Nomes in the Radical Vinculum, and 3 of the Areas are given; or if it be express'd by 5 Nomes and 4 of the Areas given, and so on: All the Areas will be given which can be generated by adding or subducting the Number , to or from the Index 0; or Unity, to or from the Index A And 'tis the same case with Curves whose Ordinates are expressed by Binomials and one Area of those which are not Quadrable Geometrically, is

Pres. 8. Theor. 6.

If for $e + fz_n + gzz_n + 8cc$, and $k + fz_n + mzz_n + 8cc$.

you put R and S as before, and in the Ordinate of any Curve 20+ no Rx++SM+v the given Quantities \emptyset , n, λ , μ , e, f, g, k, l, m, &c. semain; and that for σ , τ , and ν , any Integer Numbers be successively written, and if the Areas of two of the Curves are given which are demoted by the Ordinates so arising, if the Quantities R and S are Binomials; or if the Areas of three of the Curves be given, if A and S consist conjointly of 5 Nomes; or if she Areas of 5 Curves be given, when S and R consist jointly of fix Nomes, &c. and so on in infinitum: I say, the Areas of all the Curves will be given.

The Demonstration is like that of the former Proposition.

Prop. 9. Theor. 7.

The Areas of these Curves are equal to one another whose Ordinates are as the Fluxions of the Abscissa.

For the Rectangles under the Ordinates and the Fluxions of the Abscissa are equal, and the Fluxions of the Areas are as those Rectangles.

Corol. 1.

If any Relation between the Abscissa of two Curves be assumed, and thence (by Prop. 1.) the Relation between the Fluxions of the Abscissa be fought, and the Ordinates be supposed reciprocally proportionable to the Fluxions; then innumerable Curves may be found, whose Areas shall be mutually equal to one another.

Corol. 2:

For so will every Curve whose Ordinate is

into another equal to it self, whose Ordinate will

Corol. 3.

And every Curve whole Ordinate is $z^{\theta-1}$ into $a+bz^n+cz^{2n}+8c$. \times $e+fz^n+gz^{2n}+8c$. by taking any Quantity for, and putting = S; and z=x, will change into another equal to it self whose Ordinate shall be $\frac{y}{n}x^{n\theta-n}$ into 1+6x1+6x21+&c. × +fx1+gx21+&c.

Corol. 4.

And every Curve whole Ordinate is zer into a+bzn+czzn+&c. x e+fz+gzin+&c. x. $\times \overline{k+1}$ $\overline{z}^n+m\overline{z}^{2n}+8c.$ μ , by taking any Quantity for v and putting $\frac{\pi}{v} = S$ and z = x, changes into another Curve equal to it self, whose Ordinate is $\frac{y}{x} \frac{x^{1} - y}{x^{2}} \text{ into } a + bx^{2} + cx^{2} + &c. \times x + fx^{2} + gx^{2}$ 1-8c \ × k+1x1-+ mx21-+ &c. 14

Corol. 5.

And every Curve whose Ordinate is 29-1 into $e + f z^n + g z^{2n} + & c$. by putting $\frac{1}{z} = x$, changes into another equal to it felf, whose Ordinate is $\frac{1}{x\theta+1} \times \theta + fx^{2} + g\zeta^{2} + - \&c.$ hat is $\frac{1}{x\theta+1+x\lambda}$ ×f-tex, , if there are two Names in the Vinculum of the Root, or $\frac{1}{x\theta+1+2\pi\lambda}\times g+fx^n+cx^{2\pi}\lambda$ if there are three Nomes, &c.

Corol. 6.

And every Curve whose Ordinate is 30-1 into e+tz"+gz=+&c. | xxk+1z"+mz=+&c. |4, by putting $\frac{1}{5} = x$, changes into another equal to it (elf, whose Ordinate is $\frac{1}{x\theta+1}xe+fx^{n}gx^{2n}+6xc.$ $\times k + |x^n + mx^{2n} + &c.|^{\mu}$, that is $\frac{1}{x\theta + 1 + n\lambda + n\mu}$ f+ex* | \x |+ kx* | \mu if there are two Nomes in the Vinculum of the Root, or $\frac{1}{x\theta+1-1}$ $\times g + fx^n + ex^{2n} | \lambda \times l + kx^n | \mu$, if there be three Nomes in the Vinculum of the former Root, and two in that of the latter; and so in others.

N. B. The two equal Areas in these two last Corollaries lie on opposite fides of the Ordinates: If the Areas in either Curve join to the Abscissa, the corresponding equal Area in the other Curve ad. joins to the Abscissa produced.

Corol

Corol 7.

If the Relation between the Ordinate y of any Curve and its Abscissa x be expressed by any adfected Equation of this form, ya into e-fy=zo-gy2=z2o+by3=z3o+&c.=z6into k+b=zo+my2=z2o+ &c. this Figure, assuming $S = \frac{n-M}{n}$, $x = \frac{1}{4} z^{\epsilon}$, and $\lambda = \frac{n-A}{aA + \beta n}$ changes into another equal to it felf, whose Abscissa x, from the Ordinate v being given, is determined by an Equation not affected; as 1 0 ax x e for + gv2n + bo3 + &c. | x x k + lor + mv2n+

Corol. 8.

If the Relation between the Ordinate , of any Curve, and its Abscissa z be determined by any adfected Equation in this Form, yainto effing g)21/22 = 28 into k+1/1/26 + my21/226 + &c. +2) into p-1 q y = 4 ry2 x -1 &c. then this Figure, assuming $S = \frac{1}{n} x = \frac{1}{12} x^2 \mu = \frac{aS + \beta n}{n - A}$ and $y = \frac{1}{12} x + \frac{1}{12} x$ astyn, changes into another equal to it self whose Abscissa z, from the given Ordinate v being given, is determined by an Equation less affected, as ve into e+fv+4gv2x+&c. =S#x# into k+lv+ mo24 + &c. + S'+x' into p+qv*+rv24 + &c.

Every Curve whose Ordinate is #2!-1 into 1 2 + 2 1 2 2 1 + &c. × + + 5 7 1 + 8 7 2 1 &c. | \lambda - 1 And lastly, by assuming these to be the most simple $+\frac{1}{2}$ +and there be affumed *=ez"+fz+"+gz"+2"+ puted. &c. | π , $\sigma = \frac{\tau}{\sigma}$, and $\Im = \frac{\lambda - \pi}{\sigma}$, changes into another equal to it self, whose Ordinate is 20 x a 1 bx7 And observe that the former Ordinate in the Co rollary becomes more fimple by putting h=1, or by putting $\tau = 1$, and by effecting, that the Radix of the Dignity may be extracted, whose Index is ω , or also by putting $\omega = -1$ and $\lambda = 1 = \tau = \sigma$ = π , that I may pass by other Cases, &c.

Corol. 10.

For ex +120+=+gz+2=+ &c. vezo 1 + v/zz+== $+1_{2}$ yz^{2} +2 1 +8 c. $k+1z^{3}$ $+mz^{2}$ +8 c. and n/z" 1+2"mx2"-1 + &cc. let R, r, S and s be substi tuted respectively, and then every Curve whose Ordinate is $\pi Sr + \varphi R^r$ into $R^{N-1} S^{\mu-1} \times 4s^{\mu} + bR_{\tau}|_{en}$ Let the Ordinate be $z^{n-1} \times 4 + bz^n + cz^{2n} + 8c$.

If it be $\frac{\mu - \nu \omega}{\lambda} = \frac{\nu}{\tau}$, $\frac{\tau}{\pi} = \varphi$, $\frac{\lambda - \pi}{\pi} = \vartheta$, and $\frac{\lambda - \tau}{\tau} + \frac{\lambda

putting Unitles for t, u, A or m, and by effecting that the Radix of the Dignity may be extracted; whose Index is o, or by putting o=-1 or μ=0.

Prop. 10. Prob. 3:

To find the most simple Figures with which any Curve may be Geometrically compared, whose Ordinate Applicate y, by an Equation not affected, is determined from having the Abscissa z given.

Cafe I.

Let the Ordinate be azd-1, and then the Area will be $\frac{\pi}{4}a\xi^{\theta}$, as will easily be collected from Prop. 9. by putting b=c=c=d=f=g=b and c=t.

Cafe 2.

Let the Ordinate be $az^{0.1} \times fz^n + gz^{2n} + &c.$ | $\lambda \cdot 1$ then if the Curve can be compared Geometrically with Realilineal Figures, it may be squared by Prop. 5. by putting b = o = c = d. If not, let it be changed into another Curve equal to it, whose Ordinate shall be $\frac{a}{\theta} \times \frac{\theta - \eta}{\pi} \times e + fx + gx^2 + &c.$ by Cor.2. Prop 9. Then if out of the Index of the Dignities -1 (by Prop. 7.) you reject the Unities till those Dignities become the least possible, you will then come to the most simple Figures that can be by this means collected. Then every one of these, (by Cor. 5. Prop. 9.) gives another which is sometimes yet more fimple. And from these, by Prop. 3. and Cor. 9. and 10. of Prop. 9. compared one with another, some yet more simple Figures come out.

Cafe 3.

Let the Ordinate be zer x a+bz*+cz2*+&c. xe+fzv+gzzv+&c.|x-1, then will this Figure, if squarable, be squared by Prop. 5. But if not, then the Ordinate must be distinguished into the Parts, v0 1 × 4 × e + fz" + gz2" + &c. | 1, z1 × bz" $\times e + f z^n - g z^{2n} + &c \rightarrow 1$, &c. and by Case s. the most simple Figures are to be found with which the Figures corresponding in those Parts may be compared; for then the Areas of the Figures corresponding to those Parts, and connected with their proper Signs + and -, will compose the whole Area fought.

Caje 4.

Let the Ordinate be $z^{n} \times a + bz^{n} + cz^{2n} + &c$. whose Ordinate is $x^9 \times a + bx^{olo}$. And observe, Prop. 9. changed into a more simple one, and then that the former Ordinate grows more simple, by compared with the most simple Figures according Vol. II.

If the Ordinate confist of different Parts, then the several Parts are to be esteemed as the Ordinates of so many different Curves, and those Curves, as many as are Quadrable, are to be squared, and their Ordinates subducted from that of the whole Curve.

Corol. 1.

Hence every Curve whole Ordinate is the Square Root of its affected Equation, may be compared with the most simple Figures, whether Rectilineal or Curvilineal. For that Root always confifts of two Parts, which considered severally, are not affected Roots of Equations. Let the Equation be proposed aay) + 22))=243) + 2x3y - 24 its Root when extract. ed will be $y = \frac{43 + 23 + a\sqrt{44 + 223 - 24}}{4}$ whose ra-44+22 tional part $\frac{a^3+z^3}{4a+zz}$ and its Surd or Irrational Part a 1/44 + 2423 - 24 are the Ordinates of Curves that

ed by any affected Equation, which by Cor. 7.

The Forms of the

to Prop 8. and Cor. 6, 9, and 10, of Prop. 9 as Prop. 9. doth not go into an Equation not affect-was done in Case 2 and 3. ed, is either, if squarable at all, squared by this Proposition, or else is compared with the most simple Figures possible. And by this means is every Curve squared, whose Equation consists of three Terms; for if that Equation be affected, tis changed into one not so by Cor. 7. Prop. 9, and then by Cor. 2. and 5. of Prop. 9. passing into a most simple one, either gives the Quadrature of the Figure, if it be squarable, or a most simple Curve, with whom it may be compared.

Corol. 3.

And every Curve whose Ordinate is determined by any adfected Equation, which by Cor. 8. of Prop. 9. passes into a Quadratick affected Equation; is either squared by this Prop. and its sinst Corollary, if quadrable at all, or else is compared with the most simple Figures, and with which it admits a Geometrical Collegion admits a Geometrical Collation.

Scholium:

When Eigures are to be squared, it will be too troublesome always to have recourse to these General Rules: wherefore it is better once to fquare the most simple and useful Figures, and then to keep Tables of such Quadratures, to which to have recourse whenever such a kind of Curve is to be squared. Of this kind are the two following Tables in which a denotes the Absolute and ing Tables; in which z denotes the Abscissa, y the Restangular Ordinate, e the Area of the Curve to be squared, and d, e, f, g, b and g represent given Quantities with their Signs + and —.

A TABLE of the more Simple Quadrable Curves.

Form 1.

$$dz^{n-1} = y$$
Form 2.

$$\frac{dz^{n}}{ce + 2efz^{n} + ffz^{2n}} = y$$
Form 3.

1.
$$dz = \sqrt{e + fz^{n}} = y$$

$$2 \cdot dz = \sqrt{e + fz^{n}} = y$$

$$3 \cdot dz = \sqrt{e + fz^{n}} = y$$

$$4 \cdot dz = \sqrt{e + fz^{n}} = y$$

$$5 \cdot dz = \sqrt{e + fz^{n}} = y$$

$$6 \cdot dz = \sqrt{e + fz^{n}} = y$$

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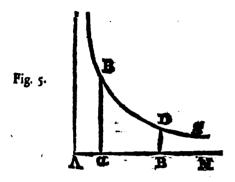
$$6 \cdot dz = \sqrt{e + fz^{n}} = y$$

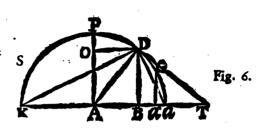
$$6 \cdot dz = \sqrt{e + fz^$$

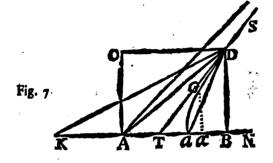
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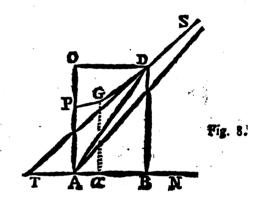
3.
$$\frac{dz^{3n-1}}{\sqrt{e+fz^n}} = y$$
. $\frac{16ee-8efz^n+6ffz^{2n}}{15n^{f_3}}dR = t$.
4. $\frac{dz^{4n+1}}{\sqrt{e+fz^n}} = y$. $\frac{-96e^3+48eefz^n-36effz^{2n}+30f^3z^{3n}}{105nf4}dR = t$.

A TABLE of those more Simple Curves which may be compared with the Ellipsis and the Hyperbola.





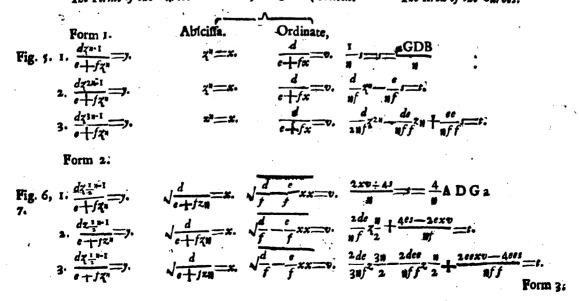




The Forms of the Curves.

Of the Conick Section.

The Area of the Curves.



Form 4

Fig. 6.

7. 8.

1.
$$\frac{d}{z}\sqrt{e+f}z_{11}=y$$
.

 $\frac{1}{z_{10}}=xx$.

 $\sqrt{f+exx}=v$.

 $\frac{4de}{nf}$ into $\frac{v_3}{2ex}=s=s=\frac{4de}{nf}$ into a GDT, or APDB÷TDB

Or thus, $\frac{1}{z_{10}}=x$.

 $\sqrt{fx+exx}=v$.

 $\frac{8dee}{nf}$ into $s=\frac{1}{2}xv$.

 $\frac{fv}{4e}+\frac{fv}{4eex}=t=\frac{9dee}{nff}$ into aGDA+

 $\frac{d}{4ex}=t$

2. $\frac{d}{z^{n}+1}\sqrt{e+f}z_{11}=y$.

 $\frac{1}{z_{10}}=xx$.

 $\sqrt{f+exx}=v$.

 $\frac{2d}{n}$

APDB, or $\frac{2d}{n}$

APDB.

Or thus, $\frac{1}{z_{10}}=x$.

 $\sqrt{fx+exx}=v$.

 $\frac{4de}{nf}$ into $s=\frac{1}{2}xv$.

 $\frac{fv}{2e}=t=\frac{4de}{nf}\times a$ GD Ks

3. $\frac{d}{z^{2n}+1}\sqrt{e+f}z_{11}=y$.

 $\frac{d}{z_{10}}=x$.

 $\sqrt{fx+exx}=v$.

 $\frac{d}{n}s=t=\frac{d}{n}\times a$ GD B or BD P K.

4. $\frac{z^{3n}+1}{d}\sqrt{e+f}z_{11}=y$.

 $\frac{1}{z_{10}}=x$.

 $\sqrt{fx+exx}=v$.

 $\frac{3dfs-2dv_3}{6ne}=t$.

Fig. 6. I.
$$\frac{d}{2\sqrt{e+f}\chi^{n}} = y. \frac{1}{2n} = xx. \int fx + exx = v. \frac{4d}{nf} \text{ into PAD or into aGDA}$$
Or thus,
$$\frac{1}{2n} = x \int fx + exx = v. \frac{8de}{nf} \text{ into } s = \frac{1}{2}xv - \frac{fv}{4e} = s = \frac{8de}{nf} \text{ into aGDA}.$$

$$2. \frac{d}{2^{n+1}\sqrt{e+f}\chi^{n}} = y. \frac{1}{2^{n}} = xx. \int f + exx = v. \frac{2d}{ne} \text{ into } s = xv = e = \frac{2d}{ne} \text{ into POD, or into AODG a.}$$
Or thus,
$$\frac{1}{2n} = x. \int fx + exx = v. \frac{d}{nf} \text{ into } \frac{1}{2}xv + s = s = \frac{d}{nf} \text{ into a DG a.}$$

$$3. \frac{d}{2^{2n+1}\sqrt{e+f}\chi^{n}} = y. \frac{1}{2n} = x. \int fx + exx = v. \frac{d}{ne} \text{ into } 3 \div 2xv = t = \frac{d}{ne} \text{ into } 3 \approx DGa \div \Delta aEB.}$$

$$4. \frac{d}{2^{2n+1}\sqrt{e+f}\chi^{n}} = y. \frac{1}{2^{2n}} = x. \int fx + exx = v. \frac{1}{ne} \text{ into } 3 \div 2xv = t = \frac{d}{ne} \text{ into } 3 \approx DGa \div \Delta aEB.}$$

$$4. \frac{d}{2^{2n+1}\sqrt{e+f}\chi^{n}} = y. \frac{1}{2^{2n}} = x. \int fx + exx = v. \frac{1}{ne} \text{ into } 3 \div 2xv = t = \frac{d}{ne} \text{ into } 3 \approx DGa \div \Delta aEB.}$$

$$6 = \frac{d}{2^{2n+1}\sqrt{e+f}\chi^{n}} = y. \frac{1}{2^{2n}} = x. \int fx + exx = v. \frac{1}{ne} \text{ into } 3 \div 2xv = t = \frac{d}{ne} \text{ into } 3 \approx DGa \div \Delta aEB.}$$

From 5.

1.
$$\frac{dz_{N-1}}{e+fz_{N}+gz_{2}} = y$$
. $\sqrt{\frac{d}{e+fz_{N}+gz_{2}}} = x$. $\sqrt{\frac{d}{g}+\frac{ff-4eg}{4gg}} = x$. $\frac{xv-2i}{n} = t$.

Or thus, $\sqrt{\frac{dz_{1}n}{e+fz_{N}+gz_{2}n}} = x$. $\sqrt{\frac{d}{g}+\frac{ff+4eg}{4gg}} = x$. $\sqrt{\frac{d}{g}+\frac{ff+$

Form 6. where p is put for $\sqrt{ff-4eg}$.

$$\frac{dz_{\frac{1}{4}n-1}}{e+fzn+gz_{3}n} = y. \begin{cases}
\sqrt{\frac{2dg}{e-p+2gz_{3}n}} = x. & \sqrt{d+\frac{-f+p}{2g}}xx = v. \\
\sqrt{\frac{2dg}{f+p+2gz_{3}n}} = \xi. & \sqrt{d+\frac{-f+p}{2g}}\xi\xi\Upsilon.
\end{cases}$$

$$\frac{2xv-4s-2\xi\Upsilon+4e}{np} = s.$$

$$\sqrt{\frac{2dezn}{f+p+2gz_{3}n}} = x. & \sqrt{d+\frac{-f+p}{2g}}\xi\xi\Upsilon.
\end{cases}$$

$$2. \frac{dz_{\frac{1}{4}n-1}^{2}}{e+fzn+gz_{3}n} = y. & \sqrt{\frac{2dezn}{fzn+pzn+2e}} = \xi. & \sqrt{d+\frac{-f+p}{2e}}\xi\xi=\Upsilon.
\end{cases}$$

$$\frac{4s-2nv-4e+2\xi\Upsilon}{np} = s.$$

Form 7.

1.
$$\frac{d\sqrt{e+fz^n+gz^{2^n}}}{\sqrt{g+fz^n+gz^{2^n}}}$$
 $\sum_{z=1}^{z=1} \frac{\sqrt{g+fz+gxz}}{\sqrt{g+fz+e\xi\xi}}$ $\sum_{z=1}^{z=1} \frac{\sqrt{g+fz+gxz}}{\sqrt{g+fz+e\xi\xi}}$ $\sum_{z=1}^{z=1} \frac{\sqrt{g+fz+gxz}}{\sqrt{g+fz+e\xi\xi}}$ $\sum_{z=1}^{z=1} \frac{\sqrt{g+fz+gxz}}{\sqrt{g+fz+e\xi\xi}}$ $\sum_{z=1}^{z=1} \frac{\sqrt{g+fz+e\xi\xi}}{\sqrt{g+fz+e\xi\xi}}$

Fig.6, 2, $dz^{y-1}\sqrt{e+fz^{y}+gz^{2y}}=y$, $z^{y}=x$. $\sqrt{e+fx+gxx}=y$. $\frac{d}{y}e=e=\frac{d}{y}$ into a G D F:

3.
$$d\zeta^{2n-1}\sqrt{e+fz_n+g\zeta^{2n}}=y$$
. $\zeta^n=x$. $\sqrt{e+fx+gxx}=v$. $\frac{d}{3ng}v_3-\frac{df}{2ng}i=e$.
4. $d\zeta^{2n-1}\sqrt{e+f\zeta^n+g\zeta^{2n}}=y$. $\zeta^n=x$. $\sqrt{e+fx+gxx}=v$. $\frac{6dgx-5df}{24^ngg}v_3+\frac{5dff-4deg}{16ngg}i=f$

Form 8:

Fig. 6.1.
$$\frac{dz^{n-1}}{\sqrt{e+fzn} + gz^{2n}} = x\sqrt{e+fx+gxx} = 0.8 \frac{dgs-4dgxv-2dfv}{4^{neg-nff}} = \frac{8dg}{4^{neg-nff}} \times eGDB+\Delta DBA.$$

2. $\frac{dz^{2n-1}}{\sqrt{e+fzn} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{4dfs+2dfxv+4dev}{4^{neg-nff}} = z\frac{dz^{2n-1}}{\sqrt{e+fzn} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{4dfs+2dfxv+4dev}{4^{neg-nff}} = z\frac{dz^{2n-1}}{\sqrt{e+fzn} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dff}{\sqrt{e+fzn} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dff}{\sqrt{e+fzn} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dfg}{\sqrt{e+fzn} } + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dfg}{\sqrt{e+fx-gx} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dfg}{\sqrt{e+fx-gx} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dfg}{\sqrt{e+fx-gx} + gz^{2n}} = z\sqrt{e+fx+gxx} = 0.\frac{2dfg}{\sqrt{e+fx-gx} + gz^{2n}} = z\sqrt{e+fx-gx} = z\sqrt{e+fx-g$

Form 10:

Fig. 6, 1.
$$\frac{dz^{n+1}}{g+bz_{10}} = y \sqrt{\frac{d}{g+bz_{10}}} \times \sqrt{\frac{df}{b} + \frac{eh-fg}{b}} \times \sqrt{\frac{2xv-4s}{uf}} = \frac{4}{uf} ADGu.$$

$$2 \cdot \frac{dz^{n+1}}{g+bz_{10}} = y \cdot \sqrt{\frac{d}{g+bz_{10}}} \times \sqrt{\frac{df}{b} + \frac{eh-fg}{b}} \times \times \sqrt{\frac{4gs-2gxv+2dv}{x}} = f.$$

Form 114

1.
$$dz^{a_1} \sqrt{\frac{e+fzu}{g+bzu}}$$
 $\sqrt{\frac{eb-fg}{b}} + \frac{f}{b}xx = 0$ $\sqrt{\frac{eb-fg}{b}} + \frac{f}{b}xx = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} + \sqrt{\frac{eb-fg}{g+bzu}} = \frac{1}{2} \cdot \sqrt{\frac{eb-fg}{g-b}} + \frac{f}{b}xx = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} = \frac{2d}{ub} = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} = \frac{2d}{ub} = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} = \frac{2d}{ub} = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} = \frac{2d}{ub} = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} = \sqrt{\frac{eb-fg}{g+bzu}} = 0$ $\sqrt{\frac{eb-fg}{g+bzu}} n these Tables the Series of the Curves, of any other Forms remaining, by help of Prop. the Third and Fourth, produced both ways in infinitum; and Fourth, produced both ways in infinitum.

In the First Table, in the Numerators of the Form, may be continued both ways in infinitum; viz. In the First Table, in the Numerators of the Areas of the 3d. and 4th. Form the Numeral Coefficients of the Initial Terms (2,-4, 16,-96, 868, &c.) are generated by multiplying the Numbers - 2, -4, -6, -8, -10, &c. into one another continually; and the Co-efficients of the subsequent Terms are divided from the Initial ones, by multiplying them gradually. In the Third Form, by $-\frac{3}{4}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, $-\frac{7}{6}$, and in the Fourth $-\frac{7}{8}$, $-\frac{7}{8}$, $\frac{9}{10}$, 6c and the Co efficients of the Denominators, 3, 15, 105, &c. are produced by multiplying the Numbers, 1, 3.

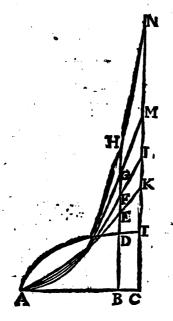
the Sign of the Number n: So, for instance, the Curve $\frac{d}{\sqrt{e-1/\chi^n}} \to \text{becomes} \frac{a}{z_{\frac{1}{2}n} + 1} \sqrt{fe\chi_n}.$

Prop. 9. Theor. 8.

Let ADIC be any Curve having its Ableissa AB=2 and its Ordinate BD=7; and let ABKC be another Curve whose Ordinate BE is equal to the Area of the former ADB divided by Unity; and let AFLC be a Third Curve, whose Ordinate BE 5, 7, 9, &c. into one another continually.

But in the Second Table, the Series of the B divided by I; and let AGMC be a Fourth Curves of the First, Second, Fisth, Sixth, Ninth and Tenth Form, are found by Division alone; and of the AFB of the Third divided by Unity; and let AHNC nate BF, is equal to the Area of the Second A

AHNC be a Fifth Curve whose Ordinate BH is equal to the Area of the Fourth AGB divided by Unity, and so on in infinitum. And let A, B, C, D, E, &c: be the Areas of the Curves whose Ordinates are y, zy, z'y, z'y, z'y, &c. and whose common Abscissa is z.



Let any Abscissa AC=t be given, and let BC=t-z=x, and let P, Q, R, S, T, &c. be the Areas of Curves having for their Ordinates y, xy, x^2y , x^2y , &c. and their common Abscissa z.

Let all these Areas rerminate at the whole given Abscissa AC, and at the Ordinate given in Posttien and infinitely produced CI: And then shall the first of the Areas thus posited, ADIC be=A-=P: The Second ABKC=\$A-B=Q. The Third AFLC=\$\frac{ttA-2tB+C}{2}=\frac{1}{2}R\]. The Fourth AGMC=\$\frac{t3A-3ttB+3tC-D}{6}=\frac{1}{6}S\]. The Fifth AHNC=\$\frac{t4A+t3B+6ttC-4tD+E}{24}=\frac{1}{2}T\].

Corol.

Whence if the Curves, whose Ordinates are y, zy, z'y, z'y, &c. or y, xy, x'y, x'y, &c. are squarable, the Curves ADIC, AEKC, AFLC, AGMC, &c. will also be squared; and the Ordinates BE, BF, BG, BH, will be proportionable to the Acreas of the Curves.

Scholium.

That the Fluxions of Flowing Quantities may be considered as First, Second, Third, Fourth Fluxions, &c. hath been said above: And these Fluxions are as the Terms of infinitely converging Series. Thus, suppose z^n a Flowing Quautity, and that by flowing it become z + o|v, then may it be resolv'd into this Converging Series $z^n + v \cdot c z^{n-1} + \frac{un-u}{2} o o z^{n-2} + \frac{u^2-3un+2u}{6} o^3 z^{n-3} + &c.$ In which Series the first Term z^n is the Flowing Quantity it self; the Second oz^{n-1} shall be the first Increment or the first

Difference, to which considered as just Nascens, the first Fluxion is proportional. The Third Term $\frac{nn-n}{2}$ oz n-2 will be the Second Increment or Difference to which considered as now Nascent, the Second Fluxion is proportional. The Fourth Term $\frac{n^2-3nn-1-2n}{6}$ of 2^{n-3} shall be the Fluents third Increment or Difference, and to which as Nascent, the Third Fluxion is proportional, Se. and so on infinitely.

These Fluxions may be expounded by BD, BE, BF, BG, BH, &c. considered as the Ordinates of Curves. As if the Ordinate BE (ADB) be a Fluent or flowing Quantity, the first Fluxion will be as the Ordinate BD: If BF be the Fluent (AEB) the first Fluxion of it shall be as the Ordinate BE, and the second as the Ordinate BE. If BH (AGB) be the Flowing Quantity, its Fluxions, considered as First, Second, Third and Fourth, shall be respectively as the Ordinates BG, BF, BE, and BD. (See the last Figure.)

Hence, in Equations which involve only two unknown Quantities, of which one is a Quantity uniformly flowing, and the other is any Fluxion of another Flowing Quantity. That other Fluent may be found by the Quadrature of Curves: Let its Fluxion be expounded or expressed by BD; and if this be the first Fluxion, seek the Area ADB BEXI: If it be the Second Fluxion, let the Area ABB BFXI be sought; if it be the Third Fluxion, let the Area AFB BCXI be sought; and the Area, when sound, shall be the Exponent of the Flowing Quantity sought.

And also in Equations which involve a Fluent and its first Fluxion without any other Fluent; or two Fluxions of the same Fluent; suppose the First and Second, the Second and Third, the Third and Fourth, Go. still without any other Fluent, then the Fluents may be found by the Method of the Quadrasure of Curves.

Let the Equation be aav = av + vv; supposing v = BE and $\dot{v} = BD$, z = AB and $\dot{z} = 1$. This Equation, by compleating the Dimensions of the Fluxions will become aav = avz + vvz, aav + vv = z. Suppose then v to flow uniformly, and let its Fluxion be $\dot{v} = 1$, then shall aa = z; and by squaring the Curve whose Ordinate is aa = zv + vv scisson be v = zv + vv. Suppose the zv + vv =

Again, let the Equation be $aa v = a \cdot + vv$, and let v be = BF, v = BE, v = BD, and z = AB:

Then by the Relation between v and v or BD and BE, the Relation between AB and BE will be found as in the Example above: after which, by this Relation may the Relation between AB and BF be found, if the Curve AEB be squared.

Such Equations as involve three unknown Quantities may fometimes be reduced to such as involve only two Unknown Quantities; in which Cases the Fluents will be found from the Fluxions,

Cerol. 2.

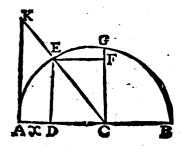
If n be supposed equal to any Term in the sollowing Series, 1, 2, 3, 4, 5, 6, 7, Se. Every Curve whose Ordinate is $\frac{x-n}{\sqrt{dx-x}}$ will be squared by this Series, and come out in finite Terms.

If m be equal to any Term in this Series, o, 1,

2, 3, 4, 5, 6, 7, $\Im c$. Every Curve whose Ordinate into $\frac{x^m}{\sqrt{dx-xx}}$ depends upon the Quadrature of the &c. = P.

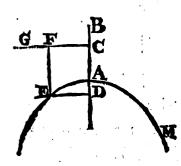
Circle: But if the Ordinate be $\frac{x^m}{\sqrt{dx+xx}}$, on that of the Hyperbola: And if on the Centre C, with the Diameter AB=d, the Circle AEB be described; and AD be made =x, and DE erecated at

Right-angles, and C E drawn: Then will the Se-



Acc divided by $\frac{d}{8}$, be equal to the Area of the Curve whose Ordinate is $\frac{x^2}{\sqrt{dx-xx}}$; after the same Manner if on the Centre C, and the Trans.

verse Axis AB=d, an Equilateral Hyperbola be described; as AE: Let AD=x and DE erected Normally, and CE drawn: Then shall the Se-



ACE divided by $\frac{d}{8}$ be equal to the Area of into $\frac{m-1}{m-6}$, &congle c the Curve whose Ordinate is $\frac{x_0}{\sqrt{dx-4xx}}$.

Corol. 4.

If m be supposed equal to any Term not included within the former Limits; The Curve whose Ordinate shall be, $\frac{x^m}{\sqrt{dx-1}-xx}$ can neither be squared. Vol. II.

red exactly, nor doth it depend on either the Circle or the Hyperbola; but yet is reducible to some more Simple Curve.

Theorem 3.

If A be the Area of a Curve, whose Abscissa is x, and Ordinate $x^m \sqrt{xx} - xx$; Let B be the Area of a Curve, whose Abscissa is the same x, and its Ordinate $x^{m-2n} \sqrt{rr} - xx$; and suppose $\sqrt{rr} - xx = y$. Then shall A be equal to $r^{2n}B$ into $\frac{m-1}{m-2}$ into $\frac{m-2}{m-2}$ into $\frac{m-2}{m-2}$ into $\frac{m-2}{m-2}$ $\frac{m-2}{m-2}$ $\frac{m-1}{m-2}$ $\frac{m-1}{m-2}$ $\frac{m-1}{m-2}$ into $\frac{m-3}{m-2}$ $\frac{m-2}{m-2}$ into $\frac{m-3}{m-2}$ $\frac{m-3}{m-2}$ into $\frac{m-3}{m-2}$ $\frac{m-2}{m-2}$ into $\frac{m-3}{m-2}$ $\frac{m-3}{m-2}$ into $\frac{m-3}{m-2}$

Corol v?

If m be equal to any Term of the following Series 1, 3, 5, 7, 9, &c. The Quadrature of the Curve, whose Ordinate is $x = \sqrt{rr + xx}$ will come out finite, and be expressed by the Theorem.

Cord. 2

If w be equal to any Term in this Series 2, 3, 4, 5.6. So. The Curve whose Ordinate is x 20 VIII will be exactly squared by this Theorem.

Corol. 3

If m be expounded by any Term different from those above mentioned; the Curve whose Ordinate is x \(\sqrt{rr} \frac{1}{4}xx \) is neither exactly quadrable, nor dependant on the Circle or Hyperbola; but yet is reducible to a more Simple Form.

Theorem 4.

If A be the Area of a Curve whole Ablcissa is x,

and its Ordinate $\sqrt{rr-xx}$: Let B be the Area of

another; whole Ablcissa x is the same with the

former; but its Ordinate $\sqrt{rr-xx}$: Then I say, $A = r^{2n} \text{ B into } \frac{m-1}{m} \text{ into } \frac{m-3}{m-4}$ $\frac{m-7}{m-6}, \text{ Sc.} = P.$ $\frac{1}{m} \frac{m-1}{m-2} \text{ into } \frac{m-1}{m-2} \text{ secs } y = -8.$ $\frac{r^4}{m-6} \text{ into } \frac{m-1}{m} \text{ into } \frac{m-3}{m-2} \text{ into } \frac{m-3}{m-4}$ $\frac{r^6}{m-6} \text{ into } \frac{m-1}{m} \text{ into } \frac{m-3}{m-2} \text{ into } \frac{m-3}{m-4}$ $\frac{r^6}{m-6} \text{ into } \frac{m-1}{m} \text{ into } \frac{m-3}{m-2} \text{ into } \frac{m-3}{m-4}$

Corol. I.

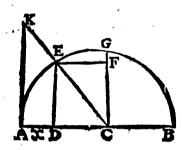
If m be equal to any Term of this Series 1, 3, 5, 7, 9, &c. the Curve whole Ordinate is will be found by this Theorem in finite Terms.

Corol. 2.

If n be equal to any Term in the following Series 1, 2, 3, 4, 5, 6, Se. The Curve whose Ordinate is is exactly quadrable by this Theorem.

Corol. 3.

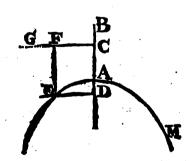
If m be equal to any Term of this Series o, 2, 4, 6, 8, 10, &c. The Quadrature of the Curve whose Ordinate is $\frac{x}{\sqrt{r_1-x_2}}$ depends upon the Quadrature of the Circle: For if from the Cen-



tre C a Circle AEG be described with the Radius CA = r; let CD be taken equal to x, and DE erected Normally in D; join CE. Then will the Sector C A E divided by Err, be equal to the

Area of the Curve, whose Ordinate is $\frac{x}{\sqrt{r_r - x_x}}$

And after the same manner, if to the Centre C and Semi-Transverse Axis Ca=r, an Equilateral



Hyperbola be described as EAM; let FC be drawn at Right-angles to AC, and equal x; then draw FE parallel to the Axis CA, till it meet the Hyperbola in E, and join E G: I say, the Hyper-

bolick Sector ACE divided by is equal to the

Area of the Curve whole Ordinate is

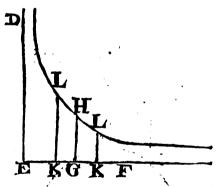
Corol. 4.

If m be expounded by any other Term different from any of the Preceeding ones; Then will the Curve whose Ordinate is be neither exactly squarable, nor dependant on the Circle, or Hyperbola; but yet is reducible to a more Simple Form.

Theorem 5.

Let A be the Area of the Curve whose Abscissa is x, and its Ordinate $\frac{x^m}{d-x}$, and let B be the Area of another Curve, having the same Abscissa x, and whose Ordinate is $\frac{x^{m-n}}{d-x}$; Then shall the Arez, $A = d_n B$ if the Ordinate be $\frac{x^{-1}}{d+x}$; Then the Area, $\frac{dx^{m-1} + ddx^{m-2}}{m-1}, &c. + d B.$

If m be equal to any Term in the following Series 0, 1, 2, 3, 4, 5, 6, &c. The Quadrature of the Curve, whose Ordinate is $\frac{x^m}{d+x}$, depends upon the Quadrature of the Hyperbola.



For drawing DE, EF at Right-angles, let EG be taken equal to d; and let GH be drawn Normal and Equal to EF. Then between the Alymptotes DE, EF, let an Hyperbola be described passing throw H; and taking GK = x, towards E in the first Case, and towards F in the latter let the Ordinary F. latter, let the Ordinate KL be drawn: Them shall the Area HGKL divided by dd be equal to the Area of the Curve, whose Ordinate is And from hence, supposing the Quadra-1+x. rure of the Hyperbola, will the Solid, generated by the Revolution of the Portion of a Ciffoid round the Diameter of the Generating Circle, be

given in Finite Terms.

as above. Let there be this Equation a-bx"= exy"y + dy2"y y. Suppose y , and it will stand a-bx=exv +dv v. This Equation, by squaring the Curve whole Abscissa is x and Ordinate v. gives the Area v; and the other Equation yay=v, by working backward to the Fluents, will give n+1 >1+1=v: whence the Fluent; is found, and from hence, and even in such Equations as involve Three unknown Quantities and which cannot be reduced to others which involve but two, the Fluents may sometimes be found by the Quadrature of Curves.

Let there be this Equation ax + bx | = rex -1y + sexry y-1-/yy: and let x=1. Then will the latter part rexr-1y: + sexryy:-1-fyy: by finding the Fluents in the Inverte Method, will become $ex^{rys} - \frac{f}{f+1}y^s + 1$; which therefore is as the Area of a Curve whose Abscissa is x and its Ordinate $ax^m + bx^n | r$, and from thence the Fluent y will be given.

Let there be an Equation, $x \times ax^m + bx^n|_{P} =$ $\sqrt{\frac{e+r_0}{e+r_0}}$, then the Fluent, whose Fluxion is x = xax - + bx P shall be as the Area of a Curve whose Absciss a and its Ordinate $ax^m + bx^n | l^n$; Also Ablchia is x and its Ordinate $ax^m + bx^n|l|$; Allo of that generating Circle; as the Summ of the double the Fluent, whose Fluxion is $\sqrt{e+fy_n}$ shall be as Motus Circularis, is to the Velocity of that Motus the Area of a Curve whose Abscissa is y, and its Ordinate $\frac{dy^{n-1}}{\sqrt{e+f}}$; that is (in Case 1, by Form 4. in Table 1.) as the Area $\frac{2d}{nf}\sqrt{e+f}n$. Let there. fore $\frac{2d}{af}\sqrt{e+fj^n}$ be equal to the Area of a Curve Math. at Groningen. whole Abscissa is x and Ordinate ax + bx 1, and

you will have the Fluent y. And observe, that every Fluent wich is collected from the First Fluxion may be increased or diminished by any Quantity that is not a Fluent: That which arises from a Second Fluxion may be augmented or lessened by any Quantity that hath no Second Fluxion: That which arises from a Third Fluxion may be encreased or diminished by any Quantity having no Third Fluxion; and so on infinitely.

After the Fluents are obtained from the Fluxions, if there be any doubt about the Truth of the Conclusion, the Fluxions of the Fluents found may be again gained, and compared with the Fluxions at first proposed; for if they then come out equal to those, you may suppose the Conclusion right; but if they are not thus equal, the Fluents must be corrected till they come out to. For both the Fluent may be assumed at pleasure, and that assumption may be corrected by putting the Fluxion of the Fluent so assumed equal to the Fluxion proposed, and then comparing the Homologous Terms among themselves.

In Phil. Trans. 252 p. 708. You have a Method for the Quadrature of Figures, Geometrically irrational; by Mr. 3. Craig.

See also, the same Author's Methodus Figurarum Lineis reclis & Curvis comprehensarum Quadraturas Vol. II. determinandi. Lond. 1685, 4°. And his Additions to it, in Philos. Trans. N. 235.

See also his Tractatus Mathematicus de Figurarum Curvilinearum Quadraturis & Locis Geometricis.

Lond. 1693, 4°.
Vera Circuli & Hyperbola Quadratura in propria sua Proportionis specie inventa & demonstrata, per

Jac. Gregory, Patavii, 4.

Le Grand & Fameux Probleme de la Quadrature du Circle resolu Geometriquement par le Circle & la Ligne Droite, per M. Mallement de Messange. Paris, 1686. 12mo. See Phil. Transaction, N. 185. where this Book is refuted by Cluverius, M. D. R. S. S.

De Quadratura Circuli, &c. per T. H.bbs. This Book Dr. Wallis hath twice refuted.

In Philof. Collett. N. 7. you have Mr. Leibnitz's Method for the Quadrature of the Circle.

In Philof. Tranf. N. 196. you will find Dr. Wallis's Quadrature of the Testudo veliformis. And in N. 207. the same thing is solved by Dr. Gregory. Mr. Caswell Aftr. Profess. of Oxford allo in Philos. Trans. N. 217. gives a Quadrature of a Portion of the Epicycloid; and after this, in the next Transactio. Mr. Halley, Savilian Professor of Geometry in Oxon, advances a general Propolition for measuring all Cycloids and Epicycloids; which is this, That the Area of any Cycloid or Epicycloid, whether Primary, Contracted or Prolate, is to the Area of the generating Circles and the Areas of the Parts generated in the formation of those Curves, are to the Areas of the Segment Circularis.

In Philos. Transatt. N. 245. Mr. Craig gives us the Quadrature of the Logarithmick Curve.

In the Memoires de L' Academie des Sciences, there is (in the Year 1699) a Quadrature of the Infinity of Segments, Sectors and other Spaces in the Vulgar Cycloid by Mr. Bernoulli, Professor of

In the All. Erud. Lipfie for Ollob. 1683, you have a Method by Mr. Tschirnhause, of determining either the Quadrature of any Geometrical Figures, or the Impossibility of the same. And in May, 1684, he published in the same ABa another Papet concerning the Quadrature of Curvilinear Figures.

In Phil. Trans. N. 284, there is a Specimen of a general Method for determining the Quadra-

cures of Figures, by Mr. 3. Craig. And in N. 278. one of Mr. de Moivre for the squaring of some kinds of Curves, or reducing them to more simple ones. Thus, Let A be the Area of a Curve whole Abscissa is x, and its Ordinate Applicate xm/dx-xx. Let B be the Area of a Curve whose Abscissa is the same as that of the former, but its Ordinate x - Jdx-xx; Ler $\sqrt{dx-xx}=y$, then shall A be=diB into $\frac{2m+1}{2m+4}$ into $\frac{2m-1}{2m+2}$ into $\frac{2m-3}{2m}$ into $\frac{2m-5}{2m-2}$ into, $\Im c = P$. $\frac{1}{m+2} x^{\frac{1}{m+1}} y^{\frac{3}{2}} = -2 \left[\frac{d}{m+1} \operatorname{into} \frac{2m+1}{2m+4} x^{\frac{1}{m}-2} y^{\frac{3}{2}} \right]$ $R = -\frac{dd}{m} \operatorname{into} \frac{2m+1}{2m+4} \operatorname{into} \frac{2m-1}{2m+2} x^{\frac{1}{m}-3} y^{\frac{3}{2}} = -S.$ $-\frac{d^{3}}{m-1} \operatorname{intC} \frac{2m+1}{2m+4} \times \frac{2m-1}{2m+2} \times \frac{2m-3}{2m} \times \frac{2m-3}{2m} = T_{1} & \text{where}$ Where observe,

1. That n is supposed to be an Integer and Affirmative Number.

2. That the Quantity do B in the Series defign'd by P is to be multiplied into as many of the Terms as there are Unites in n.

3. That so many following Series design'd by -Q, -R, -S, -T, &c. may be taken as there are Unites in n.

Which to illustrate by an Example or two.

If n=1, then I say $A=d^nB$ into $\frac{2m+1}{2m+4}$ $\frac{1}{m+2}$ $x^{m-1}y^2$. And if n=2, then $A=d^nB$ into $\frac{2m+1}{2m+4}$ into $\frac{2m-2}{2m+2} - \frac{1}{m+2}x^{m-1}y^3 - \frac{d}{m+1}$ into $\frac{2m-1}{2m+4}$ into $x^{m-2}y^3$.

4. If y be equal to $\sqrt{dx-xx}$; Then A will be =Q-R+S-T, &c. +P.

Corol. 1

If m be put equal to any Term in the following Series— $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{9}{4}$, &c. The Quadrature of the Curve, whose Ordinate is $x^m \sqrt{dx - xx}$, or $x^m \sqrt{dx + xx}$, comes out finite and is exhibited by our Series; which that we may shew by an Example: Let the Area of the Curve, whose Ordinate is $x - \frac{1}{2} \sqrt{dx - xx}$ be to be investigated: Imagine this Curve to be compared with another, whose Ordinate is $x - \frac{3}{2} \sqrt{dx - xx}$. Because in this Case n = 1. Therefore

A=d B into $\frac{2m+1}{2m+4} + \frac{1}{m+2}x^{m-1}y^3$: But $m = \frac{1}{2}$: wherefore 2m+1 = 0; and therefore $A = \frac{1}{m+2}x^{m-1}y^3 = -\frac{2y^3}{3\sqrt{xxx}}$

Here it is observable that the Area, thus found, sometimes falls short of, and sometimes exceeds the true Area, by a given Quantity: And to know such Defett or Excess, the Area thus found is to be supposed encreased or diminished by a given Quantity as q; and then supposing x=0, let the Area so increased or diminished, be supposed equal to Nothing; and so in the present Case q will be sound equal to $\frac{2}{3} d\sqrt{d}$: And therefore, $A=\frac{3}{3} d\sqrt{d} \frac{2}{3} \sqrt{x^2}$.

Corol. 2.

If n be supposed equal to any Term in the sollowing Series, 3, 4, 6, 7, &c. The Quadrature of the Curve, whose Ordinate is $x = \sqrt{dx - xx}$; or $x = \sqrt{dx + xx}$, becomes finite; and will be exhibited by our Series. Thus for instance; let the Area of a Curve, whose Ordin. is $x = \sqrt{dx - xx}$, be sought.

Imagine it to be compared with the Area of a Circle, which call A. Then shall m=0, n=3; and consequently A=P=Q=R=S: But since the Quantity 2m, in the Denominator of the third Term, by which d^*B is multiplied, is infinitely small, or rather nothing; the Quantity designed by P, will be infinite; and for the same reason, the Quantity expressed by—S, is infinite

also; and therefore the Quantities A, -2, -R, will vanish: Wherefore P=S; and the Equation divided by $\frac{2m+1}{2m+4}$ into $\frac{2m-1}{2m+2}$ becomes d^nB into $\frac{2m-2}{2m} = \frac{dd}{m}x^{m-3}y^2$: or dB into $\frac{2m-3}{2}$ = $ddx^{m-3}y^3$; and putting o and 3, instead of m and n; it will come out thus, dB into $\frac{1}{2}$ = $\frac{y^2}{x^2}$, or $B=\frac{2}{3}\frac{y^2}{x^3}$.

Corol. 3.

If m be supposed equal to any Term of the following Series -2, -1, 0, 1, 2, 3, 4, 5, &c. The Quadrature of the Curve whose Ordinate is $x^m \sqrt{dx-xx}$ depends upon the Quadrature of the Circle: But the Area of the Curve whose Ordinate is $x^m \sqrt{dx-xx}$ depends upon the Quadrature of the Hyperbola; and the Relation of that Curve to either the Circle, or Hyperbola will be exhibited in the Series, and in Finite Terms.

Corol. A.

If m be explained by any other Term different from those above mentioned: Then the Curve whose Ordinate is $x^m \sqrt{dx + xx}$, can neither be exactly squared, nor doth it depend on either the Circle of the Hyperbola: But yet it may be reduced to a more Simple Curve by our Series.

Theorem 2.

Let A be the Area of a Curve whole Absciffa is x, and ordinate $\frac{x^m}{\sqrt{dx-xx}}$. And Let B be the Area of a Curve whole Absciffa is also x; but its Ordinate is $\frac{x^{m-n}}{\sqrt{dx-xx}}$. Let $\sqrt{dx-xx}=y$:

Then shall $A=d^nB$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}$ into $\frac{2m-7}{2m-6}$, &c. =P. $\left[-\frac{\pi}{m}x^{m-1}y=-Q\right]$. $\frac{d}{m-1}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}x^{m-3}y=-S$. $-\frac{d}{m-3}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}$

N. B. The Observations made above on Theorem 1, will be of Use here also.

Corol. I.

If m be supposed equal to any Term in this Series $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$, 6q. Then the Quadrature of the Curve whose Ordinate is $\frac{x^m}{\sqrt{dx-1}-xx}$ will be sinite, and will be exhibited by this Series.

Corol. 2.

The common Rats and Mouse; Mus major Aquavellanarum Major & Minor. The Dormoule or Sleeper, Mus Noricus, Cricetus, Alpinus Seu Marmotia. (7) The Cavia Cobaya, or Cuniculus Americanus; the Guinea Pig: The Agasi and Paca of Brafile: The Mus Norwegieus or Leming: T Glis Gesneri or the Rell: The Mus Indicus, Sc. The

To these several Kinds of Quadrupeds the following Anomalous ones must also be added;

1. Such Four-footed Viviparous Animals as have a longish Snour, with their Feet divided into many Claws or Toes, and having Teeth; as (1) the Echinus Terrestris, or common Urchin or Hedge hog. (2) The Brinaceus Indicus albus. Car. Mus. Leyden. (3) The Tatu or Armadillo prima of Marcgrave. Parts; is not at all c (4) The Tatuete of Brafile; or the second Species dies on one another. of the Armadillo, according to Maregrave. (5) Tatu Apara; his third Species of the Armadillo. (6) Tatu Mustelinus, Soc. Reg. Mus. The Weefel headed Armadillo. (7) Talpa, the Mole, Want, or Moldwarp. (8) The Mus Araneus, Shrew, hardy Shrew

Shrew moule. 2. Quadrupedous and Viviparous Animals with a longish Snout, having their Feet divided into many Claws or Toes, but without Teeth, are

(1.) The Tamandua guacu of Brasile, Marcgr. Urlus Formicarius Cardani; the great Ant Bear. (2) The Tamanduais of Brasile, or Marcg ave's leifer Ant. Bear.

3 Anomalous Flying Quadrupeds with a shorter Snout, with their Feet divided as above, and are the Bat-kind or Flitter-mice: Of which there are several Sizes, and different Forms.

4. There is one very odd anomalous Animal, which hath but 3 Claws on each Foot; and that is the Ass, or Ignavus of Marcgrave; the Sloth

or Sluggard.
5. Viviparous and Sanguineous Quadrupeds breathing with Lunge, but having only one Ventricle in their Heart, are These. (1) Rana aquatica, the Frog, or Fresh. Rana Aborea seu Ranunculus Viridis, the small Tree or green Frog. (2) Buso.

five Rubeta, the Toad. (3) Testudo, the Tortoile, Gr. Mairs; of these there are Land and Water ones; and many different Species in Foreign Parts.

6. Oviparous Quadrupeds with a long Tail, Aretche out horizontally; are the Lizard Kind: As (1) Lacertus omnium Maximus; The Crocodile. (2) Cardylus, sive Caudiverbera, Uremastix Gracis, larger than the green Lizard. (2) Tapayaxin Nova Hispania. The Lacertus Orbicularis of Hermandez, Ch. 9. c. 16. Lacertus Vulgaris, the common Eft, Swift, or Newt. (4) Lacertus Viridis, the green Lizard. (5) Lacertus Fucetanus Aldre-vand; at Rome and Naples called Tarantola. (6) Lacertus Indicus; called Senembi, and Inguana.
(7) Lacertus Brafiliensis, called Tejuguacu and Teinapara, by Marcgrave. (8) The Taraguira, Ameira, Taraguico Ascuraba, Americima, Curapopepa, Teiunbam, &c. of Marcgrave; the Lacertus Indicus, &c. (9) Scincus seu Crocodilus Terrestris. (10) supposing That to be to the Velocity before the Reseps, sive Lacerta Chocidica, a Kind of socied Sers flection:: as the Motion afterwards to the Motion pent. (11) Stellio, the swift or spotted Lizard. (12) before. Thus in the last Case, where the Body A Salamandra Terrestris, Salamandra Aquatica, the Water-Fst. (13) Lacerta volans Indica. (14) Cha mæleo, the Chamelion.

QUÆRENS non invenit Plegium, in the Law,

(7) Mus Domefticus, Major & Minor : Cted to him, with this condition interted. fecerit B Securum de Clamore, &c.

QUESTA, was the Term for an Indulgence or Remission of Penance, exposed to Sale by the Popes; who by this notorious Cheat got great Summs: The Retailers of these Indulgences, were called Quastuarii, and I believe Quastionarii, vid. Matt. West. in Anno, 1279.
OUANTITAS Acceleratrix of any Vis or Firce,

is the Measure of the Velocity generated in a gia

ven Time, by that Force.

QUANTITY of Motion: Sir If. Newton in his Principia, shews that this, which is found by taking the Summ of Motions tending the fame Way, on their Difference, if they tend towards contrary Parts; is not at all changed by the Action of Bo-

For Altion and Re-altion are always equal and contrary, by his Third Law of Nature: And therefore by the Second Law, must make Equal Mutations in Motions towards contrary Parts.

If therefore the Motions tend the same Way, whatever is added to the proceeding Body, or that struck forward, is subducted from the following Body; so that the Summ of the Motions will be the same as before. If the Bodies meer, there will be an Equal Subduction of the Motion of either: And therefore the Difference of the Motions made towards the contrary Parts, will remain the same.

As suppose a Spherical Body A, to be thrice as great as the Spherical one B; and let A have Two Degrees of Velocity any way, and let B follow it in the same right Line with Ten Degrees of Velocity: So that the Motion of A, to that of B, will be at ix (3×2) to Ten. Wherefore the Summ of the Motions of both of them will be 6 1 10, or fixteen Parts. Now after B hath overtaken A, and ftruck against it, if A gain by the Stroke any Degree of Motion, as suppose 3, 4 or 5 Parts; B must lose as much: And therefore after the Concourse, A will move on accordingly with 5 or 11; and B will follow with 7. 6, or 5 Parts: So that the Summ of the Motions of both, will be still 16 as at first before the Concourse, or Shock.

But if the Body A be supposed to gain by the Stroke 9, 10, 11, or 12 Parts of Motion; and therefore to move forward with 15, 16, 17, or 18 Parts, after the Concourse: Then will the Body B, by losing just so many Degrees as A gains, either move forward, with one Part, having loft 9; or will be perfectly at reft, losing all its 10 Degrees of Velocity; or lastly will move back. wards with one or two Parts of Motion: So much being deducted out of the 11, or 12 Parts of the Progressive Motion, or forwards. And thus the Summs of the Motions the same Way forward; as 15 + 1, or 16 + 0. And the Differences of the Motions contrary Ways; as 17 - 1, or 18 - 2; will always be the same, viz. = 16 Parts, as before Concourse and Reflexion. And the Motions with which Bodies go on after Reflection being known, the Velocity of Each may be found; by had six Parts of Motion before the Reflection, and 18 afterwards; and the Velocity of two Parts before the Reflection: Its Velocity after the Reflexion will be found to be Six; by faying, as the is a Return made by the Sheriff on a Wise dire Motion of fix Parts before the Reflection, to That

QUARREL, in the Law is Quarela, à quarendo: And it extends not only to Actions personal, but also to mixe; and the Plaintiff is then cal led Quarens: And in most of the Writs it is said, Quaritur: So that if a Man release all Quarrels, (ones Deed being taken most strongly against ones self) it is as beneficial as all Actions; for by it all Actions Personal and Real are released.

Cowell's Interp.

QUARENTINE, is a Benefit allowed by the
Law of England, to the Widow of one dying fei zed of Land; and whereby She may challenge to stay in his Capital Messuage, or Chief Mansion-House (so it be not a Castle) for 40 Days after his Decease; and if She be molested by the Heir at Law, or any other; She may claim a Writ De

Quarentina habenda.

QUARENTINE also fignifies a Furlong, from the French Quarente, Forty: Becaule 'tis a Quan tiry of Land containing 40 Perches. Tis used also for that Space of forty Days, wherein any Person coming from Foreign Parts, and infected with the Plague, is not permitted to Land, or come on Shore, till that Term is expired.

QUARTER-Sessions, is a Court held by the Justices of Peace in every County, once in every Quarter of the Year. How far the Jurisdiction thereof extends: See Lamb. Eirin. Lib. 4. and Smith de Republ. Anglic. Lib. 2. c. 19. The Hold-Smith de Republ. Anglic. Lib. 2. c. 19. ing these Sessions was first Ordained by the Sta-

tute of 25 Ed. III. Statut. 1. c. 18.

QUARTER-Woeeling, in the Military Art, is turning the Front of a Body of Men round where the Flank was. If it be done to the Right, the Man in the Right-angle keeps his Ground, and faces about while the Rest wheel.

QUARTER-Wind, at Sea, is such a Wind as

comes in abaft the Main-mast Shrouds, even with

the Quarter of the Ship.

QUARTERS, (in Architecture) are those slight upright Pieces of Timber which are placed between the Punchions and Posts, they are used to

Lath upon.

QUASI-Modo Sunday, is that called Low Sunday. or the Next after Easter; so called from the first Words of the Introit, or Hymn, for Mass on that Day; it occurs often in the Date of Old Records -Charta Gilberti Prioris de Eynsham Priori de Sher-burn dat. Postridie Festi Quasi-Modo Geniti: And this Solemn Time is in some Old Deeds expressed only thus, Q. M. G. by the Initial Letters of the Words, Quasi Modo Geniti.

QUEEN-Gold, Aurum Regina, is a Royal Revenue belonging to every Queen of England, during her Marriage to the King, both by Law, Cufrom and Prescription; and payable by divers Persons in England and Ireland (on divers Grants from the Crown) by way of Fine or Oblation, amounting to Ten Marks or upwards, viz. one full Tenth-part above the Entire Fine; as Ten Pounds on every Hundred Pound Fine, on Pardons, Contracts and Agreements: This becomes a Real Debt to the Queen Confort by the Name of Aurum Regina.

of 18 afterwards: So is the Velocity of two Parts Account of by Dr. Pope in Phil. Trans. N. 2. Thus: before, to that of Six afterwards.

It is found in the Mines of Friuli, a Territory belonging to the Venetians, about a Days Journey and a half from Goritia Northwards; and at a Place called Idria, fituated on a Valley of the Julian Alps. They have been for 160 Years inbject to the Emperour, and all the People speak Sclavonian. In going thither we travell'd several Hours thro some of the finest Woods I ever saw; full of Firs, Oaks, and Beeches of an Extraordinary Thickness, Straitness and Height. like others in the Alps, is built all of Wood but the Church; and one House, in which the Over-seer of these Mines lived. The Valley and the Mountains too, out of which the Mercury was dug, were of a pleasant Verdure, which they attributed to the Moisture of the Mercury. The best and greatest of their Mines, we went into, is dedicated to St. Barbara; as the other Mines are to other Saints.

> At the Beginning of the Entrance, the Way was not difficult, nor the Descent great; but in many Places you cannot stand upright; this way of going down holds not long, before you descend by Perpendicular Ladders, all the way down; and the Bottom, where there are several Lanes cut out in the Mountains, is lined and propt with several great Pieces of Firr-Ttees as thick as they can be let: They dig the Mineral with Pick Axes, following the Veins: Tis for the most part hard as a Stone, but more weighty; of a Liver Colour, or that of Crocus Metallorum. There is also some soft Earth in which you plainly see the Mercury in little Particles. Besides this, there are often sound in the Mines round Stones like Flints, of several Bignesses; very like those Balls of Hair, which I have seen in England taken out of the Stomachs of Oxen. There are also several Marchasites, and Stones, which seem to have Specks of Gold in them; but on trial they say, they can find none. Some of these Stones are very ponderous, and well impregnated with Mercury: But others are light

having little or none in them.

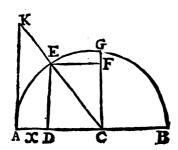
The manner of getting the Mercury is this: They take of the Earth, brought up in Buckets, and put it into a Sieve, whose bottom is made of Wires at so great a Distance, that you may put your Finger between them; 'tis carried to a stream of Running Water, and washed as long as any thing will pass through the Sieve. That Earth which passeth not, is laid aside upon an Heap; that which passeth, is reserved in a Hole, and is taken up again, and put into a fecond Sieve; and fo on to about 10 or 12 Sieves proportionably less. It often happens in the First Hole, that there is Mercury at the bottom; but towards the farther End, where the Intervals of the Wire are less, it's found in very great Proportion. The Waste Water is so much impregnated with Mercury, that it cureth ltches and other fordid Ulcers. The Earth laid aside, is Pounded, and the same Operation repeated. The fine small Earth, that remains after this, and out of which they can wash no more Mercury, is put into Iron Retorts, and the Fire forces the Mercury into the Receivers: The Officer unluted feveral of them; and I observed in all that he first poured out Perfest Mercury, and after that came a Black Dust, which being Wetted with Water, dis-QUICK-Silver: The Way and Manner how this They take the Caput Moreum and Pound it, and strangely Fluid Mineral is gained; you have a good Renew the Operation. There are 16 Furnaces for

Theorem 6.

its Ordin, be $\frac{x^{m+2n}}{rr+xx}$. I fay its Area $A = \frac{x^{m+1}}{m-1}$ $-\frac{rrx^{m+3}}{m-3} + \frac{r^4x^{-5}}{m-5}$, &c. $\frac{1}{4} r^{2n} B$.

Corollary.

If m be equal to any Term in this Series o, 2. 4, 6, 8, &c. The Quadrature of the Curve, whose Ordinate is $\frac{x^n}{r + xx}$, depends upon the Rectification of the Circular Arch. For if with the Radius



CA = r, and on the Centre C, the Circle AEGbe described: Let the Tangent C K be erected equal to x, and join C K meeting the Periphery in E. Then I say that A E divided by rr, shall be equal to the Area of the Curve whose Ordinate is X0 17+xx

A General Corollary to all the 6 Theorems.

Every Mechanick Curve ,whose Quadrature depends on any of the infinitely many Curves, whose Ordinates put on any of the following Forms, viz.

$$x^m \sqrt{dx+xx}$$
; $\sqrt{dx+xx}$; $x^m \sqrt{rr+xx}$; $x^m \sqrt{rr+xx}$; $x^m = x^m$

Suppose the Cube of the Circular Arch corre sponding to any Versed sine be made the Ordinate of the Curve, whose Abscissa shall be that very Verled-fine: The Area of the Curve is required to be investigated.

Let the Abscissa be x, the circular Arch v; the Fluxion of the Area is vix; Let the Area be vix -q. Then $v^3x + 3v^2vx - q = v^3x$; where fore $q = 3 v^2 v x$: But $v = \frac{dx}{2\sqrt{dx-xx}}$; there fore $q = \frac{3 dv^2 x x}{2\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ fore $\frac{3}{2} \frac{dv^2 x x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ fore $\frac{3}{2} \frac{dv^2 x x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x}{\sqrt{dx-xx}}$ foreign $\frac{3}{2} \frac{dv^2 x}{\sqrt{dx-xx}}$
Let A be the Area of the Curve whose Abscissa is x, and Ordinate
$$\frac{x^m}{rr+xx}$$
; Let B be the Area of another Curve whose Abscissa is the same x: Let another Curve whose Abscissa is the same x: Let $\frac{x^{m+2n}}{rr+xx}$. I say its Area $A = \frac{x^{m+1}}{m-1}$ its Ordin, be $\frac{x^{m+2n}}{rr+xx}$. I say its Area $A = \frac{x^{m+1}}{m-1}$ its Ordin, be $\frac{x^{m+2n}}{rr+xx}$. I say its Area $A = \frac{x^{m+1}}{m-1}$ and therefore $\frac{1}{2}dv^2y$. Let this Quantity be $\frac{3}{2}dv^2y$ and therefore $\frac{3}{2}dv^2y$. Then $\frac{3}{2}dv^2y + 3dvvy - r = \frac{1}{2}dv^2y$. And therefore $r = 3dvuy = \frac{3}{2}ddvx$. Let $r = \frac{1}{2}ddvx - s$. Then $\frac{1}{2}ddvx - \frac{1}{2}ddvx \frac{1}{2}dvx - \frac{1}{2}d$

And because of Solids generated by the Rotation of Curves, the Surface is generated the same way; the Longitude of Curves, and all their Centres of Gravity, do depend on the Quadratures of Curves: These will easily be computed if they depend on the aforefaid Curves.

QUADRUPEDS, are perfect hairy Viviparous Animals, having but four Feet. And these Animals according to Mr. Ray in his Synopsis Animalium are thus divided.

Into such as are Hoofed (Ungulata;) or Clamed,

or Digitate (Unguiculata,) (I.) The Hoofed Animals with four Feet, are either Whole Hoofed; Solidipeda, Moriogana, Moruza, Solidungula: As, The Horfe, As, the Onager, or Wild As: The Mule and the Zebra of Africa, or the fine striped Indian or African Ass, almost like a Mule in Form and Stature.

Of this Whole Hoofed Kind, Ariftotle has observed; that no one bath two Horns, (he might have

faid any) no one hath the Talus or Aftragalus; nor have the Males any appearance of Breafts.

(2.) Cloven-footed; and that either into Two Divisions only: As the Alagas or Bifulcate Kind, which are again subdivious into such as are which are again subdivided into such as are

1. Ruminant, Mugund Corla, i. e. Such as Chew the Cud; and their either have hollow and perpetual Horns as the Ox, Sheep, and Goat Kind: Or Decidaous, as the Hare and Deer Kind; which usually shed

their Horns annually. (See Ruminant in this Vol.)
Of the Bull Kind, they reckoned these: The common Bos; of which the Male is Taurus, the Female Vacca: (2) The German Urus, Urochs or Aurochs, (3) The Bison, (4) The Bonasus, (5) The Bubalus, or Busalo, (6) The Bos Africanus of Bellonius; Obs. 1. 2. c. 50. which he takes to be the Bubalus of the Ancients.

Of the Sheep Kind; besides the common Sort; they reckon, (2) The Arabian Ovis Laticauda, whose Tails sometimes are of 301. Weight: (3) The Ovis Strepficeros Cretica Bellonii: (4) The Ovis A-fricana, with short Hairs instead of Wool. (5) The

Gazella Africana. (7) The Capra Sylvestrin Africa-na Grimmii. (8) The Capra Mambrina or Syriaca of Gosner. (9) The Buselaphus or Moschelaphus Casi. (10) The Tragelaphus Cais, in Gesner. in Gefner.

(1) The Tragelaphus Bellonii.
Of the Hars or Deer Kind: As, (1) The Cervus, "Exact, the Red Deer. (2) The Cervus Players on Bellonis. ceros or Palmatus; the Fallow Deer. (3) Alce or the Elk. (4) Rangifer, the Rain Deer. (5) The Axis Plinii, according to Bellonius. (6) The Caprea Plimii. (7) The Cuguacu-esc and Cuguacu-zapara of Marcgrave. (8) The Caprea Groenlandica.

2. Of the Cloven-footed Animals into Two Parts

only, and which do not chew the Cud: There is only, and which do not chew the Cud: There is only the Hog and Swine Kind; and under this Head, befides the common Swine; they reckon.

(2) The Wild Boar or Swine. (3) The Porcus Guineensis Marcgravii. (4) The Porcus Indicus, called Babyroussa. (5) The Tajaca or Aper Mexicanus Moschiferus of Dr. Tyson, called by Marcgrave Tajaca Cunigoara; by others Quaubtla Cosmalt and Quapizot; and by Acosta and some others, Zaino. See a most accurate Description of this Animal, in Philos. Trans. N. 182.

Philof. Trans. N. 153.

3. There are some Four-footed Animals whose Hoof is cloven into Four Divisions; and these seem to be not Ruminant s As the Rhinoceros, the Hippipotamus, the Tapijerete of Brasile, the Capy-Bara of Brasile, the Animal Moschiferum.

II. Clawed or Digitate (Unquieulata) Four-footed Animals. Of this kind there is one Sort whose Claws are not divided or separated, but adhering one to another, covered with one common Skin, but with obtuse Nails sticking out round the Margin of the Foot; as the Elephant, which is anomalem, and not clearly referrable to this Kind, or that of Cloven footed Quadrupeds.

(2) There is another Species of this Digitate Kind of Quadrupeds, which hath only two Clams, as that of Camels; and tho these have no Horns they do both Ruminate; and have also the four

Stomachs of Horned Ruminant Animals.

Of the Camel, or Dromedary, there are two Sorts; one having but one Bunch on the Back, the other two. To this Kind belongs the Peruvian Glama, which some have reckoned among the Sheep kind. As also the Pacos, the Oon Indica or Peruviana vu.-

go, much less than the Glama.

3. A third Species of this Unguiculate Kind of Quadrupeds includes such Animals as the Greeks called, such and 'Artemburgea; which have the Foot divided into many Clams with broad Nails on them: As the Ape and Monkey Kind. Of these some have no Tails, and are called Simia or Apes. Others have Tails, and are called Mon.-Reys, Cercopitheci; and such as have either long or thort Tails, if they are of a large Size, are called Papiones or Baboons. There are great Numbers and Varieties of this Species of Quadrupeds; of which Varieties of this Species of Quadrupeds; of which Naturalists have described these. (1) The Ourang-Outang, or Homo Sylvestris of Dr. Thon, described by him in a particular Discourse. (2) The Guariza of Brasile, Marcgravis. (3) The Cagus of Brasile, greater and lesser. (3) The Cay of the same Region, described by Lerius. (5) The Caitaia of the same Country. (9) The Cercopithecus Angoleosis major. (7) The Cercopithecus Barbatus Guimeensis, 2 or 3 Sorts of it. (8) The Cercopithecus mon Rarbatus Cluss. (9) Cercopithecus Clus, called the same Country. (9) The Carcopiebecus Angolensis major. (7) The Cercopiebecus Barbatus Guineensis, 2 or 3 Sorts of it. (8) The Cercopiebecus Barbatus Guineensis, 2 or 3 Sorts of it. (8) The Cercopiebecus Clus. called Sagouin; and, if Apes and Monkeys have their Sagouin; and, if Apes and Monkeys have their Snouts very prominent like Dogs, they are called Councershali. Cynocephali.

4. A fourth Species of this Unguiculate Kind of Quadrupeds is, when though the Claws are many, yet they are not covered at the Ends with broad flat Nails, like Monkeys or Apes; but are rather like the Talons of Hawks, Gc. Crooked and Sharp-pointed. And these in respect of their Teeth may be divided into such as have many Dentes Primores, aut Incisores, (i. e. cutting Teeth) in each Jaw; of which there are two Sorts, a Greater, which either have a short round Head, as the Cat kind; or a longish Snout as the Dogkind; or a Leffer Sore; having a long slender Body with very short Legs, as the Weafel or Vermine Kind. There are some of this Species of Quadrupeds, which have only Two large remarkable Teeth in each Jaw: and thele are of the Hare Kind, and

live only upon Herbs, Grass, &c.

Of the Cat kind of Quadrupeds they reckon to be (1) The Lion, (2) The Tiger, (3) The Pardalis, whose Male is Pardus, Female Panthera, the Leonist Control of the Cat pard. (4) The Lupus Cervarius or Lynn. (5) The Catus Pardus or Cat-a-mountain. (6) The common

Cat. (7) The Bear.

Of the Dog-kind they account, (1) The Wolf,
(2) Lupus Aureus the Jackall, (3) The common Dog. Of which kind they enumerate; (1) The Mastive, (2) The Canis Venation Graius or Gracus; or according to some Scoticus, the Grey bound.
(4) The Graius Hybernicus or Irish Grey-bound. (4) The Conis Venaticus Sagax, Indagator, Sestator ferarum, Sc. the Hound. (5) The Canis Venaticus Hispanicus or aviarius: The Spaniel for Land or Water. (6) The Vertagus or Tumbler. (7) The Ganis Ottung O, Domesticus, the House-Jog. (8) The Canis Melitaus or Lap dog. (9) The Canis Getulus or Islandicus; the Sbock: And of all these Sorts there are many Varieties of Mongrels and Hebridous Breeds.

Another Sort of the Dog-kind is (4) The Fon.
(5) The Animal Ziberbicum, the Civet-Cat, as 'tis corruptly called; but by its Teeth and Snout is plainly of the Dog-Tribe. (6) The American Co-ati, or Rackoon or Rattoon. (7) The Yzquiepate. (8) The Carigueya, Maritucaca, Carigoy, Ropoza, Or Possum, (9) The Taxus, or Meles. The Badger, Grey, or Pate (in the North) (10) The Lutra or Otter. (11) The Phoca or Sea Calf, or Seale. (12) The Equus Marinus, or Morfe, or See-Horfe, mis staken by some for the Hippopotamus. The Dutch call him IValras; the Danes and Islanders, Rosma-(13) Manati seu Vacca Marina; the Sea-

Of the Vermin or Weefel-kind of Quadrupeds, is first, The Mustela vulgaris the Weesel; in Yorksbire, Foumart Or Fitcher, (Janin) (2) Viverra Indica, called Quel and Quirpele; and another Sort called Mungo and Mungathia of a reddish Grey. (2) The Mustela, the Ermine or Swar, if white; and the Mustela Sylvestris, the Ferret. (4) Putorius, the Pole-cat, (5) Martes, Foyns (whence our word, a Gown of Foins) the Marten or Martle. (6) Mustela Zi-bellina, the Sable. (7) The Genetia. (8) The Ichneumon Bellonii.

Of the Hare Kind of Quadrupeds, are first Lepus, the common Hare: (2) Cuniculus, the Rab-

All the Mercury got without the use of Fire, whether by Washing, or found in the Mines (for in the Digging some, the Particles get together, fo that in some places you might take up two or three Spoonfuls of pure Mercury) is called by them Virgin Mercury, and efteemed above the rest. The Officer told me, that making an Amalgama of Gold and Virgin Mercury, and putting it to the Fire, that which Common Mercury would not do.

The Engines for drawing the Water, are all moved by Water, brought thither in no Chargeable Aquedust from a Mountain 3 Miles distant. The Water Pumps from the bottom of the Mine by 52 Pumps, 26 on a side, is contrived to move other

Wheels, for several other Purposes.

The Labourers (being 280 always employed) work for a Julio a Day, which is not above 6 or 7 pence, and Endure not long: For although 70000 or 80000 Florins yearly; but now they None stay under ground above 6 Hours; all of Cost him not above 28000. They produced them in time (fome later, fome sooner) become

this Uic, each of them carrying 24 Resorts; in all Paralytick, and die Hestick. We saw a Man who had not been in the Mines for above balf a Year before, so full of Mercury, that putting a piece of Bra/s in his Mouse, or rubbing it in his Fingers, it immediately became as White, as if he had rubbed Mercury upon it. Those also that Work upon the Back-side of Looking Glasses, are very

Subject to the Palfer.

They convey their Wood thus. About 4 Miles from the Mines on the fides of Two Mountains, Mercury would carry away all the Gold with it, they cut down the Trees, and draw them into the Interjacent Valley. Higher up in the same Valley they make a Lock or Dam; when the Water is ready to run over it, they open the Flood-Gates, and the Water carries all the Trees impetuously to Idria, where the Bridge is built very strong, and at very Oblique Angles to the Stream, on purpose to stop them, and throw them on shore near the Mines

Those Mines heretofore. Cost the Emperor

Anno 1661.	Anno 1662.	Anno 1663.
O dinary Mercury. 198481 Virgin Mercury. 6194	7. 225066 9612	#. 244119 11862
in all 204675	234678	255981

compassed with Hills on all sides. A River of the same Name runs by it, and proves sufficient upon plentiful Rains to convey down the Firi-Trees and other Wood required in the Service of the Mines: And to this End there is an handsome Work of Piles made sloaping athwart the River (after the same manner as I observed in Newfol in Upper Hungary, cross the River Gran) to stop the Trees.

The Entrance into these Mines is not high, or upon an Hill, but in that Town it self. The

The Virgin Quick-filver, which they call Jung. fram, is that which discovers it self without the Gold Mines: And very much carried away Southhelp of Fire. Sometimes it is plainly feen in the Ore, or falls down in Drops, and sometimes Streams out in good quantity; as about Seven Tears ago it ran out of the Earth at first in a Stream as small as a Thread, and afterwards as big as a Pack-together in Barrels, the Quick-filver being nrit made thread, but ceased in 3 or 4 Days. That also is up in double Leather: And in another House accounted Virgin Quick-silver, which is separated as much Ore as can be distilled in 2 Years, except only by Water

Plain Quick-silver they obtain by Fire out of the Ore, and out of the Cinnabar of Mercury, which they dig out of this Mine. The Ore of this Mine is of a Dark Colour, mixed with Red.

The Quick filver Ore of this Mine ordinarily

contains half, and sometimes ? of Quick filver. I went into the Mine by the Pit of St. Agatha. and came up again by that of St. Barbara, descending and ascending by Ladders. I ascended at one of 639 Staves, or 89 Fathoms. It has been Glow-worms, which put into Papers, gave a dimm wrought 200 Years, about the same space of time Light like Candles in Lanthorns; and the Air also Vol. II.

2. The Town of Idria in the County of Gorisia with Newfol Mine, but comes much thort in time of and Province of Friuli, is leated low, and en- the Silver Mine at Schemnitz; and much shorter yes

of the notable Lead Mines in Upper Carinsbia.

In a Laboratory, where the Quick-filver is separated by Fire, I saw an Heap of 16000 Resorts of Iron; every one of which cofts a Crown at the best Hand from the Iron Furnaces in Carinthia. There are 800 Resorts, and as many Recipients, employed together, in drawing over the Quicksilver in 16 Furnaces; 50 in each Furnace, 25 of 2 fide; 12 above, and 13 below of each fide.

June 12. 1669, when I was there, they carried out 40 Saumes of Quick filver into Foreign Parts, deepest part of the Mine from the Entrance, is be- each Saume containing 315 pound Weight, to the tween 120 and 130 Fashoms. as far as Cremnitz in Hungary, for the Use of the ward; for they are not far from the Sonting, or Ly/onzo, a confiderable River, which runs into the Gulf of Trieste in the Adriatick Sea.

In the Castle, I saw 3000 Saumes of Quick silver together in Barrels, the Quick-silver being first made they have great Plenty of Rain to bring down the

The Country is well stored with stately Firs; Larches, Pines, Pinasters, Picea's, and that nobly crisped and well grain'd kind of Acer, whereof Viols and Violins are made: Whereof there is also Plenty in the Country of Salszburg and Care miola.

Travelling sometimes in the Night, we had continually about us a great number of large

was full of Flaming Files, affording some delight in our Old Synods and Episcopal Constitutions.

The way to this Place from Croatia I found difficult; and coming from it to Aidofebini and Weight of Lead, Iron and common Metals, of Croatia, I passed over Swartzenburg, or the Black usually an Hundred Pounds; at Six-score to the Mountain, from whence I descended to Miles in a Hundred. Rocky Country, and far more Stony than the

Craw, or Campus lapidsfus, in Provence.

find Pure Quick filver, running in small Grains like Pearls; the Juice of which Plant being expressed, Folk stone, &c. and exposed to the Air of a Clear Night, there

Knights Fee. QUINQUAGESIMA; See Quadragefima.

QUINTAL, or Quintan, was an old Sportive Exercise, practifed utually at Weddings, and was in the Ground, on the Top of which was a slender Beam turning round on a Spindle: At one of whose Ends was a Sloap or flat Board; and at the other a Bag of Sand or Dirt. And the Sport was with a long Staff or wooden Launce to ride a of Ground whether Square or Oblong, taken out Tilt at the Board, and to be either so skilful or of a Corner, or any Place else of a Ground-plat, lucky to escape the Blow which the Sand Bagg to make a Court or Yard, &c. would be likely to give the Runner at this Quin- QUOINS are the Stones and Bricks placed in would be likely to give the Runner at this Onin-tan, by the turning round of the Beam. This the Corner of any Building; and if any stick feems to have been the same with that Sport called without the Brick-work (their Edges being CyArietum Levatio, which is frequently prohibited pher'd off) they are called Rasick Quoins.

Cennet Par. Antiquities.

QUINTAL, also was formerly used for a

QUINQUE Portus, the Cinque or Five Ports of the Kingdom of England, were so called formerly In the Valley of Lance, which runs between the Mountains of Turin, grows a Plant like Mountains of Turin, grows a Plant like Poronicum, (so also called by the Inhabitants and Botanists,) near the Rosts whereof you may chester, and Rye; and several other Places which are called their Members; as Seaford, Feversham,

These had formerly, and have still, great Priwill be found as much Mercury, as there is lost of Juice.

vileges allowed them on the account of finding the King a certain Number of Ships of War, on occasion: The Numbers of which are these. Ha-QUIETUS, was formerly a Writ of Discharge strong is bound to find twenty one Ships, each granted to those Barons and Knights, who personally attended the King in his Wars, or any Fois to find Five Ships, with 24 Men and a Boy in reign Expedition; by which they were exempted each. Hithe also must find Five Ships, and in from the Claim of Scutage, or a Tax on every each 21 Men and a Boy. Dover is to find 21 Ships, in each 21 Men and a Boy. Sandwich should find Five Ships, each carrying 21 Men and a Boy. The Ships and Boys are 57. The Men 1188. The Service, which the Barons of these Cinque-Ports either so dangerous or ludicrous as to be forbid often by Ecclesiastical Authority; The manner of their own Charges for fifteen Days, and to set out it was thus: A Post was erected perpendicularly to those Places withher they are to go, and to stay as long as the King pleases, at his Charge, See Somner's Treatise of Rom. Forts and Ports in Kent

QUIRK, is a Term in Architecture for a Piece of Ground whether Square or Oblong, taken out

RAF

ACHAT, Rachetum, from the French Racheter,

used for Liberi-Homines; and Spelman thinks it to

be what Bracha calls Rade-knights.

RADIAL Curves are Curves of the Spiral kind, RAIN-BOW. In order yet further to explain whose Ordinates, if they may be so called, do all the Phanomena of the Rain-bow; Sir Isaac Nameon terminate in the Centre of the including Circle, in his Excellent Treatife of Opticks, p. 126. adand appear like so many Radis or Semi diameters of that including Circle. See Spiral.

RADMAN is a word often used in Dooms-day, and seems to be the same with Rade-knight or Radknight. Others think it comes from Read, Counsel, and then Read man, is a Counsellor.

RAFTERS, in any Building, are those Pieces of Timber, which stand by pairs upon the Reason, meet in an Angle at the Top, and help to compose scatter into Drops, and fall like Rain; for the Sun the Roof of a Building: They should not stand on these Drops certainly causes the Bow to appear farther than 12 Inches from one another.

RAI

RAGEMAN, is a Statute so called, of Justices ACHAT, Rachetum, from the French Racheter, to redeem, was formerly used for the same as affigned by K. Edw. 1. and his Counsel, to go a Theff-boote, viz. the Compensation or Redemption of a Thief, Skene de verb. signif.

RADECHENISTORS in Dooms day book, is Years next before Michaelmas, in the fourth Year of his Reign. Cowel.

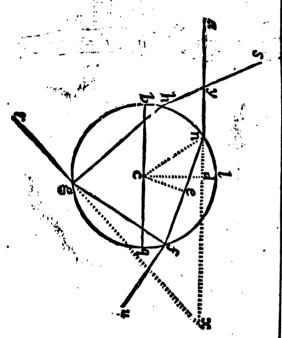
vances this Proposition.

By the Properties of Light (discovered by his Net Experiments) to explain the Colours of the Run-bow.

This Bow never appears but where it rains in the Sun-shine; and it may be artificially made by sponting out Water, which by breaking alost shall to an Eye duly posited to the artificial Rain, and

the Sun. And hence it is now agreed, that this Bow is made by the Refraction of the Sun's Light in Drops of falling Rain. This was understood by some of the Ancients, and of late more fully difcovered and explained, by Anton de Dominis, A. Bp. of Spalato in Libro de Radiis visus & lucis; Printed at Venice, A. D. 1611. and written above 20 Years before. He shews there, how the Interior Bow is made in round Drops of Rain by a Refraction of the Sun's Light, and one Reflexion between them; and the Exterior by two Refractions and two Sorts of Reflexions between them in each Drop of Water: And he proves his Explications by Experiments made with a Phial full of Water; and with Globes of Glass filled with Water, and placed in the Sun, to make the Colours of the two Bows appear in them. The same Explication Des Cartes hath pursued in his Meteors, and mended that of the Exterior Bow. But fince they understood not the true Origin of Colours, its necessary to pursue it here a little further.

For understanding therefore how the Bow is made, let a Drop of Rain or any other Spherical Transparent Body be represented by the Sphere



b n f o described with the Centre c, and Radius on, and let a n be one of the Sun's Rays incident upon it at n, and thence refracted to f; where let it either go out of the Sphere by refraction to npon it at m, and thence refracted to f; where let by Computation the greatest Angle 4 xr will be it either go out of the Sphere by refraction to found 42° 2', and the least Angle 4 y 150° 57'. And wards u, or be restlected to g; and at g let it eitin the most refrangible Rays, the Sines 1 and r, b; and at b let it go out by Refraction towards s, greatest Angle a x r will be found to be 40° 17°; cutting the Incident Ray in j: Produce an and rg and the least Angle a j : 54° 7'.

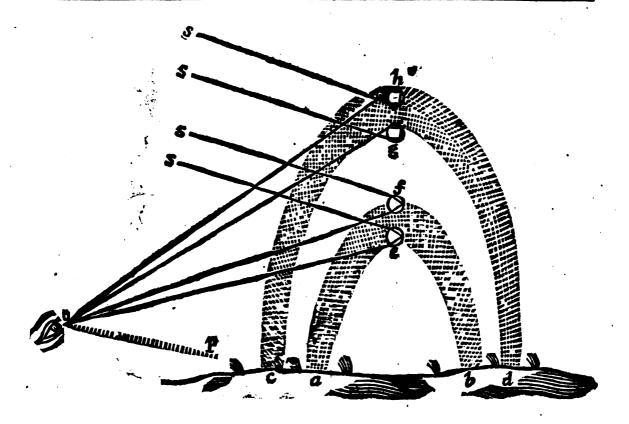
till they meet in x; and on ax and n f let fall the Perpendiculars c d and ce; and produce c d till it fall on the Circumference at /; parallel to the Incident Ray draw the Diameter bq, and let the Line of Incidence out of Air into Water be to the Line of Refraction, as I to'r. Now if you suppose the Point of Incidence n, to move from the Point b continually till it come to l, the Arch q will first increase and then decrease, and so will the Angle axr, which the Rays an and gr contain: And the Arch qf, and Angle axr will be biggest when nd is to en: as $\sqrt{11-rr}$ is to Also the Angle a j j, which the Rays an and b s contain, will first decrease and then increase, and grow less, when m d is to en :: VII Jar: In which case we will be tond:: as 3 r to , and fo the Angle which the next emergent Rays. viz. 1 after 3 Reflexions, contains with the incident Ray an, will come to its limit when nd is to en:: 45 V 11-rr is to J19 rr; and nend:: as 4 r to 1, and the Angle with the Raynext after the emergent, (i. e. the Ray emergent after 4 Reflexions) contains with the Incident Ray, will come to its Limit when n d is to cn:: as $\sqrt{11-rr}$ is to $\sqrt{24} rr$; in which Case n e will be to n d:: as 57 to 1; and so on infinitely: The Numbers 3, 8, 15, 24, &c. being gathered by continual Addition of the Terms of the Arithmetick Progression 3, 5, 7, 9, &c. The Truth of all which Mathematicians will easily examine.

Now it is to be observed, that as when the Sun comes to his Tropicks, the Days increase and decrease but a very little for a great while together; so when by increasing the Distance cd, these Angles come to their Limits, they vary their Quantity but very little for some time together; and therefore a far greater Number of the Rays which fall upon all the Points n, in the Quadrant bl, shall emerge in the Limits of these Angles, than in any other Inclinations. And tis to be observed farther, that the Rays which differ in Refrangibility will have different Limits of their Angles of Emergence, and consequently according to their different Degrees of Refrangibility, emerge most copiously in different Angles, and being separate from one another, appear each in their proper Colours. And what these Angles are, may be easily gathered from the foregoing Theorem, by Computation.

For in the least refrangible Rays the Sines 1 and r (as was found above) are 108 and 81, and thence ther go out by Refraction at r, or be reflected to are 109 and \$1; and thence by Computation the

Supposing

٦.. آيا.



Supposing now then o be the Spectator's Eye, Sense with the deepest Red in that Region. And and op a line drawn parallel to the Sun's Rays, the Angle s b o being equal to p o b = 54° 7', shall of, og, ob, and be illuminated by the Sun's Rays so, sf, sg, sb: The Angle soo being equal to the Angle poe = 40° 17', shall be the greatest Angle in which the most retrangible Rays can after one Reflexion be refracted to the Eye: And therefore all the Drops in the Line os, shall send the most refrangible Rays most copiously to the Eye, and thereby strike the Senses with the deepest violet Colour in that Region. And in like manner the Angle s fo being = to the Angle po f = 42° 2'.
Thall be the greatest in which the least refrangible Rays after one Reflexion can emerge out of the Drops; and that these Rays shall come most copioully to the Eye from the Drops in the Line of and frike the Senies with the deepest red Colour in that Region. And by the same Argument, the Rays which have intermediate Degrees of Refrangibility, shall come most copiously from Drops between e and f, and so strike the Senses with the intermediate Colours, in the Order which their Degrees of Refrangibility require: i. e. in the Progress from e to f, or from the Infide of the Bow to the Outside in this Order; Violet, Indico, Blue, Green, Yellow, Orange, Red. But the Violet, by the mixture of the white Light of the Clouds, will appear faint, and incline to a Purple.

Again, the Angle sgo being equal to the Angle pog, or 50° 52', shall be the least Angle in which the then least refrangible Rays can, after 2 Reflexions, emerge out of the Drops; and that the least confirmed, by the known Experiment of hanging refrangible Rays shall come most copiously to the up in the Sun-shine a Glass-globe filled with Wa-

and let poo, pof, pog, and pob, be Angles of do 17': 42° 2': 50° 57', and 54° 7' respectively; and these Angles turned about their common fide op, shall with their other sides oe, of, og, and ob, describe the Verges of 2 Rain-bows af be, and ob, describe the Verges of 2 Rain-bows af be, and cbdg: For if e, f, g, b, be Drops placed any where in the Conical Superficies described by oe, and be illuminated by the Sun's Rays. in the Regions between g and b, shall strike the Senses with the intermediate Colours, in the Order which their Degrees of Refrangibility require, (i. e.) in the Progress from g to b, or from the intide of the Bow to the outer, in this Order: Red, Orange, Yellow, Green, Blue, Indico, Violet. And fince these 4 Lines e, of, og, ob, may be simated any where in the above-mentioned Conical Surface, what is faid of the Drops and Colours in these Lines, is to be understood of the Drops and Colours every where in these Superficies.

Thus shall there be made two Bows of Colours, an interior and stronger, by one Reslexion in the Orops, and an exterior and fainter by two; for the Light becomes fainter by every Reflexion: And their Colours shall lie in a contrary Order to one another, the Red of both Bows bordering upon the Space gf, which is between the Bows.

The Breadth of the interior Bow foe, measured a-cross the Colours shall be 1° 45', and the breadth of the exterior gob, shall be 3° 10'; and the Distance between gof, shall be 8° 5'. The greatest Semidiameter of the innermost, (i.e.) the Angle p of being 42° 2'; and the least Semidiameter of the outermost p o g being 50° 57'. These are the Measures of the Bows, supposing the Sun to be a Point; but by the breadth of his Body, the breadth of the Bows will be increased, and their Distance decreased by half a Degree.

This Explication of the Rain-bow is yet farther Eye from the Drops in the Line og, and ftrike the ter; and then viewing it in such a Posture, that

the Rays which come from the Globe to the Eye may contain with the Sun's Rays an Angle of either 42 or 50 Degrees: For if the Angle be about 42 or 43 Degrees, the Spectator suppose at o (in the preced. Fig.) shall see a full red Colour in that fide of the Globe which is opposed to the Sun, as is represented at f. And if that Angle become less (suppose by depressing the Globe to e) there will appear other Colours, Yellow, Green and Blue successively, in the same side of the Globe. But if the Angle be made about 50 Degrees, (as suppose by lifting up the Globe to g,) there will appear a red Colour in that fide of the Globe which is towards the Sun: And if the Angle be made greater, (suppose by lifting up the Globe to b) the Red will turn successively to the other Colours, Yellow, Green, Blue, &c. The same thing may be done (as the Author tried) letting the Globe rest, and only raising and depressing the Eye, or moving it 10, as to make the Angle of a just Magnitude.

RAINS: Our Seamen call that Track of the Sea to the Northwards of the Equator betw. 4 and 10 Degrees of Latitude, and lying between the Meridian of Capa Verde, and that of the Eastermost Islands of the same Name, or of the Capa Verde Islands, they call this Track the Rains: Because there are almost continual Calms, constant Rains, and Thunder and Lightning to a strange Degree there; and the Winds, when they do ever blow, are only small uncertain Gusts, and shift about all round the Compass; so that Ships are sometimes here detained a long while, and can make but very little way.

RANDEZVOUS, in a Military Sense, is a Place appointed by the General of an Army, for all the Forces to meet on a Day appointed; let what Weather, &c. happen that will.

RANK, in a Military Sense is the Order or firait Line made by the Soldiers of a Battalion, or Squadron drawn up fide by fide, Doubling of Ranks is puring two into one

is putting two into one.

RAPACIOUS Animals, are in general such as live upon Prey: And its a general Division of Birds, into such as are Rapacious and Carnivorous, and such as are Frugivorous. The Characteristick notes of Birds of Prey are; that they have a great Head and a short Neck, hooked, strong and sharp poin ted Beak and Talons, sitted for ravine and tearing of Flesh; strong and brawny Thighs for striking down their Prey: A bread thick sleshy Tongue like that of a humane Creature; 12 Feathers in their Train; and 14 slag Feathers in each Wing. The two Appendices, or blind Guts, are always very short; They have a Membranous Stomach, and not a Musculous one or a Gizard, such as Birds have that live on Grain: They are very sharp-sighted, and are not Gregarious, but Solitary generally speaking, though Vultures will sly 50 or 60 in a Company.

RAPHA, in Anatomy, is a Ridge or Line which runs along the Under side of the Penis, and reaching from the Franum to the Anus, divides the Scrotum and Perinaum in two. This line is not usually cut in the Grand Operation of cutting for the Stone, because tis both harder than the rest of the Skin there-abouts, and also because you must then cut upon the Interstices of the Muscles, which will make the Ro-union the more difficult.

RATE of a Ship of War is its distinction as to Bigness and Capacity; and this is usually accounted by the Length and Breadth of the Gun-deck, the Number of Tuns they contain, and the Number of Men and Guns they carry. For such Men of War as have their Gun-decks from 159 to 174 Feet in length, and from 44 to 50 Foot broad! That contain from 1313 to 1882 Tuns, that have from 706 to 800 Men, and carry from 96 to 110 Guns: We reckon of the First Rate.

Second Rate Ships, have their Gun-decks from 153 to 165 Feet long; and from 41 to 46 broad: Contain from 1086 to 1482 Tuns; and carry from 524 to 640 Men. and from 81 to 640 Men.

Third Rases have their Gun-decks from 142 to 158 Feet in length; from 37 to 42 Foot broad: They contain from 871 to 1262 Tuns; carry from 389 to 476 Men, and from 64 to 80 Guns.

Fourth Rates are in length on the Gun-deck from 118 to 146 Foot, and from 29 to 38 broad: They contain from 448 to 915 Tuns; carry from 226 to 346 Men; and from 48 to 60 Guns.

Fifth Rates have their Gun-decks from 100 to 120 Foot long, and from 29 to 31 Feet broad: Contain from 259 to 542 Tuns; carry from 145 to 190 Men; and from 26 to 44 Guns

to 190 Men; and from 26 to 44 Guns.

Sixth Rates have their Gun-decks from 87 to 95
Foot long, and from 22 to 25 Foot broad: They
contain from 152 to 256 Tuns; carry from 50 to
110 Men, and from 16 to 24 Guns.

Our New-built Ships are much larger, as well as better, than the Old ones of the same Rase; and that is the Reason of the double Numbers all along; the larger of which express the Proportions of the New-built Ships.

RATION, is now in the Army, a word in use for a certain Proportion of Ammunition-Bread or Forrage distributed to every Man in the Army, as his Portion for such a Time.

RAVISHMENT de Garde was a Writ that formerly lay for the Guardian by Knighes Service, or in Soccage, against him that took away from him the Body of his Ward.

RAYS of Light with Regard to Opticks, are by Sir Is. Newton considered, as the last Parts of that wonderful Fluid; and that as well such as are successive in the same Lines as contemporary in several Lines: For 'tis manifest that Light consists of Parts both successive and contemporary; because in the same place you may stop that which comes one moment, and let pass that which comes presently after, and in the same Time you may stop it in any one place, and let it pass in another. Wherefore the least Light, or part of Light, which may be stopt alone without the rest of the Light; or propagated alone, or do or suffer any thing alone, which the rest of the Light does not, or suffers not, he calls a Ray of Light.

The Mathematicians indeed usually consider the Rays of Light to be Lines reaching from the luminous Body to that illuminated; which were just if Light were propagated in an instant, as some have supposed: But the Observations of the Eclipses of Jupiter's Satellites made first by Mr. Romer, do shew that 'tis propagated in Time, and in particular that it takes up about 7 Minutes in moving from the Sun to the Earth.

The

The incomparable Sir If. Newton in his Opt. Book 2. Part 3. p. 65. After having premiled p. 50. that those Surfaces of transparent Bodies reflect the greatest Quantity of Light, which have the greatest Refracting Power; and also that in the Confines of equally refracting Mediums there is no Reflexion; and at pag. 45. That the Transparent parts of Bodies according to their feveral Sizes must reflect Rays of one Colour, and transmit those of another on the same Grounds, that thin Plates or Bubbles do transmit or reflect those Rays; which he takes to be the ground of all their Colours : proceeds, in the Eighth Proposition, to enquire into the Cause of the Rays of Lights being reflected, and he shews that the Cause of Reflexion is not the impinging of Light on the folld or impervious Parts of Bodies as hath commonly been believed, as appears from the following Confiderations.

(1.) That in the Passage of Light out of Glass into Air, there is a Reflexion as strong as in its Passage out of Air into Glass, and rather something stronger, and much stronger than in its Passage out of Glass into Water: And it seems not probable that Air should have more restecting Parts than Water or Glass. But if that could be supposed it would not do, because the Reslexion is as firong or fironger when the Air is drawn away from the Glass (as suppose in the exhausted Receiver of Mr. Boyle's Air-pump) as when it is adja-

cent to it.

(2) If Light in its Passage from Glass to Air be incident more obliquely than at an Angle of 40 or 41 gr. it is wholly reflected; but if less obliquely, it is in a great Measure transmitted. Now it is not to be imagined that Light at one Degree of Obliquity should meet with Poresenough in the Air to transmit the greatest Part of it, and at another Degree of Obliquity should meet with nothing but Parts to reflect it wholly; especially considering that in its Passage out of Air into Glass, how obliquely scever it falls, it finds Pores enough in the Glais to transmit the greatest Part of it. If it be said. that it is not reflected by the Air but by the utmost Superficial Parts of the Glass; there is still the same Difficulty: Besider, that such a Supposition is un-intelligible, and will also appear to be false by applying Water behind some part of the Glass instead of Air. For so in a convenient Obliquity of the Rays, as suppose of 45 or 46 gr. at which they are all reflected where the Air is adjacent to the Glass, they shall be in a great Meafure transmitted where the Water is adjacent to it: Which argues, that their Reflexion or Transmission depends on the Constitution of the Air and Water behind the Glass, and not on the firiking of the Rays upon the Parts of the Glais.

(3.) If the Colours made by a Prism placed at the Entrance of a Beam of Light into a darkned Room, be successively cast on a second Prism placed at a greater Distance from the former, in such manner that they are all alike incident upon it; the second Prism may be so inclined to the Incident Rays, that those which are of a blue Colour shall all be reflected by it, and yet those of a red Colour pretty copiously transmitted. Now if the Reflexion be caused by the Parts of Air and Light at a distance, he shews in another Place. Glass, how comes the Blue, at the same Obliquity of Incidence, wholly to impinge on those Parts so pinging on the solid Parts of Bodies but by simpinging on the solid Parts of Bodies but by some as to be all reflected, and yet the Red sind Pores other Principle, its probable that these Rays which gnough to be in a great Measure transmitted?

(4.) Where 2 Glasses touch one another, as he shews in the first Observation, there is no sensible Reflexion, yet why fhould not the Rays of Light impinge on the Parts of Glass, as much when contiguous to other Glass, as when so to Air?

(5.) When the Top of a Bubble of Water in Obs. 17. at last began to grow very thin, there was so very little Light reslected from it, that it appeared intensely black; and yet round about where the Water was thicker, the Reflexion was so strong as to make the Water to appear very

Nor is it only at the least Thickness of Bubbles and thin Plates that there is no manifest Reslexion, but at many others continually greater and greater: For he found (in Obier. 15.) that Rays of the same Colour were by turns transmitted at one Thickness, and reflected at another, for an indeterminate Number of Successions; and yet in the Surface of the thinned Body, where it is of any one Thickness, there are as many Parts for the Rays to impinge on, as where it is of any other Thickness.

(6.) If Reflexion were caused by the Parts of reflecting Bodies, it would be impossible for this Plates or Bubbles at the same place to restect the Rays of one Colour and transmit those of another, as by the 13 and 15 Observations tis plain they do: For it is not to be imagined that at one Place the Rays which (for inftance) exhibit a Blue, should have the Fortune to dash upon the Paris; and those which exhibit a Red should fall upon the Pores of the Body: And then at another Place, where the Body is either a little thicker or thinner; that on the contrary, the Blue should fall on

its Pores, and the Red upon its Pares polished.

(7) Were the Rays of Light reflected by impinging on the folid Parts of Bodies, their Reflexions from these Bodies could not be so regular as they are. For in polishing with Sand, Glass, Putty, or Tripoly; it is not to be imagined that those Substances can by grating and fretting the Glass, bring all its least Particles to an accurate Polish, so that all their Surfaces shall be truly plane or truly spherical, and look all the same way, so as together to compose one even Surface. The smaller indeed the Particles of these Substances are, the smaller will the scratches be, by which they continually fret and wear away the Glass until it be polished: But be they never so small they can wear away the Glass no otherwise than by grating and scratching it, and breaking off the Protuberances; and they polish it no otherwise than by bringing its roughness to a very fine Grain, so that the Scratchings upon it become too small to be vifible. And then if Light were reflected by impinging upon the folid Parts of the Glass, it would be scattered as much by the most polished Glass as by the roughest: Wherefore it remains a Problem, how Glass polished by freeting Substances can reflect Light so regularly as it doth; and this can't well be solved, unless the Reslexion of the Ray be effected, not by a fingle Point of the re-flecting Body, but by some Power of the Body which is evenly diffused all over its Surface, and by which it acts upon the Ray without immediate contact, for that the Parts of Bodies do act on do impinge on the folid Parts of Bodies, are not

reflected but stifted and lost in the Bodies; for otherwife two Sorts of Reflexions must be allowed. Should all the Rays be reflected which impinge on the Internal Parts of Water or Chrystal, there Substances would rather have a cloudy, than a transparent Colour. To make Bodies look black many of the Rays must be stopt, retained and lost in them, and it feems not probable that any Rays can be stopt and stifled in them, which do not impinge on their Parts. After this he shews in Prop. 9. That Bodies reflect and refract Light by one and the same Power variously exercised in various Circumstances; as appears from several Consideracumstances; as appears from several Considera-tions. 1. Because when Light goes out of Glass into Air, as obliquely as it can possibly do, if its Incidence be made still more oblique, it becomes totally reflected; for the Power of the Glass after it hath tefracted the Light as obliquely as is posfible, if the Incidence become still more oblique, becomes too strong to let any of its Rays go thro' and consequently cause a Total Reflexion. 2. Because Light is alternately reflected and transmitted by thin Plates of Glass for many Successions, according as the Thickness of the Glass increases in Arithmetical Progression; for here the Thickness of the Glais determines whether the Power by which Glass acts upon Light, shall cause it to be reflected, or permit it to be transmitted. And, 3. Because those Surfaces of Transparent Bodies, which have the greatest refracting Power, reflect the greatest Quantity of Light, as was shewn in the first Proposition.

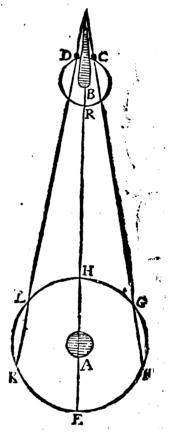
And in the Latin Edition of his Opticks towards the End, under the 21st Query, he shews that the Cause of Reflexion and Refraction both, is only the Attraction of the Part of the Body acting upon the Rays of Light at a little diftance, as they pass our of, or thro the Surface of the Glass. (See Light.) For as the Rays pass out of Glass into a Vacuum they are always inflected towards the Glass; and if they fall on the Vacuum too obliquely, they will return again to the Glass, and be totally reflected. Now this Phænomenon can't be attributed to the Resistance of the Vacuum, (which is nothing) but must be attributed to some force in the Glass, which reduces or draws back the Rays after they are gotten out of the Glass into the Vacuum. For if the hinder Surface of the Glass be covered with clear Water, Oil, pellucid and liquid Honey, a Solution of sublimate, &c. Then the Rays which otherwise would have reflected, will pass into that Liquor. And this shews plainly that the Rays are not reflected, till after they have pass'd the hinder Surface of the Glass, or are beginning to go out of it. For if as they are going out, they fall into any of the Liquors above-mentioned, they then go on in the Course they were in before: because the Attraction of the Glass is balanced by the Attraction of the Parts of the Liquor.

And this appears yet plainer, by the Compression of two Prisms, or Object Glasses of a long Telescope, together, when one is plain, and the other a little Convex; for then they will neither exactly touch, not yet be at any considerable distance one from another, as it may be not above the part of an Inch.

For then the Rays which, at passing out of the neous, would see the Imme hinder Surface of the first Glass, would have been into the Shadow at the same reflected and turn again to it, if the Distance of Time, as another would do it the 2° Glass had been considerable, will now all it would be the same thing on readily in that part, pass through the Second regard to the Points K and L.

Prism or Object Glass, just as if there were a hole thro'it. See Sir Is. News. Observ. 1. 4. and 8th. of Part 1. Book 2. of his Opticks.

It hath been discovered by that Excellent Danish Astronomer, Mr Romer: that tho' the Motion of the Rays of Light coming from us to the Sun be amazingly swift, yet it is by no means instantaneous. And the Velocity of that Motion may be thus determined in the Figure annexed; let the Circle HLKEFG represent the Earths annual Orbit, described by its Revolution round the Sun, which suppose placed in A. Let the Point B represent the Planet Jupiter, casting a Shadow backwards towards those Parts which lie behind him in respect to the Sun. Let the little Circle DRC denote the Orbit of any one of the Satellites of Jupiter, revolving round that Planet placed in B. And let the Chord GF be in length equal to the Semi-diameter of the Earth's annual Orbit AE, of AH: As let also LK be, on the other hand.



All this supposed, 'tis plain that those Immersions of Jupiter's Satellites into his Shadow, and those only which happen from their Conjunction to their Opposition with that Planet, can be visible to the Inhabitants of the Earth, which live within the Semi-circle H G F E: And those Emersions out of his Shadow, and those only which happen from the Satellites Opposition to their Conjunction with Jupiter again, can be visible to such as live under the Semi-circle H L K E: Because the Interposition of the Body of Jupiter, hinders both from being visible. 'Tis apparent also, that an Observer placed in F, if the Motion of Light were instantaneous, would see the Immersion of a Satellite into the Shadow at the same Moment of absolute Time, as another would do if placed in G; and it would be the same thing on the other side with regard to the Points K and L.

But if the Propagation of Light take up any fensible Time, 'tis plain that the Observers posited in Gand L, being nearer to Jupiter by an entire Semidiameter of the Magnus Orbis, than those in F, and K; must needs see the Immersions and Emerfions a little sooner than those can do; and from the Space of Time which is proportionable to that Semi diameter of the Earth's Annual Orbit, may Estimation be made of the Velocity of the Rays of Light; and so the thing is in Fact: For whenever the Earth is in that part of its Orbit which is nearest to Jupiser, the Immersions of the Satellises into his Shadow do anticipate the mean Time which they should happen in, according to Cal culation; as when the Earth is in the opposite Parts of the Orbit, they do really appear later than by Calculation they should do. And so they will appear later to an Observer placed in F, than to one placed in G; and the Emersions later to one in K, than to one in L: As Mr. Romer first found, and is now agreed on by all Aftronomers. There was indeed some doubt about this matter started by Cassini; but our Accurate Mr. Halley Savilian Professor of Geometry at Oxford, bath cleared up all the Difficulty; and demonstrated that this Progreffive Motion of the Rays of Light, to such a Distance, and in such a given Time, is absolutely nece flary to account for the Phenomena of the Eclipses of the Satellites of Jupiter. And as to the Time, or with what determinate Velocity the Rays move, Mr. Romer judged that it required about Eleven Minutes of an Hour, for the Light reflected from Jupiter, to move the length of the Chord FG in the Figure above; or the Distance of the Semi-diameter of the Earth's annual Orbit: But this, by Cassini's more accurate Observations, feems to be much lessened, for according to him it can't be above 7 Minutes and 5 Seconds. Suppose then it be reckoned at 9 Minutes, which is the Medium between Romer's Eleven, and Cassini's Then will the Motion of Light be so prodigious swift, as to move about Eighty Millions of Miles in 9 Minutes: That is 8888888 Miles in a Minute; and 148148 Miles in a Second; and 74074 Miles in half a Second, or while you can pronounce One, Two, distinctly.

A Motion, tho not instantaneous, as no one can

be; yet so wonderfully swift, that the Motion of a Bullet from the Mouth of a Cannon, (or any such like Velocity of a Body projected,) is like the creeping of a Snail, the Motion of the Leggs of the Ignavus, or the imperceptible Pace of the Hand of a Clock, when compared with it: Nay, the Mozion of the Earth it self in the Annual Orbit, which yet is pretty swift, (viz. at the Rate of 31 English Miles in a Second) is not the Ten Thousandth part

of the Velocity of the Rays of Light.

From which very surprising Proposition, the Ingenious Mr. Whiston deduces these Corollaries.

- 1. That the Eclipses of the Sun, Moon, or Sarellites of Jupiter, do not happen at the same moment of Time, that they appear to us to do.
- 2. That the more remote any Planets are from its, the longer will be the Distance between the stant from the sirve and apparent Time of their Eclipses: Thus, Line. Sometime tho the Moon's Eclipses will appear to us to be the Reserve-Line. mearly at the fame Time, at which they really REAR. Rank, happen; yet those of the Sun must appear later, when drawn up.

those of the Satellites of Jupiter, later yer; and thole of Saturn's Satellites, latest of all.

- 3. The apparent Places of the Sun, and the Planets in the Heavens, are not their true and real ones at any Time of Oblervation.
- 4. Supposing the Distance of the fixed S:ars from us to be so immensely great, as we have all the reason in the World to conclude it to be; and to which the Distance of the Sun from us hardly bears any sensible Proportion; 'tis plain that the Light of the fixed Stars cannot come to us in many Hours, nor in many Days nor Weeks; perhaps, not in some Months Time. So that, as that Excellent Mathematician the Honourable Mr. Francis Roberts, was once in Discourse suggesting to me; if the Author of Nature should please to annihilate Sprius, or any other fixed Star; it might be 3 Months Time before we should miss him, and find his Place vacant in the Heavens.

REACTION: See Repulse.
BEACTION; The Naturalists say, that Reaction is directly contrary and equal to Action, in Bodies. Or the mutual Actions of two Bodies striking one against another are exactly equal, but made with contrary Directions. Or yet in other words by the Action and Reaction of Bodies one on another, there are produced equal Changes in each; and those Changes are impressed towards (directly) contrary Parts, or ways. This rowards (directly) constary Paris, or ways. This will be best understood by Instances: For, whatever Body presses or draws another, is equally pressed or drawn by it again. If any one press a stone with his Finger, his Finger is as much pressed by the Stone: If a Horse by a Rope, Gr. draw a Stone, the Horse shall equally be drawn by the Stone; for the Rope being stretched both ways, endeavours to relax it self again, and by that means will draw the Horse towards the Stone; and will as much binder the Progression of the Horse, as it forwards the Procession of the Stone. If any Body lighting against another doth by its force any way change its Motion; it self will undergo the same Change in its own proper Motion, but towards contrary Parts, from the Reaction of that Body, and the Equality of its mutual Pression. By these Actions are produced equal Changes, not indeed of the Velocisies, but of the Mosions of Bodies; (i.e. in such Bodies as have no Impediment any other way) for the Changes of their Velocities, being made towards contrary Parts, (because the Motions are equally changed) are reciprocally proportional to the Bodies them-(elves

REAFFORESTED is used, where a Forest hath been Disafforested, and then made a Forest a-gain: As the Forest of Dean, by 20 Car. 2.

REAP-Towel, or Rip-Towel, was formerly a Gratuity or Reward given to Customary Tenents, when they had reaped their Lord's Corn.

REAR-Half-Files, are the 3 hindermost Ranks of a Battalion when it is drawn up 6 deep.

REAR-Line of an Army encamped; second Line: this lies about 400 or 500 Yards distant from the first Line, which is called the Front-Line Sometimes there is a Third, which is called

REAR. Rank, is the last Rank of a Battallion

REA-

REASON or Reson, and, as some seem to write it more truly, Raising Pieces, are those Pieces of Timber which lie under the Beams on the Brick or Timber in the Side of a House.

REASONABLE-Aid, was a Duty claimed by the Lord of Fee of his Tenants, holding in Soccage or Knights Service to marry his Daughter, or

to make his Son Knight.

REBATE, is a Difference between a certain Quantity of Money, due at a certain Day, and the present Value or Worth of it; or in other words, how much less a Man ought to pay, who pays at the present, a Summ of Money not due till a certain Number of Years, &c. are expired. On this fee an Act both from Equity and a Mathematical Calculus in the Acta Eruditorum Lipfia, from October. 1683, by G. G. Leibnicz.

REBELLIOUS Assembly, is a gathering toge ther of Twelve or more Persons, intending or go ing about, practiting or putting in Ure unlawfully, and of their own Authority, to change any Laws, Statutes, &c. to destroy Enclosures, break down Banks of Fish ponds, &c. unlawfully to ger common; to destroy Deer in Parks, Coneys in Warrens, Doves in Dove Houses, Fish in Ponds. to burn Stacks of Corn, or to abate Rents or Prizes of Victuals, &c. See Ch. 1. Mar. 12. and 1

Eliz. 17.

REBELLUM in some of our old Charters significant on the control of the nifies the same as a Rejoinder, Replication, or

Answer in a Court of Equity.

RECEIVER is commonly used in the Civil Law in an ill Sense, for one that receives stolen Goods, and conceals them; but when annexed to other Words, 'tis used in a very good one; as

RECEIVER of the Fines, which is an Officer that receives the Money of all fuch as compound with the Crown upon an Original Writ in the

Court of Chancery. There is also the RECEIVER General of the Dutchy of Lancaster, which gathers in all Fines, Forseitures, Asses-

ments, &c. within that Dutchy.

RECEPTACLE of the Chile, was known and described by Bartbolomæus Eustachius many Years before the Discovery of the Lacteal Veins, vid.

Koil's Anatom. p. 47, 48. In living Bodies this
Receptacle is easily found, but with greater difficulty in such as are dead. It lies about the de scending Trunk of the great Artery, between the Celiack and Emulgent Arteries, surrounded by several Lymphatick Glands, which are called Glandula Lumbares, which discharge their Lympha into it. It appears to be only a large Bag formed by the Union of the second Order of Lacteals, and many Lymphæducts which open into it; it will contain about an Ounce of Water. Sometimes in Brutes as well as in Men, it is divided into two or three Parts, which at last unite into one Duck a-

bout the Bigness of a Goose-quill.

RECLINATION of a Piane, is the Number of Degrees which any Dial Plane lies or falls backward from the Zenith. This is found easily by the means of long Rules, and a Quadrant; for having drawn an Horizontal Line on the Plane, by a Level or Quadrant, and to it another Line at therefore CD Right-angles, to which apply a Ruler so, that one End of it may hang over or reach beyond the Plane: Then will a Quadrant applied to the under Edge of that Ruler, shew you the Degrees and Minutes of the Plane's Reclination; accounting

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from that Side of the Quadrant that is contiguous to the Edge of the Ruler.

RECLUSE, is one that by reason of his or her Order in Religion is thut up, and cannot ftir out

of a Cloyster, &c. See Liesleson, Sect. 434. RECOGNITIO is the Impannel of a Jury or the Inquest of 12 or more legal Men, who were therefore called Recognitores. So, habere Recognitionem, was to have a Trial or Verdict of Jurors; for Liberty of which a Fine was formerly paid to the King. Recognitio Nova Affic, is a new Trial. RECTA Directrix, is a Line in Conicks made

by the mutual Intersection of the Vertical Plane, with the Plane of the Base. De la Hire.

RECTA Prisa Regn, was formerly a Right the King claimed of taking out of every Ship laden with Wines, One Butt or Pipe, before the Mast, and Another behind it, as a Custom or Duty due to the Crown. K. Edw. 1. in his Charter of Primiles and Another behind it, as a Custom or Duty due to the Crown. vileges to the Barons of the Cinque Ports, among other things, discharges them particularly from this

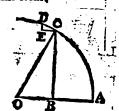
RECTATIO, was a word formerly used for a Claim of Right; or an Appeal to the Law, for the recovery of such a Claimed Right. So also the

Word.

RECTITUDO was then used for a Right or Legal Due; and Oblations and Tithes were called Rectitudines Dei.

RECTIFICATION of Curves. To what hath been said on this Point under Restissing in Vol. 1. and under Cycloid in Vol. 2. twill be proper to add, what the ingenious Mr. Moiore advances in his Illustrious Specimens of the Use and Advantages of the Doctrine of Fluxions: Where he faith, that the Redification of Curve Lines will be ob-tain'd, if we confider the Fluxion of the Curve as a Hypothenuse of a Rectangular Triangle, whose fides are the Fluxions of the Ordinate and Abscisse. But in the Expression of this Hypothenuse, care must be taken that only one of the Fluxions be remaining, as also only one of the indeterminate Quantities, viz. that whose Fluxion is retain'd. Some Examples will render this clear,

The right Sine CB being given, to find the Arch A C. Let AB=x. CB=y. OA r. GE the Fluxion of the Abscisse, ED the Fluxion of the Ordinate, CD the Fluxion of the Arch CA. From the Property of the Circle 21x



-xx=yy, whence 21x 2xx = 277, and there-But C D1 = 11 + xx = And confequently

If rr - yy be thrown into an infinite Series, and

the several Members of it be multiplied into .r ,, and then the flowing Quantity of each be taken, we shall have the length of the Arch A C. After the same manner, giving the versed Sine, the same Arch may be found. For reluming the Equation

found above 2rx - 2xx = 277, we have y =

$$\frac{rr \times x - 2rx \times x + x^2 \times x}{x^2 + x^2 \times x} = \frac{1}{x^2 + x^2}$$

7 r x x -- 2r x x x + x x x x -, that is, (reducing

all to the same Denominator, and expunging . . .

contradictory Terms) ----, whence CD

and consequently the length of the **丰 7.** ×

, J2rx-xx Arch AC may be easily found from what is said

already. The Fluxion of the Curve Line is sometimes more easily found by comparing the two similar Triangles CED, CBO, for this Proportion arises.

CB: CO:: CD, that is for the Circle $\sqrt{2rx-xx}$

:+:: x: r x √2r—xx



The Curve of the Cycloid may be determin'd by the same Method too. Let ALK be a Semi-Cycloid, whose generating Circle is ADL. Having any point as B in the Diameter AL, draw

BI parallel to the Base LK meeting the Peripheus of the Circle in the point D; compleat the Rectangle AEIB, and draw PH parallel to EI and infinitely near toit, as also BI cutting FH in G, and the Curve AK in H. Put AL = d. AB (= El) = x. GH =x. It is known that the right Line BG is every where equal to the Summ of the Arch AD and the right Sine BD: whence 'tis manifest, that the Fluxion I G is also the Aggregate of the Fluxions of the Arch AD and the right Sine BD. But the Fluxion of the Arch AD was found =

and the Fluxion of the right Sine

BD will be found to be dx = 2xx therefore IG

$$2\sqrt{dx-xz}$$

= dx - xx and therefore I H? (= I G! +

$$\sqrt{dx-xx}$$

 $GH_1) = ddxx - dxxx$; from whence IH =

$$\frac{x\sqrt{dd}-dx}{\sqrt{dx-xx}} = \frac{x\sqrt{d}=d}{\sqrt{dx}} = \frac{x\sqrt{d}}{\sqrt{dx}} = \frac$$

quently AI = $2dx = 2\sqrt{dx} = 2AD$. This Conclusion may also be very easily deduc'd from the known Property of the Tangent. For fince the little part of it, as I H, is always parallel to the Chord AD, the Triangles IGH, ABD are similar, whence AB: AD:: GH: IH, that is, x: \dx::

$$x: x \sqrt{dx}$$
, therefore IH $= x \sqrt{dx} = \frac{\frac{1}{3} - \frac{1}{2}}{x}$. By

the help of the Fluxion IH also, we may investigate the Area of the Cycloid. The Fluxion of the

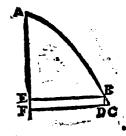
Area AEI, is the Rectangle EIG =
$$dxx - x^2x$$

But the Fluxion of the Portion ABD is the same; therefore the Area AEI and the correspondent Portion (of the Circle) ABD, are always equal.

Let AB be the Curve of the Parabola, whose Axis is AF, Parameter a; let AE = x, E B = y, A B = z,

$$BD = \dot{x}$$
, $DC = \dot{y}$, BC

The Equation expressing the Nature of the



Parabola, being ax = yy, we have ax = 2yy, whence x=2yy; but BCi=BDi+CDi,

that is
$$77 = xx + yy = \frac{4y^2 y^2}{11} + yy = \frac{4y^2 y^2}{11}$$

 47^2 yy + aay y, and therefore $z = y \sqrt{47^2 + 46}$

$$= y \sqrt{y^2 + \frac{1}{4}aa}.$$
 If now by this Expression

Curve AB will easily be known It appears far? ther, that giving an Hyperbolical Space, this Curve

is also given, and vice versa. For 1 a z = y See Court of Requests, in Vol. 1.

 $\sqrt{r^2 + \frac{1}{4}} aa$, and consequently $\frac{1}{2} az$ is the Space

whole Fluxion is $y = \sqrt{y^2 + \frac{1}{4}} aa$. But such a Space is no other than the Exteriour (Equilateral) Hyperbola A B E G, whose Semi-axis A B $= \frac{1}{2} a$, its Abscisse AE = y, and its Ordinate EG =

For the Mensuration of a Surface described by the Conversion of a Curve round its Axis; we are to assume for the Fluxion of it, a Cylindrick Superficies, whose Altitude is the Fluxion of the Curve, and whole distance from the Axis is the Ordinate Applicate corresponding to that Fluxion. Ex. gr. Let AC be the Arch of a Circle, which turning round the Axis AD, generates a spherical Superficies, which we would measure. Now DC the Fluxion of the Arch is already found to be =

, which if we multiply by the Peri-

 $\sqrt{2rx-xx}$

 $\sqrt{2rx-xx}$ (putting — the Ratio of the

Circumference to the Radius) we shall have ex for the Fluxion of the spherical Superficies, and consequently that Superficies it self, is ex.

RECTUM, was used formerly for a Trial Commune Restum was a Trial at Law; or in common Courte of Law: And Stare ad Rellum, was to fland Trial.

REDUNDANT Hyperbola is one so called, because it exceeds the Conical Sections, in the Number of its Hyperbolical Legs; being a Triple Hyperbola with fix Hyperbolical Legs: See

RED Book of the Exchequer is a MS. Vol. of several Miscellany Treatises, in the keeping of the Queen's Remembrancer in that Office; in it are the Number of the Hides of Land, in many Counties, before the Conquest, &c. See Bp. Nicholfon's Hift. Library.

RED seer, when a Piece of Iron in a Smith's Fire of his Forge is heated too much, it will R-dfeer, as they call it, that is, break or crack under the Hammer, while it is working between hot and cold. Some call this Red shire.

RE-Extent in the Law, is a Second Extend made on Lands or Tenements, on a Complaint made that the former Extent was partially performed.

REEVE of a Church is the Guardian of it; or the Church Warden; as Shire Reeve is the Sheriff or Guardian of a County; and Port Reeve the Warden of a Port, or Haven.

REFECTORY was that Place in a Monastery where the Monks, Friars, Nuns, &c. usually Di ne d'and Supped.

REFERENDARY, Referendarius, was a Term insed by the Old Saxons, as appears by Grants and Charters, for such a Person as a Master of Requests was to the King or Queen, amongst us before the Vol. 11. Court of Requests was taken away by 16.17. Car. 1.

REFINING is the Art of separating all other Bodies from Gold and Silver, and this is performed four Ways.

The End of Refining is the Separation of all other Bodies from Gold and Silver, which is performed 4 ways, viz. by Parting; by the Tel; by the Almond Furnace or the Sweep; and by Mercury. 1. Parting is done with the Aqua-fortis. Some Refiners, to make the Aqua fortis, take Salt Peter 3 pound, and Dantzick (not Ba-glish) Vitriol 2 pound (for the English Vitriol makes a weaker Water, and Dirty Colour'd Verditer, and wholly spoils it.) After they are well Bruised and Mixed in a Mortar, they Distill 100 pound of the Materials, put into a Cast-Iron Pot, after this manner.

Build a Furnace 2 Yards high or more; and at the top place in your Iron Pot: To which fit a Head of Earth, like the Head of a large Distillation for Chymical Oyls, which must have a large Belly, branching it self out 8 Inches from the Iron phery belonging to the Radius BC, that is, by Pos, into 3 Branches; one whereof in the midft comes directly straight forward, two other Lateral ones come Obliquely: All which Branches are 4 or 5 Inches hollow in Diameter, and 5 or 6 long. To these Branches are fitted Glass Bodies, Narrow and Hollow at both Ends, Large and Globous in the Midst. These must be exceedingly well Lated on with Colcothar, Rags, Flour and Whites of Eggs. To the first Glass Body is Lated on another Glass, of the same Figure and Size, and in order 8. alike in all, till they come to the Receiver, which is an Ordinary Gallon Glass. All These Rows of Glasses lie on Boards shelving from the Hedd to the Receiver. The two Upper Receivers or Glass Bodies need Exceeding good Luting, for the rest Ordinary Lute will serve.

The Luce is made of good Lome, some Horfedung, and a little Colcothar; although the two former do well.

A little Fire and that of Newcastle Coals does the Work. And you need never Break or Unlute any of the Receivers; but the Lowermost.

The Aqua foreis being Distilled off, is put into a large Earthen Pot, and there is added of Fine Sil. ver, one or two Penny weight (which is called Fixes) to every Pound of Aqua-forris, which within 4 bours, will purge it from all Dirt and Impusrity, and make it fit for Parting, which is thus

If their Silver Gilt be Fine enough for Wire, they only Melt it in a Wind Furnace, and Caft it, Melted, into a large Tub of Water, that they may have it in small Pieces; but if it be but Standard, they first Fine it on the Test. These small Pieces taken from the Water, being well Dryed, are put into a Glass Faper-fashion'd, a Foot High, and inches at the Borrom; and then the Glaffes are Charged with Aqua-fortis about 2 thirds of it, and fet in a Range of Iron covered 2 Inches deep with

Sand, and a Gentle Charcoal Fire is made under it.
Small Bubbles will foon arife, and the Warer
allo run over. If 10, they rake off the Glasses, and hold them till it doth Defervescere, or elle pour out some of it into a Vessel which is at Hand.

If Lead be Mixed with it, they cannot keep it from Running over.

When

this Ebullition, it will Rife no more.

Quantity of Copper contained in it.

If the Water Boil over, 'twill Penetrate the

Bricks and Wood.

They commonly let it stand a Night on the Iron-Range, with a gentle Heat under it, and in the Morning softly pour off the Water impregnated with all the Silver; all the Gold lying like black Dirt at the bottom; which being washed out is put into small Parting glasses, and set over the Sand with their Conduit Water for an bour, and then the Water poured off. This is repeated 5 or 6 times, to Separate the Salt from the Gold, which is now fit to be melted, and cast into Ingots,

To regain the Silver, they have large Round Washing Bowls, lined within with melted Rosin and Pitch (for otherwise the Water would eat the Wood, and penetrate the fides of the Bond) covered with Copper Plates 10 Inches long, 6 wide, and Half or more thick. Into which Bowls they pour good store of Water (the more, the better the Verditer) and then the Silver Water, which working on the lofter Metal of Copper, leaves all the Silver in most fine Sand at the Bottom, and Sides of the Bowl, and Plates of Copper; which being taken out, is Washed, Dryed and Melted for

If any Brass or Shroffe Metal be in the Plates, they gather very little of the Silver; the Latter

mixing with the Silver.

With the Copper-water, poured off from the Sil-They ver, and Whiting, Verditer is made thus. put into a Tub a Hundred Pound weight of Whising, and thereon pour the Copper-water, and fir them together every Day, for some Hours toge-ther. And when the Water grows pale, they take it out, and let by for farther Use, and pour on more of the Green Water; and so continue till the Verditer be made; which being taken our, is laid on large Pieces of Chalk in the Sun, 'till it be dry for the Market.

The Water mention'd to be taken from the Verditer, is put into a Copper, and boiled till it comes to the Thickness of Water-Gruel, now principally confisting of Salt-Peter deduced, (most of the Spirit of Visriol being gone with the Copper into the Verditer,) a Dish full whereof being put into the other Materials for Aqua-fortis, is Re-distilled, and makes a Double-water, almost Twice as

good as that without it.

2. By the Test, all Metals are separated from Silver, except Gold, because they swim over it, when they are all melted together.

The Test is thus made. They have an Iron Mould, Oval, and two Inches Deep. At the Bottom hereof are 3 Arches of Iron, set at Equal Distances, 2 Fingers wide, if the great Diameter of it be 14 Inches long; and so proportionable in Greater or Lesser Tests. This Cavity they fill with fine Powder of Bone-Ashes, moistened with Lixivium, made with Soup-Ashes. Some use Cakes of Pot-Ashes, or other Ashes well cleansed, and so pressed well together with a Muller, that it be comes very close and smooth at the Top. There is left above, a Cavity in the Midst of it, to contain the melted Silver. This Cavity is made greatest in the Middle; for the Bone-Ashes come up a small Channel in that End, which is most re lows.

When the Water hath been once Quieted from mote from the Blaft, for the Running off of the Baser Metals, and so is made Declive to the Cen-The Greenne's of the Water, manifesteth the ter of the Test, where its not above half an Inch deep

The Test thus made, is fet Annealing 24 Hours, and then 'tis fet in a Chimney a Yard High, parallel almost to the Nose of a great Pair of Bellows; and then therein is put the Silver. Which being covered all over with Billets of Barked Oak, the Blast begins, and continues all the while strongly. The Lead, purify'd from all Silver, (which they call the Soap of Metals) first put in, melts down with the Silver, and then the Lead and Copper swim at the Top, and run over the Toft. Whose Motion the Refiner helps with a long Rod of Iron drawn along the Surface of the Silver towards the fore mention'd Slie; and often ftirring all the Metal, that the Impurer may the better rise; and by continuing this Course, Sepa-ration is made in 2 or 3 Hours.

The greatest part of the Lead slies away in

If the Lead be gone before all the Copper, 'twill rise in small Red siery Bubbles; and then they say the Metal Drives, and must add more Lead. The force of the Blast drives the Higher Metals to the lower fide of the Test, and helps its running

When the Silver is fully Fined, it looks like most pure Quick-filver; and then they take off their Sogs and let it Cool. In the Cooling, the Silver will frequently from the Middle, spring up in small Rays, and fall down again. If moist Silver be put into that which is melted, twill spring into the Fire.

A good Test will serve two or three Firings. So soon as the Silver will hold together, they take it out of the Test, and beat it on an Anvil into a round Figure, for the Melting Pot; which being set in a Wind Furnace, surrounded with Coal, and covered with an Iron-Cap that no Charcoal fall into it, is then melted.

If any Drofs or Filth be in the Melting-Pot, they throw in some Tincal, which gathers the Drofs together, that it may be separated from it.

These Melting Pots are never Burned, but only Dryed, and last a whole Day, if they be not suffered to Cool; but if they once Cool, they infallibly Crack.

3. In the Almond Furnace or Sweep, all forts of Metals are separated from Cinders, parts of melting Pots, Tests, Brick, and all other harder Bodies; which must be first beaten into small Pieces with a

Hammer on an Iron Plate.

Those which stick but superficially to the Sil ver, they Wash off thus; they have a Wooden round Instrument 2 Foot wide, somewhat hollow in the Middle, with a Handle on each side. On this they put the Materials, and hold them in a Tub of Water below the Surface, and so waving it to and fro, all the lighter and loofer matter is separated from the Metal.

The Furnace is 6 feet High, 4 feet Wide, and 2 feet Thick, made of Brick; having a Hole in the Midst, at the Top 8 Inches over, growing Nar-rower towards the Bottom of it, where on the Fore-part, it ends in a small Hole, environed with a Semi-circle of Iron, to keep the Molten Metal. About the Middle of the Back, there is another parallel to the Circumference of the Mould; only Hole to receive the Nose of a great Pair of Bel-

When

and Hor, they throw two or three Shovels of Coal. to one of the fore-mention'd Stuff, and so pro- the reflected Axis. ceed during the whole Work, which continues three Days and Nights, without Intermission. After Eight or Ten Hours the Metal begins to run; and when the Receiver below is pretty full, they lade it out with an Iron Ladle, and cast it into Sows in Cavities, or Forms, made with Ashes.

They frequently stop the Passage Hole with Cinders to keep in the Heat; and when they think a Quantity of Metal is melted, they Unstop the Hole

to pals it off.

If the Stuff be hard to Flux, they throw in some Slag (which is the Recrement of Iron) to give it Fusion.

A stinking blue Smoak proceeds from the Furnace, and all By standers put on the Colour of Dead

To get the Silver from those Metals, and to Re-

no other Art than that of the Teft.

4. By Quick filver the Filings of Gold and Silver are separated from Dust, &c. This Dust is put into a Hand Mill with Quick silver, and being continually Turned upon that and the Metals, an Amalgama is made of them, and Fair Water poured in, carries off the Dust as it runs out again by a small Quill.

This Amalgama is put into an Iron, with a Bolthead set into the Fire, having a long Iron Neck 3 Feet long, to which is fitted a Receiver. The Fire Distills off the Mercury into the Receiver, and the Gold and Silver remains in the Bolt bead.

Hour lines, Azimuths, Parallels of Declination, or of Altitude, &c. and all the Furniture of Dials; on such Places as the Suns direct Rays can never in the reversed Axis defired. come to directly, but only by the help of some reflecting Surface; as suppose on the Ceiling of a Room, Se where the Beams may be reflected by a piece of Looking Glass placed on the Board. Stool or Transome of a Window; or other convenient place: And this may be done either by a Glass placed Horizontally, or at oblique Angles to the Horizon.

1. If the Glais be placed Horizontally, you may, by the following Method, upon any Wall or Ceiling of a Room, where that Glass can reflect a Spot of Light, draw erue Hour Lines, Furniture, &c. tho' the Surface be never so irregular, as convex, concave, or of any form whatfoever.

First, draw on Past board or other Material, or get made in Brass an Horizontal Dial for the La-

titude proposed.

Then by the help of the Azimuth, or at the time when the Sun is in the Meridian; or by knowing the true Hour of Day, whereby may be drawn several Lines on the Ceiling, Floor, and Wall of the Room; so as in respect of the Central of the Classic C tre of the Glass they may be in the true Meridiancircle of the World: For if right Lines were extended from the Centre of the said Glass by any Point, though elevated in any of those Lines so drawn, it would be directly in the Meridian circle of the World.

Now all reflective Dialling is performed from that Principle in Opicks, which is, That the Angle lower at pleasure, till it, as formerly, touch the said of Incidence is equal to the Angle of Restetion. And same Hour Thread, and mark again where about as any direct Dial may be made by help of a Point on the Wall or Ceiling, the End of the said Thread.

When the Funace is Annealed with Charcoal found in the direct Axis, so may any reflected Dial be also made by help of any Point found in

> And in regard the reflected Axis for the most part will fall above the Horizon of the Glass without the Window, so that no Point there can be fixed, therefore a Point must be found in the said reflected Axis continued below the Horizontal of the said Glass, until it touch the Ground or Floor of the Room in some part of the Meridian formerly drawn, which Point will be the Point in the reversed Axis desired, and may be found, as followeth.

One End of the Thred being fixed at or in the Centre of the said Glass, move the other End thereof in the Meridian formerly drawn below the said Glass, until the said reversed Axis be depressed below the Horizon, as the direct Axis was elevated above the Horizon, which may be done To get the Silver from those Metals, and to Re- by applying the Side or Edge of a Quadrant to the fine their Copper from the Liebarge, they now use Thred, and moving the End thereof to and fro in the said Meridian, until the Thred with a Plummet cut the same Degree as the Pole is above the Horizontal Glass, and then that Point where the End of the Thred toucheth the Meridian either on the Floor or Wall of the Room, is the Point in the reflected reverled Axis sought for.

Now if the reverled Axis cannot be drawn from the Glass by reason of the jetting of the Window or other impediment, that Point in the reverse Axis may be found by a Line parallel thereto, by fixing one End of it on the Glass, and the other End in the Meridian, so as that it may be parallel to the Floor or Wall in which the reverled Axis point will fall, and find the Axis point from that REFLECTED Dialling is the Art of describing other End of the Lath: so if the same Distance be set from that Point backward in the Meridian on the Floor, as is the Lath, the Point will be found

Thus having found a Point in the reflected reversed Axis; it is not hard, by help whereof and the Horizontal Dial, to draw the reflected Hourlines on any Celling or Wall, be it never so concave or convex.

To do which; First note, that all straight Lines in any projection or any Plane, do always represent great Circles in the Sphere, such are all the

Hour lines.

Place the Centre of this Horizontal Dial in the Centre of the Glass, the Hour lines of the said Dial being horizontal; and the Meridian of the World, which may be done by Plumb lines, let fall from the Meridian on the Ceiling: Then fix the End of a Thread or Silk in the said Centre of the Dial or Glass, and draw it directly over any Hour line on the Dial which you intend to draw at the further side of the Room, and there let one hold or fasten that Thread with a small Nail.

Then in the Point formerly found on the reverled Axis on the Floor, fix another Thread there (as formerly was done in the Centre of the Dial) then take that Thread, and make it just touch the Thread (on the Hour line of the Horizontal Dial extended) in any Point thereof, it matters not where abouts, and mark where the End of that Thread toucheth the Wall or Ceiling, and there make some Mark or Point.

Then again move the same Thread higher or

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also toucheth. In like manner may be found more Points at pleasure, but any two will be sufficient for the projecting or drawing any Hour-line on Line. any Plane, how irregular soever. For if you move bring the said Thread directly between your Eye and the Points formerly found, you may project thereby as many Points as you please at every Angle of the Wall or Ceiling, whereby the reflected Hour-line may be exactly drawn.

Again, in like manner remove the said Thread fastned in the Centre of the Horizontal Dial, (which also is the Centre of the Glass) on any other Hour-line desired to be drawn, and as before fasten the other End of the Thread, by a small Nail, or otherwise at the further Side of the Room, but so that the said Thread may lie just on the Hour-line proposed to be drawn on the Horizontal Dial. Then (as besore) take the Thread fastened in the Point on the reflected Axis, and bring it to touch the Thread of the Hour line in any part thereof, and mark where the End of that Thread toucheth the said Wall or Ceiling: Then again (as before) move the said Thread so, as that it only touch the said Thread of the Hour line in any other part thereof, and also mark where the End of that Thread toucheth the said Wall or Ceiling: So is there found two Points on the Wall red, by help of which two Points the whole Hourline may be drawn; for if (as before) a Thread be so situated, that it may interpose between the Eye and the said two Points found, you may make many Points at pleasure, whereunto the said Thread may also interpose, which for more Conveniency may be made at every Angle or bending of the Wall or Ceiling, be they never so many: So that if Lines be drawn from Point to point, that said reflected Hour-line will be also exactly drawn.

In like manner may the Hour-lines be drawn fo, that the Reflex or Spot of the Sun from the said Horizontal Glass situated in the said Window (as before) shining amongst the said re-flected Hour-lines drawn on the Wall or Ceiling, will exactly thew the Honr of the Day defired.

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To draw the Equator and Tropicks on any Wall or Ceiling to any Horizontal reflecting Glass.

1. To draw the reflected Aquator or Equinoctial line on the Wall or Ceiling, which represents a great Circle.

Glass, and move the End thereof to and fro in the Meridian line drawn on the Ceiling, until by help of a Quadrant the said Thread be elevated equal to the Complement of the Latitude, (which will Thread falls; then on that Point and the said Meridian line on the Ceiling erect a perpendicular Line, which Line may be continued on any Plane whatfoever, and is the reflected Equinoctial-line defired.

Note that all great Circles are right Lines, and are always drawn or projected from a right

a Thread, and also your Eye to and fro, until you 2. To draw the Tropicks. Note, that all Parallels of Declination are lesser Circles, and are Conick Se-

> First, make or take out of some Book a Table of the Sun's Altitude for each Hour of the Day calculated for the Place of the Latitude proposed, take the Thread fixed in the Centre of the Glass, and by applying one Side of a Quadrant to the faid Thread, and moving one End of it to and fro in the Hour-line proposed, elevate the said Thread answerable to the Suns height in that Hour, when he is in that Tropick you desire to draw, and mark where the End of that Thread so elevated toucheth in that Hour-line proposed. So may you in like manner find a several Point in each Hourline for the Suns height in that Tropick, whereby a Line may be drawn on the Wall or Ceiling from Point to point formerly made in the said Hourlines, which is the Tropick defired.
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> In like manner may any Parallel of Declination

be drawn: If there be first calculated a Table of the Sun's Altitude at all Hours of the Day, when or Ceiling, being in the reflected Hour line desi-the Sun hath any Declination proposed, whereby may be drawn either the Parallels of the Sun's place, or the Parallels of the Length of the Day.

> To draw the Paralle's of Declination to any refletted Glass mist easily, by help of a Trigon first made on Past-board or other Material.

Fix the Trigon to the reflected reversed Axis, so that the Centre of the Trigon may be in the Centre of the Glass, then will the Equinoctial on the Trigon be perpendicular to the said Axis: Then take the Thread fixed in the Centre of the Glass, and lay it along either of the Tropicks, or other Parallels of Declination required, which is drawn on the said Trigon, which Thread must be continued so, that the End thereof may touch any Hour-line, and on that Hour line mark the Point of Touch, the Thread being fill laid on the same Now if Lines be drawn round about the said Parallel of Declination on the Trigon: In the same Room, equal to the Horizon of the said Glass, it manner find a Point in each Hour line. Lastly, will shew when the Sun is in or near the Hori-draw a Line by those Points so found, which will be the Tropick-line or other Parallel of Declination, as the Thread was laid on, on the Trigon.

> To draw the Azimuth-lines on any Wall or Ceiling to any Horizontal reflecting Glass. Note, that all Azimuths are great Circles.

First, find a Vertible point, either above to the Zenith, or below to the Nadir of the Glass (by Take the Thread fixed in the Centre of the some called a Perpendicular or Plumb-line) and mark in what Point it cuts the Floor of the Room, which Point I call the reflected Vertical-point, wherein the End of a Thread is to be fixed: For by a Point found in the reflected Axis of the Hobe always perpendicular to the reversed Axis) rizon the Azimuths may be drawn, as by a Point marking in the Meridian where the end of that found in the reflected Axis of the Equinocial the Hour-lines may be drawn:
Then on Past-board or other Material draw the

Points of the Compass or other Degrees, and fix the Centre thereof in the Centre of the Glass, and the Meridian thereof in the Meridian of the World,

as was shewn in arawing the Hour-lines, being

careful to place it Horizontal.

Then take the Thread fixed in the place of the Glass, and draw it over any Azimuth, which is defired to be drawn, and at the further fide of the Room fasten that Thread with a small Nail as it was in drawing the reflected Hour-lines: Then take the Thread whose End is fastened in the said reflected Vertical-point, and bring that Thread fo as just to touch the said Horizontal Thread, and augment it, until the End thereof touch the Wall or Ceiling, and there make a Mark or Point. In like manner, move the taid Thread, whose End is fasten'd in the said Vertical point, higher or lower at pleasure, till as formerly it touch the said Horizontal Thread, and mark again where-abouts the End thereof toucheth the faid Wall or Ceiling: Now by help of these two Points found in the reflected Azimuth-line, the whole Azimuth Ceiling, and there make a Mark or line may be drawn; for if (as before in drawing there one Point found on the Wall the Hour-lines) a Thread be so situated, that it the respected Horizon of the World. may interpose between the Eye and the said two Points, you may make many Points at pleasure to which the faid Thread so situated may also interpose, which may be made at every Angle or bending of the Wall or Ceiling (as before) whereby the reflected Az muth line defired may be drawn. In like manner may the other reflected Azimuth lines be drawn.

Also there may be Lines drawn parallel to the Horizon round about the Room, by help of the Thread fixed in the Centre of the Glass, and a

Thus have I showed the drawing of a reflected Dial from an Horizontal Glass, with all the usual Furnisure thereon, though the Wall or Place on which it n to be drawn, be never so gilbous or irregular, or in what shape seever.

Now the Glass may be exactly situated Horizontal, if you draw a reflected Parallel for the present Day, and know also the true Hour, and so place the Glass, that the Spot or Reflex of the Sun may fall thereon on the Ceiling, for there is no way by an Instrument to do it, the Glass is so fmall.

2. If the Glass be placed obliquely, and not parallel to the Horizon, it will recline with some Angle from the Zenith, and then to draw the reflected Dial true, these two Things are principally to be confidered.

- 1. The Reflected Horizon.
- 2. The Refletted Meridian.

Note the Horizon and Meridian are two great Circles.

1. To draw the reflected Horizon according to the Situation of any reclining Glass whatsvever.

First, let two Pieces of nealed Wire be fastened on the Window on each side of the said Glass, the Plummet be in the direct Meridian of the World Ends thereof being without the Room in the Air, with the Centre of the Glass. Then (as before) at whose Ends let there be fastened a Thread which tie a Thread cross the Room, in such sort that may be pulled straight at pleasure, by bending of from or by some part of the said Thread both the

of each Wire be exactly Horizontal with the Centre of the Glass, which may be tried by a Quadrant: Then I tie a String or Thread cross the Room, in such a Sort that I may from most part of the Thread lee the reflecting Glass, and therein the said Horizontal Thread without the Room: Then on the said Thread cross the Room, I tie a slipping Knor to move to and fro at pleasure, which Knot I move to and fro on the said Thread, until by looking in the said Glass I find from my Eye the said Knot and part of the Horizontal Thread without, all as it were in a right Line, the one interpoling the fight of the other. Then being careful to keep the Knot in that polition, fasten one End of a Thread in the place of the Centre of the reclining reflecting Glais, and bring that Thread to, as just to touch the aforesaid Knor, augmenting that Thread, until the End thereof touch the Wall or Ceiling, and there make a Mark or Point; so is there one Point found on the Wall or Ceiling in Then I begin again, and remove the position of that Thread (which went overthwart the Room) either higher or lower at pleasure, still having regard that I may from the most part of the said Thread see the reflecting Glass, and therein the same Horizontal Thread without the Room. Then, as before, I move the said Knot on the said Thread to and fro. until (as before) by looking in the faid Glass ${f I}$ find from my Eye the faid Knot, and part of the Horizontal Thread both in one right Line, the one Thread fixed in the Centre of the Glass, and a interposing the sight of the other; and by the said Quadrant for the Elevation thereof, which will Knot I bring the Thread, whose End is sastened shew the Sun's Altitude at any appearance there-lin the Centre of the said Glass, and keeping it just to touch the said Knot, I continue it, until the End thereof touch the Wall or Ceiling, as before, and there I make another Mark or Point; so is there two Points found in the said reflected Horizon on the Wall or Ceiling. By which said two Points, if a Thread (as before) be so situated, that it may interpose between the Eye and the laid two Points, there may be many Points to be in the same Interposition of the Thread, which (as before) may be made at every bending or Angle of the Wall or Ceiling, whereby the refler Ged Horizon defired may be drawn, by drawing a Line from point to point round about the Room; which will be the true reflected Horizon according to the Situation of the Glass.

> 2. To draw the Reflected Meridian, according to the Situation of any Reclining Glass whatsoever.

First take a Lath or thin Piece of Wood of any convenient Length at pleasure, as some one and an half, or two Foot long, and at each End thereof make a Hole, the one to hang a Thread or Plummet, and the other is to put a small Nail therein to fasten it in some part of the Window over the Centre of the Glais, so that the Thread and Plummer may hang without the Room: Then by help of the Sun's Azimuth you may draw the Meridianline. (as before) as if the Glass were horizontal, and move the Lath with the Thread and Plummet at the End of it to and fro, until the Thread and the Wire, then bend those Wires upward or reclining Glass and the Thread to which the Plum-downward, until the Thread fastened at the End met is fastened may be seen at one Time: Then

(as before) on the said Thread, which crosses the Room, I tie a slipping Knor, which I move to and fro on the said String, until by looking in the said Glass I find from my Eye the said Knot and some part of the perpendicular Thread without, all as it were in one right Line, the one shadowing or interpoling the fight of the other; being then very careful to keep that Knot in the same Postion, then take the Thread (the End whereof being fastned in the said Centre of the Glass) and bringing it just to touch the said Knot, I augment that Thread, until the End thereof touch the said Wall or Ceiling, and the said Thread also touch the Knot, as before: Then in that place where the End of the said Thread toucheth the Wall or Ceiling, I make a Mark, which Mark or Point will be directed in the restected Meridian of the World, according to the Situation of that Then again I remove that Thread, (over-Glass. thwart the Room) on which the said Knot is, either higher or lower than it formerly was, at pleafure, still having regard that from some part of the said Thread within, you may see both the reclining Glass and the perpendicular Thread without at one Time; and (as before) move the said slipping Knot on the said Thread, until by looking in the said reclining Glass, you see the said Knot and some part of the perpendicular Thread without in one right Line, so as the one shadows or hinders the fight of the other, (as before) which Knot then must not be removed from its Situation; then take that Thread (whose End is fastened in the Glass) and bring it to touch that Knot, the End of the faid Thread being continued to touch the Wall or Ceiling: so is that Point of Touch on Meridian of the World. So is there two Points found in the said reflected Meridian on the Wall or Ceiling; by which, if a Thread (as before) be so situated, that it may interpose between the Eye and the said two Points, many Points thereby in the faid reflected Meridian may be made at every Bending or Angle of the Wall or Ceiling, whereby the reflected Meridian defired may be drawn, by drawing a Line from Point to point obliquely in the Room, which will be the true re-flected Meridian of the World, according to the Situation of that Glass.

Now this reflected Horizon and Meridian being first drawn, they will be of great use in drawing the Hour-Lines, together with all the Furniture that possibly can be drawn on any Dial.

To draw the Reflected Hour-Lines to any Reclining Glass on any Plane whatsoever, that the Sun will be reflected on: By belp of an ordinary Horizontal Dial for that Latitude.

First, extend several Threads from the Centre of the Glass to the extremity of the reflected Horizon in the Room (which for more Conveniency and Use may be the several Hour-lines, and may also serve as a Bed to situate the Horizontal Dial on the reflected Horizon) having regard to fituate the Centre of the Dial on the Centre of the Glass, and the Meridian of that Dial on the re-

fastened in the Centre of the Glass, and move the other End thereof to and fro in the reflected Meridian under the reflected Horizon, until by help of a Quadrant the said Thread is found to be depressed under the reflected Horizon, equal to the Latitude of the place, and where the End of the said Thread intersects or meets the reflected Meridian either on the Floor or Wall, that Point is the reflected reversed Axis, as was required. In which Point fasten one End of a Thread, which Thread will be of great use in drawing the reflected Hour-lines on any Wall or Ceiling whatfoever. Now if this Thread, whose End is fastened in a Point on the reflected reversed Axis, be taken and brought to touch any part of any one of the Threads of the Hour-lines (produced to and fastened in the reflected Horizon) the faid Thread being continued so, as the End thereof may touch the Wall or Ceiling, and also any part of the said Thread touch the Hour-line or Thread proposed; that Point on the Wall or Ceiling is in the reflected Hour line desired to be drawn: Also the other Point in the same reflected Hour-line may be found; if the said Thread, whose End is fastened in the reflected Axis, be brought to touch some other part of the same Hour-thread proposed; so that when (as before) the End of the said Thread toucheth the Wall or Ceiling, some part of that Thread may also touch the Hour-line defired, which Point or Touch on the Wall or Ceiling, is also another Point in the said reflected. Hour line desired. By which two Points so found (as before) the reflected Hour-line may be drawn by a Thread, projecting from those Points from the Eye, as it was formerly directed in drawthe Ceiling another Point found in the reflected ing the reflected Hour-lines to an Horizontal

> To draw the Reflected Equinoctial line, and also the Tropicks on any Wall or Ceiling, to any Reclining Reflecting Glass.

1. To draw the Reflected Equincctial-line on the Wall or Ceiling.

Take that Thread, whose End is fastened in the Centre of the reclining Glass, and move the other End thereof to and fro in the said reflected Meridian formerly drawn, until (by help of a Quadrant) the said Thread is elevated above the reflected Horizon formerly drawn, equal to the Complement of the Latitude, (which as before will be always perpendicular to the reversed Axis) and make a Point in the said reslected Meridian, where the End of the said Thread toucheth; then on that Point and the said reflected Meridian on the Ceiling, raise a perpendicular Line, which is the reflected Equinoctial line desired.

2. To draw the Reflected Tropicks, or other Parallels of Declination.

First, (as before) make or take out of some Book or Table of the Sun's Altitude for each Hour of the Day, calculated for the Place of Latitude proposed, when the Sun is in either of the Tropicks, or other parallel of Declination: Then take that Thread, whose End is fastened in the Centre flected Meridian of the World: Then to find the of the Glass, move the other End thereof to and Point in the reflected reversed Axis on the Floor of fro in the Hour-line proposed, until by applying the Room: Take a Thread, one End thereof being one side of a Quadrant to the said Thread you

find the faid Thread elevated above the reflected Horizon answerable to the Sun's height in that Hour proposed, when he is in that Tropick or Degree of Declination proposed. Which Altitude required will be found in the foresaid Table for that End calculated, which said Thread being of the Elevation above the reflected Horizon, as the said Table directeth: Then mark where the End of the Thread (so elevated) toucheth the Wall or Ceiling in that Hour line: So is one Point found the Horizon: Hence the reflected Vertical-point, in the reflected Parallel of Declination defired to whereby the reflected Azimuth-lines are drawn, be drawn. In like manner, find in the said Table in the same Parallel or Degree of Declination what Altitude the Sun hath at the next Hour, and elevate the laid Thread, whole End is fastened in the Centre of the Glass, equal to the Sun's Altitude in that Hour above the faid reflected Horizon, by help of the faid Quadrant, and where the other End of the said Thread salleth in the Hour-line proposed, make another Mark or Point. And so in like manner make the Points (belonging to that Parallel of Declination) in the remaining Hourlines, according to the several Altitudes found in the said Table of Altitudes: Then drawing by hand a Line to pass through those several Points so found as before, which Line is the reflected Parallel of the Sun's Declination desired. In like Declination, which may have respect to the Sun's place, or the Length of the Day, as shall be de

To draw the Said reflected Tropicks, or other Parallels of Declination, without any Tables cal culated, only by belp of a Trigon first made on Past board, or other Material. Note, that all Parallels are leffer Circles.

First (as formerly is shewed in drawing the Parallels of Declination to a reflecting Horizontal Glass) fasten the Trigon on the reflected reversed Axis, so that the Centre of the Trigon may be in the Centre of the Glais, then also will the Equi-noctial on the Trigon be perpendicular to the said reflected reversed Axis: Then take the Thread fixed in the Centre of the said Glass (which is also in the Centre of the Trigon) and lay it upon that Parallel of Declination, drawn on the faid Trigon, whose reflected Parallel is required to be drawn on the Plane or Ceiling: Then move the Trigon, the Thread lying on the said Parallel, until the End of the said Thread touch any Hour-line on the said Wall or Ceiling, in which Point of Touch on that Hour-line make a Mark, so will that Point be in the reflected Parallel of Declination desired. In like manner, move the said Trigon, still keeping the Thread on the same Parallel. until the End of that Thread touch another Hourline on the said Plane or Ceiling, and there also make another Mark. And so in like manner find a Point in each Hour-line, through which that re flected Parallel must pass; then drawing a Line to pass through those several Points on the said Plane two Points being found will be sufficient. or Ceiling, which Line is the reflected Parallel of the Sun's Declination defired.

In like manner may be drawn any other reflected Parallel of Declination required.

To draw the Reflected Azimuth lines to any Reclining Glass, or any Plane whatsoever that the Sun-beams will be reflected on. Here nose that Azimuths are great Circles.

First, know that the reflected Vertica!-point in the Axis of the reflected Horizon, will always be found in the reflected Meridian. And look how many Degrees the reflected Horizon differs from the direct Horizon, so many must the restected Axis of the Horizon differ from the direct Axis of may be thus found.

Take that Thread whose End is fixed in the Centre of the Glass, and move the other End thereof to and fro in the reflected Meridian, until by applying one Side of a Quadrant thereto, you find the said Thread depressed just 90 Degrees, or perpendicular under the reflected Horizon; then make a Mark or Point where the other End of the faid Thread toucheth the faid reflected Mcridian on the Wall, Ground or Floor of the Room, which Point so found, is the reflected Verticalpoint desired, in which Point fasten one End of a Thread:

Then on Past-board or other Material draw the Points of the Compass or other Degrees, placing the Centre thereof in the Centre of the Glass, and manner may be drawn all or any other Parallel of the Meridian thereof in the reflected Meridian of Declination, which may have respect to the Sun's the World, which said Past-board must be also situated in the reflected Horizon just as the Horizontal Dial was formerly directed to be fituated for drawing the reflected Hour-lines: And as the Threads from the Centre fastened in the reflected Horizon were also the Hour-lines on the Horizontal Dial, whereby the reflected Hour-lines were drawn: So now the Threads from the Centre fastened in the reflected Horizon may be the Horizontal Azimuth-lines, whereby the reflected Azimuth-lines may be drawn: Or if that Thread, which is fastened in the Centre of the Glasse drawn exactly over any Azimuth-line, the End whereof being fastened by a Nail or other Means in the reflected Horizon on the other Side of the Room. there may several Points be found in the Wall or Ceiling, through which the reflected Azimuth-line

must pass, as followeth: Take that Thread, one End of which is fastened in the said Vertical-point, and bring it just to touch the Azimuth-thread formerly fastened, and continue it until the End thereof touch the Wall or Ceiling, (and also the Thread it self touch the said Azimuth it self, as before) in which Point of Touch on the Wall or Ceiling make a Mark, thro which Point that reflected Azimuth-line must pass. Then move the faid String fastened in the said Vertical-point, so that it may just touch the said. Thread again, but in another place: Then as before continue that Thread, until the End thereof touch the Wall or Ceiling again, as before, and there make another Mark, through which the faid reflected Azimuth-line must also pass: In like manner may more Points be found for your further Guide, in drawing that Azimuth-line. But

To draw any Reflected Line by any two Points gia ven over any Plane whatsoever, without projecting by the Eye.

Fasten two Threads in the place of the Centre of the said reclining Glass, drawing the said Threads

Threads straight, fastening each of the other Ends in the two reflected Azimuth-points formerly found on the Wall or Ceiling. Then fittuate a Thread cross or thwart the Room, so as it may cross those other Threads from the Centre, near at right Angles, and also just touch both of them in that Situation. By which faid Thread crois the Room may any Number of Points in the said restected Azimuth line to be drawn, be found at pleasure: For if the End of another Thread be also fastened in the Centre of the said Glass, making the other End thereof to touch the Wall or Ceiling, but so that it may also just touch the said Thread, which is fastened cross the Room, which Point of Touch on the said Wall or Ceiling is another Point in the said reflected Azimuth-line required to be drawn. In like manner may more Points be found at every Angle or Bending of the Wall or Ceiling for the exacter drawing the reflected Azimuth-line required, which doth find Points, whereby is drawn the same restected Azimuth-line (or other Lines) as was formerly done by a Thread to fituated, that it may interpose between the Eye and any two Points assigned on the Wall or Ceiling.

In like manner, if the Thread fastened on the further Side of the Room were removed to another Azimuth-line on the faid Past-board, and then fasten it again on the further Side of the Room (as before) you may by help of the said Thread, sastened in the said Vertical point, find several Points on the Wall or Ceiling, thro' which that Azimuth-line will pass: So may you either by this or the former way draw what Azimuth-lines you please, either in Points of the Mariner's Compass or Degrees, as you please, by drawing it first on Past-board, as before is directed.

And note generally, that such Relation the point found on the Floor or Ground in the reflected reverled Axis, hath to the Hour-line drawn on the Horizontal Dial, in drawing the reflected Hourlines. The same hath the teflected Vertical-point drawn on the Past-board in the drawing the reflected Azimuth-lines.

To draw the Reflected Parallels of the Sun's Altitude, or Proportions of Shadows to any Reclining Glass on any Plane whatsoever, that the Sunbeams be reflected on. Here note, that Parallels of Altitude are lesser Circles, therefore are not represented by a Right-line.

First, know generally that what respect the Parallels of Declination have to Hour-lines, such have the Parallels of Altitude to the Azimuths.

For if one End of a Thread be fastened in the muth-line, until the said Thread be elevated any Latitude defired.

Number of Degrees proposed above the reflected Horizon (the Elevation of which Thread being found, by applying a Quadrant thereto) and making a Mark or Point where the End of the said Thread toucheth the said reflected Azimuth drawn on the Wall or Ceiling, that Point so found is the Point through which that Almicanter or reflected Parallel of the Sun's Altitude must pais.

In like manner, remove the other End of the said Thread fastened in the Centre of the Glass to another reflected Azimuth-line, and (as before) move it higher or lower, until by applying the Edge of a Quadrant to that Thread, you find the said Thread above the reflected Horizon on the same Number of Degrees first proposed, and at the End of the said Thread in that reflected Azimuthline drawn on the Wall or Ceiling, I make ancther Mark or Point, through which the same reflected Almicanter or Parallel of Altitude must also pass: And so in like manner I find a Point on each reflected Azimuth-line, through which the same Parallel of Altitude must pass. Then drawing by hand a Line to pass through these several Points so found, as before, that Line is the reflected Parallel of the Sun's Altitude proposed. In like manner may be drawn all the other Parallels of Altitude defired, which will shew the Sun's Altitude or the Proportion of any Shadow to its Altitude, at any Appearance of the Sun's Reflexion thereon.

To draw the Jewish or old Unequal Hour-lines to any Reclining Glass on any Plane whatsoever that the Sun-beams will be reflected on. Here note, that the Jewish Hour-lines are great Circles.

First, (by the Rules formerly given) draw two reflected Parallels of Declination of 16 deg. 55', the one being near the Summer, and the other near the Winter-Tropicks: For when the Sun hath found on the Floor or Ground, to the Azimuths that Declination, the Day is 15 Hours long in the Summer, and 9 in the Winter: Then (as is for merly directed) fituate a Thread just between the Eye, and those three Points in the said reflected Dial, as is expressed in the insuing Table, so may you thereby draw all or any of those Jewish Hourlines defired, which will at any Appearance of the Spot by the Reflex of the Glais amongst those Hour-lines, shew how many of the Equal Hours is past since Sun-rising, as was defired. Now in this Latitude of 51 deg. 30'. If the Parallels of the Sun's Declination be drawn, both when the Day is 9 and 15 Hours long, that is, when it is 16 deg. 55', any of those Jewish Hour-lines will intersect the common Hour-lines, either upon the Place of the Centre of the reclining Glais, and the Hours, Half-hours, or Quarters. And such a Deother End moved to and fro in any reflected Azi- clination may be found, that it shall so do in any

Unequ. Hours.	н.	5 M.	Equal H.	Н	9 М.		Unequ. Hours.	Н.	5 M.	tiquai	н	9 M.
0	4	30	. 6	7	30							_
ı	4	45	7	8	15		7	1	15	4	0	45
2	7	00	8	9	00	1	8	2	30	2	1	30
3	8	15	9	9	45	1	9	3	45	3	2	15
4	9	30	10	10	30	- 1	10	5	00	4	3	00
1 5	10	45	11	11	15		11.	6	15	5.	3	45
6	12	00	13	12	00		12	7	30	6	4	30

Reflec_i

REFLECTING Telescope. See Telescope. REFLECTION, is a Power the Human Mind hath of perceiving its own Operations, within it felf, when it is employed about the Ideas it bath before gotten by Sensation; which Operations, when we come to reflect and consider on them, do furnish our Understanding with a great Num ber of Ideas, which could not be had by bare Senfation, of things without us: Such as Perception Thinking, Believing, Doubting, Rasoning, Knowing, Willing, &c. and all the differing Actions of the Mind.

REFLECTION in the Pythagorean or Copernican System is the Distance of the Pole from the Horizon of the Disk; which is the same thing as the Sun's Declination in the Ptolemaick Hypothe-

REFLEXIBILITY of the Rays of Light is their Disposition to be turned back into the same Medium, from any other Medium on whose Surface they fall; and therefore those Rays are more or less reflexible, which are returned back more or

less easily.

As if Light pass out of Glass into Air, and by being enclined more and more to the common Surface of the Glass and Air, begins at length to be totally reflected by that Surface; those Sorts of Rays which at like Incidences are reflected most copiously; or by inclining the Rays begin soonest to be totally reflected, are most reflexible. Newton's Opticks, p. 2.

There is the same constant Relation between Colour and Reflexibility: Light of a violet Colour being in like Circumstances reslected at least Thickness of any Plate or Bubble; (see Obs. 13, in passing thro' the Atmosphere, from the highest 14, and 15, compared with 4 or 18th) The red and rarest Part of it down to the lowest and den-Rays at the greatest Thicknesses; and the intermediate Colours at intermediate Thicknesses: So that the coloretick Properties of the Rays must be connate with them, and immutable.

reduce a Body of Men either by disbanding the Island Chrystal, vulgar Glass, (i.e. Sand melted Whole, or only breaking a Part, and retaining the

Company is Broke, and he continued in either fering from one another in Denfity, yet have they

Hour only, by the means of some Refracting

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Transparent Fluid: As thus,
If you stick up a Piu or Stick, or assign any Point in any Concave, Bowl, or Dish, to shew the Hour, and make that the Centre of your Horizontal Dial; (tee Reflected Dialling) afligning the the rest of the Hour-line also on the Edges of the Bowl, and taking away the Horizontal Dial, elevate a String, or Thread from the End of the said Pin fastened thereto over the Meridian Line, equal Thread to cast a Shadow on any Hour point for-merly mark'd out on the Edges of the Bowl, that Shade in the Bowl is the true Hour-line; and if any confiderable Variation. the Bowl be full of Water, &c. When this is done,

of the Top of the Pin, but when filled again with the same Liquor.

REFRACTION, Sir If. Newton in his Opticks 56, 57, 58. On this Natural Supposition that Bodies refract Light by alling upon its Rays in Lines perpendicular to their Surfaces, demonstrates: That the Sine of Incidence of every Ray of Light considered apart, is to its Sine of Refraction in a given Ratio. See Incidence. Ratio.

And as he shews that the Sun's Light consists of Rays of different Degrees of Refrangibility; so p. 61. he proves that the Difference of the Refraction of the least Refrangible and most Refrangible Rays is about the 27 1 Part of the whole Refraction of the mean refrangible Rays; and that in some Refractions, the Refraction of the least to that of the most refrangible Rays, is very near-

ly as 27 to 28.

Then in Book 2. Part 3. He demonstrates that Bodies reflect and refract Light by one and the same Power variously exercised in various Circumstances, (see Reslexion) and then he comes to this Proposition; That if Light be swifter in Bodies than in vacuo, in the Proportion of the Sines which measure the Refraction of those Bodies, then the Forces of the Bodies to reflect and refract Light, are very nearly proportional to the Den-lities of the same Bodies; excepting that uncuous and sulphureous Bodies refract more than others of the same Density. Of this at p. 73. he gives a Table, and compares the refracting Power of many Bodies with that of the Air.

And the Retraction of the Air is determined by that of the Atmosphere observed by Astronomers, and he shews that the whole Refraction of Light sest, is equal to the Refraction it would suffer, in passing at like Obliquity out of a Vacuum immediately into Air of equal Density, with that in the

lowest Part of the Atmosphere.

REFORM, to reform in a Military Sense is to one of a Pseudo Topaz, a Selenitis, Rock Chrystal, duce a Rody of Man sither by debending the together) and Glass of Antimony; which are ter-Rest, or sometimes by incorporating them in other Regiments. So that a

REFORMED Officer is one whose Troop or by fermentation) the these Substances be very difwhole or half Pay, doing Duty in the Regiment. their refracting Powers almost in the same Ratio to one another as their Densities are: Excepting REFRACTED Dials are such as shew the true that the Refraction of that strange Substance, island Chrystal, is a little greater than the Rest. particularly Air, which is 3400 Times rarer than the Pseudo Topaz, and 4200 Times rarer than Glass of Antimony, hath, notwithstanding its Rarity, the same refracting Power in respect of its Density, which those two very dense Substances have in re-Meridian Line on the Edges of the Bowl, point out spect of theirs; excepting so far as those two differ one from another.

Again, the Refraction of Camphire, Oil Olive, Line feed Oil, Spirits of Turpentine, Amber, which to the Latitude or Elevation of the Pole of the are fat sulphureous Bodies; and a Diamond, Place: Then with a Candle, or by bringing the (which probably is an Unctuous Substance coagulared) have their refractive Powers in proportion to one another as their Densities; without

But the refractive Power of these Unauous Boit will never them the true Hour by the Shadow dies is 2 cr 3 Times greater in respect of their 4 B 2

Densities, than the refractive Powers of the for- of their way (in Observat. 24 of his Opticks) in

mer Substances in respect of theirs.

Water hath a refractive Power in a middle Degree between those two Sorts of Substances, and probably is of a middle Nature; for out of it grow all vegetable and animal Substances, which consist as well of sulphureous, fat and inflamable lours, having proportionably intermediate Degrees of Refrangibility.

Salts and Visiols have refractive Powers in a REGAL Piffes are Whales and Sturgeons, An. 1.

middle Degree between thole of earthy Substances and Water; and accordingly are composed of those two Sorts of Substances; for by Distillation

and Rectification of their Spirits,

Spirits of Wine have a refractive Power in middle Degree between those of Water and oily Substances; and accordingly seems to be composed of both, united by Fermentation: The Water, by means of some Saline Spirits with which it is impregnated, dissolving the Oil, and volatilizing it by the Action; for Spirit of Wine is inflamable by means of its oily Parts; and being diffilled often from Salt of Tartar, grows by every Distillation more and more aqueous and flegmatick.

So that it seems rational to attribute the Refra-Rive Power of all Bodies chiefly, if not wholly, to the fulphureous Parts with which they abound. For it's probable that all Bodies abound more or less with Sulphurs. And as Light congregated by a Burning Glass, acts most upon sulphurous Bodies, to turn them into the Fire and Flame; so, since all Action is mutual, Sulphurs ought to act most upon Light: And that the Action between Light and Bodies is mutual, appears from hence, that the densest Bodies which refract and reflect Light most strongly, grow hot-test in the Summer Sun, by the Action of the refracted or reslected Light.

At the End of his Latin Edition of the Opticks under Query 21. He shews that the Cause of Refraction (and Reflexion both) is the Attraction of the Parts of the refracting Body, acting at a little distance, upon the Rays of Light as they

pass thro' it.

And because the Particles which compose the Island Chrystal (see Light) do all act by a consi milar Ratio, on the Rays of Light in order to produce that Unusual Refraction, which is observed in that odd Body: Therefore 'is probable that those Particles in the forming the Parts of that Chrystal, were not only disposed themselves in certain Order, so that their Extremities all looking the same way, they did concrete into regular Fi gures; but also that their Sides, that is such as were homogeneal as to their attracting Forces, by a kind of Polar Virtue or Polarity, were all turned the

The same Excellent Author shews Optic. Lat. p. 316. That having demonstrated in his Principia; that if Refraction were caused by the Attraction of the Rays of Light; the Sine of the Angle of Incidence must be to That of the refracted Angle always in a given Ratio; and this being by repeated Experience found to be true in Fact: tis then plain that Attraction is the Cause of the

Rays of Light.

REFRANGIBILITY. of the Rays of Light, Sir, Is. Newton defines to be their Disposition to be re frattea, or eurned out of their way, in passing out of one Transparent Body or Medium into ano ther; and a greater or less Refrangibility of Rays at the Time when it was first delivered.

like Incidences on the same Medium

He shews also that there is constant Relation betwen Colours and Refrangibility: The most refrangible Rays being of a violet Colour; the leaft refrangible Red; and those of intermediate Co-

Eliz. c. 5. to which some add Porpusses. The King by his Prerogative, hath every Whale cast ashore in his Dominions, unless granted to Subjects by special Words: The King himself hath the Head and Body; and the Queen the Tail to make Whale bones for her Royal Vestments.

REGALIA, are the Personal Prerogatives of a Prince; and these are either Prerogatives of Ju-fice; such as his Power over Weights and Measures; of Coining Money; of making Magistraces, Sc. or Prerogatives of Favour: Such as the Power

of making Communities and Colleges, &c.

REGARDERS of the Forest were formerly a Sort of Officers, who were every Year, upon Oath, to make a Regard, or to make a View of the Forest Limits, and to enquire into all the Damages and Trespasses committed, and to present them at the next Swain Mote or Forest Court. Manwood refers their Institution to K. Henry II. Spelman thinks the Name at least was given since; and that then they were the same with those Officers, called Custodes Venationis. Dr. Kennes's Par. Antiq

REGIUS Professor Anno 12. Car. 2. cap. 17. K. Henry the Eighth founded five Lectures in each of our Universities, viz. of Divinity, Hebrew, Greek, Law, and Physick; the Readers of which Lectures are in the University Statutes, called Regis Professores.

REHABERE facias seismam, quando Vicecomes liberavit seisinam de majore parte quam deberet, Is a Writ judicial mentioned, Reg. Judic. fol. 13.51: and in fol. 54. there is another Writ mentioned of this Name and Nature.

REHABILIATION Anno 25: H. 8. cap. 21: was one of those Exactions mentioned in that. Statute to be claimed heretofore by the Pope in England; and seems to signifie a Bull or Breve, for re-inabling a spiritual Person to exercise his

Function, that was formerly disabled.

RE INFORCED Ring of a Cannon, is that which is next after the Trunnions, between them and the Vens, and the Re-inforced part of a Gun, is from the Bale Ring to the Re inforced Ring. This part is made thicker in Metal than any other

part of the Piece.

RELATION in the Law sense is the same as Fillio Juris, to make a Nullity of a thing from the beginning (for a certain Intent) which had Essence, Vide Co. Lib. 3 fol. 28. Butler and Baker's Case; but more plainly thus: Relation is where, in confideration of Law two Times, or other things are confidered so, as if they were all one; and by this the thing subsequent is said to take its Este & by Relation, at the Time proceeding. As if A deliver a Writing to B, to be delivered to C, as the Deed of A, when C has paid a Summ of Money. Here when the Money is paid, and the Writing delivered; this shall be taken as the Deed of A, And fo their Disposition to be turned more or less out Bills of Parliament, to which the Queen assents

of Force from the first Day of the Session.

RELIEF, Relevamen, (in Doomsday Relevation And this being understood Relevium) was a certain Summ of Money, which the Tenant holding by Knights Service, Grand Sergeanty, or other Tenure, for which Homage to any other Rate of Interest. or Regal Service is due; or by Soccage, for As to the Nature of the following Tables, they which no Homage is duely paid to his Lord at his differ a little from Mr. Acroids, in the Rate of Interance, Mag. Cart. c. 2. and 38. E. 1. Stat. 1. tereft for which they are calculated. Entrance, Mag. Cart. c. 2. and 30. E. 1. State 1. Skene de Verbor. Saith Relief was given by the Tenant or Vassal that was of perfect Age, after the expiring of his Wardship, to the Superior Lord, of whom he held his Lands in Knight Service: That is by Ward and Relief; for by payment thereof he Relieves, and as it were relevat, raiseth up again his Lands after they were sunk into his Superiors Hand by Reason of Wardship, &c. his Superiors Hand, by Reason of Wardship, &c. See also 12 Car. 2. c. 24.

RELIEF, Relevium, was a Fine formerly paid to the King by every one that came to the Inheritance of Land held in Capite, or Military Service, to Relieve, or as it were to redeem their E. state, and to hold Possession of it. At first it consisted in Horses and Arms, till by the Assis of Arms in 27 Hemy 2. every Man's Armour was preserved for his Heir, and the Relief payable in Money, of which the fixt Rates were determined

lying such Relief, and for obtaining by that means Possession of such Estate.

Some Customary and Servile Tenants paid a Relief for renewing of a Tenure, on the Death of the last Possessor. Kenner's Paroch. Antiquit.

RENEWING of Leases and Lives, &cc. (See also Reversions) Tho' there be Variety of Tables extent for computing Interest and Annuities; (in this Vol.) yet till the little Book of Tables for Renewing and Purchasing College and Church Leases, was published at Cambridge, (and recommended by the Famous Sir Is. Newson) there was a Defect in this Affair. But there the Tables are not only easie and commodious, and their Construction clear; but the Ground and Reasons of Renewing, are given, from the Construction and Use of a little Table of Reversions; which you will find inferred here with its Use and Application under the word Reversion.

I have therefore given you the following, plain and easie Tables of Renewing, from the said Book; by the Use of which the Renewing of Leases or Lives, will become a clear, facile and intelligible

Thing.

And altho' these Tables are only for Leases of 21, 20, 40, and 10 Years; yet by the Table of Reversions above mentioned, other Tables of Renewing of Leases for any Number of Years under 41, may be made; as by this Example will ap-

pear.

Suppose in a Lease of 31 Years, I would renew 7 Years lapted; allowing 6 l. per Cent. peofit. To do this, I take the Summ of the Reversions for 7 Years from 31 upwards (from the Table of Reversions) accounting 31 as 1; which Summ is 11.7 s. 7 d. 0 q. or according to the way of accounting in the following Tables; 1

on the last Day of Parliament shall Relate, and be purchase; and that is the Fine to be paid for renewing the 7 Years lapsed, and which was sought.

And this being understood it will not be difficult to do the like for any other Number of Years, either in this or any other Lease; and according

but one Years Value, at 11 le 11 s. 8 d, 4, 10 per Cent. The Reason of which is, because the Rate of Interest is greater: But when the Rate of Interest lesser, then the Fine is greater.

Thus at 10 l. per Cent. The Fine for renewing 7 Years lapled, is 1 Years, 1 Quarters, and 1 Weeks Value: But at 8 l. per Cent. the Fine for renewing 17 Years lapsed, is above 1 Year and 3 Quarters Value; and at 6 per Cent. the Fine is 2 Years and almost an half Value.

So in the Table for renewing a Lease of 20 RELIEFS were payable also not only to the King as Supreme Lord, but to all Barons and Knights by those Tenants who held under them by Military Service. Relevate was the word for paying such Relief, and tor obtaining by that means the means are the service whereas in his, it is 1 l. 3 s. 8 d. That is one Year and above two Months Value by Military Service. Relevate was the word for paying such Relief, and tor obtaining by that means the service was the service where the service was the service was the service was the service where the service was the se ter, because the Rite of Interest is less, as was said above

> And that this is Right, will appear, if you consider that the Tables for Renewing of Leases, consist of the Summs of the Tables of Reversion, or Decrease

Money.

For tis apparent that the greater the Rate of Interest is, the greater is the Decrease of Money in the Reversion: And consequently the lesser are the Summs of those Reversions; which are the Fines for Renewing: An Example will make this very plain.

If you look into the Table of Reversions, you will find: That 1 l. or 20 s. in 40 Years, decreales to a Pence Half penny at 12 l. per Cent. compound Interest; and at 10 l. per Cent. it decreases to 5 Pence Farthing in 40 Years: Now the Summ of these Reversions for 7 Years, accounting 40 as 1; 39 28 2, &c. is but 2 s. 1 d. 2 q. But at 10 per Cent. the Summ for 7 Years is 4 s. 2 d. 3 q. which Summs are the Fines for renewing 7 Years lapsed in a Lease of 40 Years, at the Rates of 12, and 10 per Cent.

From whence tis clear and plain, that the leffer the Rate of Interest is, the greater must be the Fine for renewing: And the greater that Rate is, the leffer must be the Fine: And consequently the Difference between these Tables and Æcroids ariles only from the different Rate of Interest, for

which they were calculated.

The following Tables for renewing and purchafing of Leases, do shew the Value in Years, Quara ters, Months, and Decimal Parts of a Month, accounting 3 Months to a Quarter, and that a Month is divided into Ten parts. And tho this way of Division be not quite so exact, as if it were express in Decimals of Pounds, Shillings, Pence, &c. Yer 'tis more familiar and commodious, and the Year, 2 Quarters, 1 Month, and 5 Decimal parts Difference is very inconfiderable, for it will never be above a Decimal of a Month over or under the true Value, which in these Considerations is not to be regarded. And therefore when a Fine is required of any Person, either for renewing or purchasing of a Lease, the Tables will shew exactly enough what Rate of Interest is allowed: And so if any one would give or take a Fine according to any Rate of Interest proposed, they may do it near enough by the Tables.

At 1 l. per An. Rent, the Divisions by these Tables will be 5 s. per Quarter, 1 s. 8 d. per Month, and a Decimal of a Month 2 d. And because there are 4 Weeks in a Month it will be 5 d. per Week; five Decimals of a Month therefore make 10 d. which are equal to 2 Weeks, and 3 Decimals of a Month are but 1 Penny above a Week; so that 'tis easie to turn the Decimal parts of a Month into Weeks.

And these Kind of Numbers will be easily added or suftracted as in these 2 Examples.

Suppose I were to these 2 Fines,	add	γ. 3	Q. 2 3	M. I	d. p 6 7
	Summ	6	2	0	3

ADDITION.

I say 7 and 6 makes 13 Decimals, 10 of which making a Month, I write 3 and carry 1; 1 I carried and 2 Months makes 3 Months; wherefore I write a Cypher, and carry 1 Quarter, &c.

And this being understood, Substraction will also be easie, as in this Instance.

If from You take	· 3	Q. 2 3	<i>M</i> . I I	d. p. 6 7
Remains-	 	2	2	9

The first Table which offers it self for Renewshews the Values in Years, Quarters, Months, and to 14

Decimal parts of a Month, as all the Rest do : the First part of this Table is calculated at 111. 111. 8 d. $\frac{1}{4}$, $\frac{1}{1}$, per Cent. per An. Compound Interest, so that the Fine for Renewing 7 Years Lapsed, or the present Worth of 7 Years in Reversion, not to begin till 14 are expired, is exactly one Years Value; which Fine, and consequently Rate of Interest, Bishops, Deans and Chapters, Heads and Fellows of most Colleges in both Universities, do observe in Letting and Renewing of their Leases; but at other Rates of Interest, the Fine for Renewing 7 Years lapsed, the Table shews as followeth, viz.

The Fine for Renewing 7 Years Lapled

```
Y.Q.M.D.pts.
                                                                       'l. s. d.
S p c. is 1 3 2. 0 Which by the 29 3 4 6 p. c. is 2 1 2 6 Table of Red. 24 13 4 8 p. c. is 1 3 0 3 Rent is 12 15 0
```

The Years in esse may be valued as a Lease of so many Years, as in this Lease of 21 Years, if 7 Years are run out, then there are 14 in effe, whole Value are as a Lease of 14 Years, and may be found by the Table for Purchasing; or if you subtract the Value of the Years in Reversion from the Value of the whole Lease, the Remainer is the Value of the Years in esse.

To find the Value of some of the Years in Reversion, as suppose 3 of the 7, I do thus, because 3 wants 4 of 7, I take the Value of 4 Years in Reversion, from the Value of 7 in Reversion, the Remainer is the Value of 3 Years required.

Example. The Value of 7 Years in 7 X. Q. M. D p. Reversion, at 11 l. 11 s. 8d \ 1 0 0 0 per Cent. is The Value of 4 Years in Reversion at the same Rate is >0 Which subtract

Which Remainder being given for a Fine, will ing of Leases, is for the Term of 21 Years, it make up the Lease to 17 Years, that is, 3 added

A Table for the Renewing of any Number of Years lapfed in a Lease for 21 Years.

	8	d		s. c.	5	per	Cen	s.		6	per	Cen	t.		8	per	Cer	ıt,	·	10	per	Cen	s.
Years Lapled.	Years.	Quarters.	Months.	Decimal Parts	Years.	Quarters.	Months.	Decimal Parts.		Years.	()uarters.	Months.	Decimal Parts.	•	Years.j	Quarters.	Months.	Decimal Parts.		Years.	Quarters.	Months.	Decimal Parts.
11 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	0000001111222233344455	0011230012012020210	1 2 1 0 0 2 2 2 0 1 2 1 1 1 2 t 0	45076 6 6 5 7 3 3 8 8 3 5 5 3 9	00111122334556778910	1 2 0 2 3 1 3 1 3 2 0 2 1 0 2 1 1 0 3	1 2 1 0 2 2 2 2 0 1 2 1 0 2 2 0 1 2	38 5 5 8 36 - 4 1 1 5 2 38 8 4 1 5		0001122233144566/7899	1 2 3 1 2 0 1 3 1 3 1 3 2 0 3 2 1 6 2	0 1 2 0 1 1 1 2 0 2 1 0 0 1 2	52248 66 955 8 56 1 1 6 50 1	,	00001112221334456678	012301301310210	2211220121000010222	40770 5348 5 72277 2 428		0 0 0 0 0 1 1 1 1 2 2 2 3 3 4 4 5 6 6	01123012301313103	1000110001121	64358 43508 06 73 42 79
19		3	1	5	11	3	1	3		10	3	اما	. 8		9	0	1	1		7	2	2	8
1_	To	tal	Val	ue.	To		Val	_		To	ial \	Val	_		To		Val	_		To		Val	uc.
	17	3	0	3	 12	3	0	8		11	3	01	1		10	0	ø	2		8	1 2	ľ	17

The next Table is for the Term of 20 Years, the First part thereof is calculated according to the Rate of about 12 l. 6 s. per Cent. per Ann. so that I Years value is the Worth of 7 Years lapsed, or plain, I shall give one Example: As suppose, I am Reversion; which Fine, and consequently Rate to find the Value of 4 of the 7 Years in Reversion in this Lease; then according to the Rule given in Years; but at other Rates of Interest: The Fine the Lease of 21 Years, I do thus; because 4 wants for Renewing 7 Years lapsed in this Lease of 20 3 of 7, I take the Value of 3 Years in Reversion, from the Value of 7 in Reversion, the Remainder is the Value of the 4 Years required.

The Fine for Renewing 7 Years lapled.

The Years in effe may be valued as a Lease of so many Years, or their Value may be sound, by subtracting the Value of the Years lapsed, from the Value of the whole Lease, as was directed because the last of the Years. fore in the Lease of 21 Years.

is the Value of the 4 Years required.

The Value of 7 Years in Reversion at 61. per Cent.

The Value of 3 Years at the same Rate is Which subtract Remains

This Remainder being given for a Fine will make up this Lease to 17 Years, that is 4 added to 13.

A Table for the Renewing of any Number of Years lapfed in a Lease for 20 Years.

12 /. 6 s. p c.	5 per Cent.	6 per Cent.	8 per Cens.	10 per Cent.
Decimal Parts Months. Unarters. Years. Years Lapfed.	Decimal Parts. Months. Quarters. Years.	Decimal Parts. Months. (Quarters. Years.	Decimal Parts. Months. Quarters. Years.	Decimal Parts. Months. Quarters. Years.
1 0 0 1 2 2 0 0 2 5 3 0 1 1 0 4 0 1 2 6 5 0 2 1 5 6 0 3 0 6 7 1 0 0 0 8 1 0 2 6 9 1 1 2 5 10 1 2 2 9 11 2 0 7 12 2 1 1 9 13 2 3 0 6 14 3 1 0 0 15 3 2 2 9 16 4 1 0 6 17 4 3 2 1 18 5 2 1 6 19 6 1 2 2 Total Value. 7 1 0 8	O I I 5 O 3 O 3 I O 2 2 I 2 I 5 2 O 1 O 8 3 O 8 3 O 8 3 O 8 3 O 8 3 O 8 3 O 1 8 4 O 1 8 4 O 1 8 4 O 1 8 4 O 1 8 6 O 1 5 8 O I	G I O 7 C 2 I 7 C 3 2 9 I I I 4 I 3 O I 2 O 2 I 2 2 I 4 3 O I O 3 2 I O 4 O I 3 4 2 2 O 5 I O I 5 3 I 6 6 2 O 6 7 I O O 8 O O 8 3 O O 8 0 O O	0 0 2 6 0 1 2 3 0 2 2 3 0 3 2 6 1 1 0 1 1 2 C 8 1 3 1 9 2 1 0 3 2 2 2 0 3 e 1 2 3 0 8 4 0 0 8 4 2 1 2 5 3 0 8 6 2 0 0 7 0 2 8 8 0 0 4 8 3 1 7 Total Value. 9 3 0 8	0 0 1 8 0 7 0 1 2 9 0 2 2 2 2 0 3 1 8 1 0 1 7 1 1 1 8 1 2 2 3 2 0 0 1 2 1 1 3 2 3 0 0 3 0 2 0 0 3 0 2 0 0 3 0 2 0 0 6 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0

The third Table for renewing of Leases, is for the Years in essential before, are value Term of 40 Years; it is calculated according lued as a Lease of so save save for 40 Years, if 14 Years are run out, then there of using differs not from the other, nevertheless an are 26 in esse, whose Value are as a Lease of 26 Example will be convenient, which therefore 1 Years, and may be found by the Table for Purshall give; as suppose there be 14 Years lapsed or chasing, &c. run out in a Lease for 40 Years, What must I give

T. Q. M.D.pes. 5 p. c. is 2 3 0 4 Which by the 27 16 8 Leafs up to 32 Years.

8 p. c. is 1 0 1 3 At 10 l. yearly 20 0 3 4 Rent is 1 2 p. c, is 0 1 1 1 Rent is 1 3 0 8 4

SHE I

run out in a Leale for 40 Years, what must I give to make up this Leafe again, according to those several Rates of Interest fignified by the Table? That is, What must I give for 14 Years in Reversion, after 26 in esse? Or, What's the present Worth of 14 Years, beginning 26 Years hence? Worth of 14 Years, beginning 26 Years hence? For answer I find by the Table that the Fine for Renewing 14 Years lapsed.

The Value of some of the Years in Reversion, may be found in this Lease, by the same Rules that they were found by in the foregoing Leases; as if it were required to find the Value of the 14 Years in Reversion in this Lease of 40 Years, then because 6 wants 8 of 14, 1 take the Value of 8 Years in Reversion from the Value of 14 in Reversion, and the Remainder is the Value of 14 in Reversion, and the Remainder is the Value of the 6 Years required which will make the 1. s. d. lue of the 6 Years required, which will make the

A Table for the Renewing of any Number of Years lapled in a Lease for 20 Years.

	_ 5	per			Ī	6				T	18	3 pc	r C	ent.	··		10	Der	Cer				2 per	Cer	
Years Lapfed.	Years.	Quarters.	Months.	Decimal Parts.		Years.	Quarters.	Months.	Decimal Parts.		Tears.	Court (cra-	Onstant		Decimal Parts		Years.	Quarters.	Months.			/ Years.		Months.	Decimal Parts.
1 2 3 4 5	00000	0 1 1 2 3	I 0 2 I 0	75334		100000	0	I 2 0 2 0	6		00000			I I 2	5 1 8 5 2		00000	190000	0000	2 58 2 6		00000	100000	100000	1 3 4 6 8
6 7 8 9 10	0 1 1 1 -	30123-	2 1 0 0	5 8 2 7 4 -		0001	2 3 3 C I	2 0 2 1	0631		00000	1 1 2 2			0 98 90		00000	0 0 1 1 1 1	2 2 0 0 I	0 5 0 5 2		00000	00000	I I I I 2	0 2 5 8 2
11 12 13 14 15	2 2 2 3	012301	000001.	2 1 2 4 7		1 1 2 2	1 2 3 0 0	2 I 0 0 2	2 480 2 9 1		0 0 1 1	3301	1	14	2		00000	I I 2 2 2	Ĭ 2 0 1 2	9 6 4 4		00000	0 I I I	2 0 0 I I	6 1 5 1 7
17 18 19 20	3 3 4 4 1	1 2 3 1 2 - 0	1 2 2 1 2 - 0	2 0 9 0 3 8		2 2 3 3 7 2	- 1	2 2 0 0	8 7 9 2 0		I I I 2	1 2 2 3 O	1	7 6 6 8 2			1	3 0 1	1	5 7 0 5 2		00000	I 2 2 2 3	2 0 1 2 0	4 2 1 1 2
22 23 24 25 26	5 5 6 6 7	0 1 3 1 3 1	2 1 0 0 0	5583		3 4 4 5 -	3 0 2 3 I	2 0 2 0	5 4 6 1 8 8		2 2 2 3 3 1 2	1 2 3 0 I —	00001	8 6 5 8 3			I I I 2	2	2	98040	-	0 0 1 1	1	- _	4942
27 28 29 30	7 8 8 9 10	3 1 3 1	0 0 1 2	1 4 1 1 5		5 6 7 7 8	2 0 2 0 2 0	2 1 1 2 2	770	•	3 4 4 4 5 7 5	2013013	2010213	5 3 4			2 3 -	2 1	2	8 0 4 3 5 5		I I 2 2 2	3	100000000000000000000000000000000000000	3 7 5 6
32 33 34 35	10 11 12 12 -	2 1 0 3 .	2 I 0 0	3 9 8 2		8 9 10 10	3103	0 2 1 0	78 3 38 7		56677	2 0 2 1 3 2	2 2 2 0 2	005501 4			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	3 2	2 2 2	1 2 8 9		3 4 4	I 2 0 2	2 6	2
36 37 38 39	13 15 16 Tot					12 13 14 Tot	al V	I 2 I	2 3 0 e.		9 10 10	3	I I 2	069		8	7 1			1 .		6	3 2 1	2 4 I d O d I I	5
<u> </u>	17	ol.	I	7		15	01	이	31		11]	31	2	0		1 9) 3		1 2		- 1	810			. [

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A Table for the Renewing of any Number of Years lapfed in a Lease for 20 Years.

Vears Vear		17 . 18 s. per Cent.	5 per Cens.	6 per Cent.	8 per Cent.	10 per Cent.
4 2 0 1 7 2 2 6 7 3 1 2 6 1 2 15 6 0 1 7	Lapled. 12345 678	Decimal Parts 3 0 3 0 5 9 0 3 1 1 3 2 2 1 Total Value.	Vears.	Vears. 78 3 38 7 2 3 6 Total Value.	Vears. S 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Vears. O O I I 2 2 3 4 5 Total

This being the last Table for Renewing of Leases, is for the Term of 10 Years: The First ber of Years lapsed in any Lease, to be 27.3 4 part thereof is calculated according to the Rate of about 17 l. 18 s. per Cint. so that the Fine for remewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. so that the Fine for renewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. so that the Fine for renewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. so that the Fine for renewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. so that the Fine for renewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. so that the Fine for renewing 4 Years lapsed is one Years Value, but at 18 s. per Cint. other Rates of Interest, the Fine for renewing 4 Years lapsed, is by the Table as followeth, viz. the Fine for renewing 4 Years lapsed

T.QMD.p. 5 p. c. is 2 2 1 7 Which by the 26 68 4

6 p. c. is 2 1 2 3 Table of Re 24 68 4

8 p. c. is 2 0 1 0 duction at 10. 520 16 8

10 p. c. is 1 3 0 4 per Ann.

The Verse in Communication of the communica

The Years in effe are valued as before directed in the other Leales; as if there be 4 Years run out in this Lease of 10 Years, then there are 6 Years in esse, whose Value are as a Lease of 6 Years, &c.

The next Table is for the Reduction of the Values given in Years, Quarters, Months, and Decimal Parts of a Month, into Pounds, Shillings, and Pence, the Use of it is very plain and easie, as by Example will appear.

Example.

Suppose the Fine for renewing any Number of Years lapsed, in any Lease to be 6 7. 2 9. 2 m. 4 d.p. and the yearly Rent 55 l. What is this Fine in Pounds, Shillings, and Pence? Then by the Table I find

:		l.	S.	d
	under 2 Quarters	25	00	c
against 50 /	under 2 Months	8	06	1 8
	under 4 Dec. parts	1	13	4
1 '	Cunder 2 Quarters	2	Io	
against 5 1.	Sunder 2 Months	Q	16	8
	Lunder 4 Dec. parts	0,	03	4
	.	-		-

- -- Summ of all is Then for the 6 years Value I (ay, 6 times 55 h is 330 l. which added to 38 h 10 s. o d. the Summ 330 00 368 00

Which is the Value reduced into Pounds, Shillings, and Pence required.

Table I find

	. :		, , ,			<i>l</i> .	5. -	d.
			Cunder 3	Quarrers	. 1	75	00	b
202	inft i	001	Junder 2	Months	-	16	13	Ā
~ 5~	1		under 5	Dec. parts !	- 1	4	03	I
			C under 4	Dec. parts		3	o 6	8
	1		Cunder 3	Outro		,		,
			Jundar .	Manufa	- 1	37	10	Ģ
ag	inft	sol	Junder 5	Tion mante	-	8	c6	4
	•		Cunden	Dec. parts		2.	01	8
		!	under 4	pec. parts		I	13	4
	•	ì	Cunder .	Quarters				
1	1	į	11.		,	4	10	0
1	Rainfl	6	under 5	Dec porte		. 1	00	0
l:	•		under 5	Dec. parts	:	0	05	0
		!	under 4	Dec. parts		0.	04	0
		• • •	1	Summ is	1	54	13	8
	Th	e 2	years Valu	e add, viz.	3	12	60	9
		į -	•	4 _ 1	-	_		_

Which is the Fine reduced into Money required In like manner is any other Fine reduced, at any other yearly Rent from 1 l. to 600 l a Year, of if it be more, it is but adding, after the same manner as is done in the Examples, as suppose the Rent to be 700 l, per Ann. then I must find the Values for 600 l, and for 100 l. and add them together, &c.

The Summ is

A Table for the Reduction of the Values given in Years, Quarters, Months, and Decimal Parts of a Month, into Pounds, Shillings, and Pence.

Yearly Rent.	32	ar	ters	. 2.@	yarı	er.	1 D	narte	37	2 M	lont	bs.	11/	10n	tb.	III L	ec.	pa	rt.	12De	c. p	art.	(3 <i>D</i>)	ec.pa	278.	141	er.p.	art.	SUE	. 04	t
early ent.	1.	- ;	. d	. 1.	5.	<u>d</u> .		. S. (d	1.	5.	 d.	1.	. s	. d	-	l.	s.	d.	1.	5.	ď	I.	- <u>:</u> s.	- d.	1.	s.	_ d.	I.	S.	d.
1 2	l °		5 9	1 .	10	_	0	0	0	0	3	4 8	0		8	0		0	2	00	0	4	0	0	6	0	0	8	0	0	IC —
3	2		5 0	1	10	0		15	0	0	13	_	0	•	6 4 5 c 5 8	0	•	0 0	4	0,0	0	8	0	1	6	0	1 2	4	0	1 2	8
_5	3	_1	5	1 -				_	٥		16	8	0	_ 8		0		9 2_1	8	0	I	8	0	2	6	0	2 3	8 4	0	3 4	4
6 7 8	5	I	5 0	1 -	10		1	10	0	1	3	4	0	11	ام	0	1	I I	2	0	2 2	0	00	3	6	00	4	8	00	5	C
9	6	E	5	1 .	0	0	2 2	•	0	1	10	8 c	0 0	19	4	0	1	[. [4	0	2 3	48 C	0	4	0	0	6	4	0	5 6 7	8
20	- <u>7</u>	-	0 0		<u> </u>	-	$\frac{2}{5}$		0	$\frac{1}{3}$	<u> </u>	8	0	16	1	0		<u> </u>	8	0	<u>3</u>	-4 8	0	<u> </u>	9	0	6	8		<u>8</u>	4 8
30 40	22 30	-	0 0	''	0	. 1	7	•	0	5 6	0	c 4	3	10		0		•	8		3	0	0 I	15	0	I	0	80	I	5	0
5°	37 45	I	0 0		°		12		0	8.	6	8	4 5	3	- 1	0	10		4		6 · 0	8 c	Í	5 10	0	I 2	13	4	2	I O	8
. 70 80	52	-	0 0	35 40	0	_	17	10	c	13	13	4	5	16	- 1	0	11		8	I	3	48	I 2	15	0	2 2	6	8	2 I	8 6	4
90 Ico	67 75	I	0 c	1 7,	0	_	22 25	10	c	15	13	0	7	10	٥	0	19		8		ე 3	0	2	5	0	3	0	807	3 1	-	9
300			0 0	1 .	- 0	c	75	0	٥.	33	6	8	16	13		1	13		4	3	<u>6</u>	8	5	0	ol Oli	6	13	4	8	<u>6</u>	8
40c 500	300	•		200		c	100	0	4		13	4 8	33	13	_ []	3	3	5 8	8	6 1		4 2	Ó	0	01	13	6	8	16 1		4
. 600			•	300	0	- 1	150	_		00		0	f 0	0	اه	7	0				-	01		o	C 2		3	0	•	0	0

The way of purchasing by Lives was common-Book: Example, suppose there bothree Lives upequal, there is another way which is more agreeable to Reason, and it is this, viz. for every Life to decrease one Year, as if one Life be reckoned as a Lease for ro Years, then two will be as a the Table tor purchasing of Lives sheweth.

So if you reckon one Life as a Lease of 9 Years, 3 Lives 11 Years, 1 Quarter, 2 Months, and 6 De-

cimal parts Purchase, &c.
So if one single Life be reckoned as a Lease of

their Lives upon an Estate should die, to take in others to make up the Number again, is done by Years lapsed in the same Lease, and if three are the Table of Reversions at the Beginning of the dead I must reckon 24 lapsed: So at 61. per Cens. Vol II.

ly to reckon one Life as a Lease of 7 Years, two on an Estate, which at 7 Years Purchase for the Lives as a Lease of 14 Years, and three Lives as a Lease of 21 Years: But this way seeming Unand as a Lease of 27 Years, at 7 l. per Cens. and first Life, are valued at almost 12 Years Purchase, and as a Lease of 27 Years, at 7 l. per Cens. and if one of those Persons should die, what must be given to make up the Number again? Then I-lay, one Life which is dead was as a Lease of 10 Years, and therefore to take in a New Life, I Lease of 19, and three as a Lease of 27 Years, &c. may reckon 10 Years of the 27 lapled, and for so that at 7 l. per Cent. one Life is reckoned worth take as it were a Fine for renewing 10 Years. a little above 7 Years Purchase, two Lives 10 lapsed in a Lease of 27 Years: now to find this Years, 1 Quarter, and 1 Month's Purchase, &c. as Fine, I take the Summ of the Reversions for 10 Fine, I take the Summ of the Reversions for 10 Years in the Table under 7 l. per Cent. counting 27 as 1, 26 as 2, and 25 as 3, &c. And fo I find then two will be as a Lease of 17, three as a Lease the Summ to be 21. 41. 5 d. 29. that is two of 24. 30. as is evident by the Table; and one Life will be worth above 6 Years and 2 Quarters I may take for renewing or taking in a New Life; Purchase, 2 Lives 9 Years and 3 Quarters Purchase, 10 if two Lives be dead I may reckon 19 Years the Summ to be 21. 41. 5 d. 29. that is two: Years, and almost one Quarters Purchase, which lo if two Lives be dead I may reckon 19 Years lapfed in a Lease of 27 Years, and find the Summ. of the Reversions for 19 Years, for a Fine for ta-So if one fingle Life be reckoned as a Lease of 12 Years, then two will be as a Lease of 23, three as a Lease of 33 Years, &c. so that at 6 per Cent. one Life is worth above 8 Years and a Quarters Purchase, two Lives above 12 Years and a Quarters Purchase, &c. as the Table shews.

Now suppose any of those Persons which have their Lives upon an Estate should die, to take in 10 Years, if two Lives are dead I must reckon as a Lease of their Lives upon an Estate should die, to take in 10 Years, if two Lives are dead I must reckon as

Cccc 2

A Table for the Purchasing of Lives.

Number	Word Cent	hat hat		are per	Number	Numbir	WOI!	•	7 l.	pe:	Number	ber	Cent		hey :	are per
of Years. of Lives.	Years.	Quarters	Mmibs.	Dec. pares	of Lives.	of Years.	Tears.	Quarters.	Months	Dec. parts	of Lives.	of Tears.	Tears.	Quarters.	Months.	Dec. paris
1 10 2 19 3 27 4 34 5 40 6 45 7 49 8 52 9 54	10 11 12 13 13 13	0 1 332 2 353	0 1 2 1 0 1 0 1 1	306192236	1 2 3 4 5 6 7 8 9	9 17 24 30 35 39 42 44 45	6 9 11 12 13 13 13	2 3 1 1 3 1 1 2 2	0 0 2 1 2 0 2 0 1	2 1 68 2 1 4 6 2	1 2 3 4 5 6 7 8 9	23 33 42 50 57 68	15	I I I 0 2 0 0 I I	I 0 2 2 2 0 2 I 2	6 6 6 7 7 8 8 2

reckoning one Life as a Lease of 12 Years, three Lives are as a Lease of 33 Years, and so if one of thus: Suppose a Landlord would make a Lease these Lives be dead. I may reckon 12 Years lap of Land up to 40 Years, wherein his Tenant hash fed in a Lease of 33 Years, if two Lives are dead, I may reckon 23 Years lapsed in the same Lease, and begin at 33 to summ the Reversions, under 61, per Cent. because the Lives are valued according to the same Rate of Interest. This being understood, it will not be difficult to do the like for any other Number of Lives, and at other Rates of Interest, and Number of Years for one Life; for you may by the Table for purchasing of Leases, &c. make Tables for purchasing of Lives according to what Rate of Interest you think is most convenient; as suppose you reckon one Life as a Lease of 10 Years, and you would have 5 l. per Cent. profit, then that will be worth 7 Years and almost 3 Quarters Purchase, but at 8 l. per Cent, it is worth but 6 Years and almost 3 Quarters Purchale, &c.

The Table for purchasing is calculated for several Rates of Interest, that so the Purchaser may use that which is most convenient for him, as, in purchasing of Free-hold Land, 51. per Cent. may be enough, but for Copy hold or Leases of Land 6 1. per Cent. for Leases of Land and good Houses 8 1. per Cent. and for Leales of ordinary Houses 101, or 121. per Cent.

The Use of the Table is very plain and casie, as by Example will appear, viz.

Example.

What is a Lease or Annuity of 20 Years worth at 5, 6, 8, 10, or 12 per Cent. per Annum?

T.Q.M.D.p.	l.	s. d.
## \$\frac{1}{6} \f	249 229 196 170 149	3 4 6 8 6 8 3 4

To increase the Number of Years in a Lease 10 Years to come, what is it worth? Then I say,

A Lease for 4 Years at 6 per Cens. is worth 20 Years at the same Rate are worth Which subtract The Remainder is

Which is the Fine to be given to make the Lease up to 40 Years.

To buy a Lease which is not to begin until your old Lease is out; as thus, suppose a Man's Lease is out within 4 Years, and he defires to have a New Lease of 21 Years, to begin when his 4 Years are out, what is this Lease worth in ready Money?

For Answer, I add 4 Years which is the Time he hath in his old Leate, and 21 together, the Summ is 25, then I find she Worth of these 25 Years, and subtract from it the Value of the Years, the Remainder is the Value of the faid Lease in ready Money.

7. Q. M. D. p. A Lease for 25 Years at 6 l. pe Cent. is worth The 4 Years at the same Rate are worth, Which Subtract The Remainder is the Value of the Leafe in ready Money required,

A Table shewing how many Years, Quarters, Months, and Decimal Parts of a Months Purchase, any Annuity or Lease of any Land or House is worth, according to several Rates of Interest, viz. according to 5, 6, 8, 10 and 12 per Cent.

1 11	5	per	Cen	1.	6	per	(8.	·.	1	8	per	Cen	r.		10	per	Cen	۶.	1	12	p+}	Cen	
Number of Years to be purchased.	Years.	Quarters.	Months.	Decimal Parts.	Years.	Quarters.	Months.	Decimal Parts.		Years.	Quarters.	Months.	Decimal Parts.		Years.	Quarters.	Months.	Decimal Parts,		Yеав.	Quarters.	Months.	Decimal Parts.
3345 6789	01234 5567	- 33221 - 0310	2 1 2 0 1 1 0 0 2 1	1 4 7 6 5 0 9 4 5 7 6	01234 4566	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 1 2 2 2 2 1 2 0	13016510056	-	01233 4556	100013 20 to 1	1000011200	14978-5400		01233 44556	32103 1313	1: 2 2 2 0 I I I O	9880512401		01233 4445	1.32102 0231	1 2 1 0 1 1 0 2 0	73852 37698
10 11 12 13 14 15	7 8 8 9 9 10 10	2 - 1 3 1 3 1	2 - 0 I I I	06 74775 0	7 788 99 10	1 31 31 2 0	1 1 1 0 2 -	316625512	-	6 7 7 7 8 8 8	2 0 2 3 0 2 1	2 - 1 0 1 2 0 - 1	5 -6 48 97 -		-66777 -	0 1 1 3 0 1 2 1 3	1 - 2 0	7 9 7 2 4 2 8		5 56666 6	2 30123	1 2 2 2 1 0 2	33157
17 18 19 20 21 22 23 24	11 12 12 - 12 13 13	31201 3013	10212 - 0120	00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	10 11 11 - 11 12 12	1 3 0 1 3 0 1 2	2012 - 0000	7 9 6 1 4	1	9999 0000	30123 0012	1 1 0 0 2 1 0	2 5 5 2 8 2 4 4 3		~~~~ ~~~~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~	0010100000	0 2 1 0 1 0 1 2	2 431 7258		7777 - 7777	30111-2223	1 0 1 2 - 0 1 2 0	7 4 4 6 7 7 6 4
25 26 27 28 29 30 31	14 14 14 15 15	0 1 2 3 0 1	I - I I I I I I	5 I - 4 7 7 6 3 I	12 13 13 13 13	3 0 0 1 2	0 2 1 1 0	3 0 58 0 I	. 1 . 1	10	2 330011	2 - 0 2 0 I 0	726912		9 9 9 9 9 9 9	0 0 1 1	0 2 2 0 I	9 086307	,	7 7 7 7 8 8 8	37 333000	I - I 2 2 0 0 I	7 7 3 7 2 6 0
40 50 60 70 80 90	17 18 18 19 19 19 F	3 1 2 3	0 2 1	0 2 1 2 0	15 16 16 16 16	2 C I 2	2 2 1	7 6		11 12 12 12 12 12	i i	2 I 2 2	378	\ \frac{1}{2} \	oggodd F		0 2 2 2 2 2	6899		8 8 8 8 8 F		2 0 0 0 1 1	900
	20	l c	ol o	1 0	16	5 2	2 2	2 0	,	12	2	10	0		10	0	10	0		8	1	1	 0

How

T. Q.M. D. will be found to be - 13 3 0 I Then find the Value of the? 6 Years which will be Which subtract

The Remainder in the Va-Ine of the Reversion requi red,

The Value of the Years lapfed or in Reversion Although this may be done by the Table of Reversions at the Beginning of the Book, yet I think it will not be amiss, if I shew how it may be done by the Tables of Purchasing also.

Suppose you are to buy the Reversion of a Lease after 6 Years, that is, if it be 6 Years before you commence, what is the present Worth of a Lease inppose of 30 Years at 6 per Centum? Then I find the Value of Answer look the Value of the whole Lease, which

T. Q M.D.p.

And because there are 12 Years lapsed, there are 18 Years in esse whose Value is Which subtract

The Remainder is the Va-lue of the Years in Reversion required,

Years.	I	e incr /. ve		ot	1 l.	Ann	nitv	to I	T /	. read	der N∨	10-
13,		/. VE		1	L.	:-	,	1				
			arly	at		paid			ney	, wi le at		ur-
	0	per C	eni.			ther			Cen		01.	per
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	<i>l</i> .	s.	d.	9.	l.	s.	d.	9	l.	s.	d.	9.
1	ī	1	2	1	1	0	0	0	I	I	2	0
2	I	2	5	2	2	1	2 8	0	0	10	6 6	0
3 4 5	I	3 5 6	9	3	3 4	3			0	7 5	9	0
4	ī	6	3	. 0	5	7 12	8	3	o	4	9	0
	_			_					_			
6	I	8	4	1	6	19	6	I	0	4	2	0
7 8	I	10	0	3	8	7	10	I	0	3 3 2	7	0
9	I	. 13	10 9	1	9 11	17 9	11 9	3	0	3	2 11	0
10	ī	15	9	3	13	3	7	3 (o.	2	8	0
	_			-1			<u> </u>	_	-		-	
11	I	17	II	2	14	19	5	0	0	2	6	I
12	2	· 0	3	0	16 18	17	4	2	0	2	4	2
13 14	2		7 2	3 2	21	17	7	2	6	2 2	3 1	0
15		5 7	11	0	23	5	3	ō	0	2	ō	3
	_	<u> </u>				 -			-			
16	2	10	9	2	25	I	5	0	0	I	11	2
17 18	2 2	13	10	0	2 8 30	18 18	3	0	0	I	10	3
19	3	17	1 6	0	33	15	2	0	0	1		1
20	3	4	2	o	36	15	8	ō	0	ī	<i>9</i> 8	3
 .	-	- -	 -		_	<u> </u>		_	1			
21	3 3 3	7	II	3	39	19	10	0	0	I	8	3 3 1
22 23	13	16	0 4	3	43 46	7 19	10	0	0	I	7 7	3
24	4	. 0	11	2	50	16	3	2	6	î	7	o
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26	1	<u> </u>	11	- -	-	~	1	_	0		6	—- I
	4	16	5	3	59	3 14	ī	0	0	ī	6	ō
27 28	Ę	2	2		68	10	6	2	0	ī		3
29	5 5	8	4	. 3	73	12	9	Ī	0	1	5 5	2
2 <i>9</i> 30	15	14	10	0	79	I	2	0	0	1	5	_1

by Example will appear.

The first is this, suppose 30 l. be put out for 20 Years, what will it amount unto in that time at 6 per Cent. Compound Interest?

Then I look against 20 Years, and find under the Increase of 11. &c. 31. 4s. 2d. which shews that I l. in 20 Years time will increase to 3 l. 45 2 d. which I multiply by 30 thus,

		l.	s.	d.	
30 times 3 1. is		90		0	
30 times 4 s. is		6	0	0	
30 times 2 d. is	•	0	5	0	
	Summ	96	5	0	_

That is, 30 l. in 20 Years time at 6 per Cent. Compound Interest, will amount to 96 l. 5 s. o d.

The Use of the Second is thus, What will an Annuity of 30 l. forborn 20 Years amount to in gain. that time? Then for Answer I look against 20 RE Years, and under the Value of 11. Annuity, &c. I find 361. 155. 8 d. which 361. 155. 8 d. is the Value of 11. Annuity forborn 20 Years, then I multiply 36 le 15 s. 8 d. by 30 l. thus,

3.71		. <i>1.</i>	5.	d.
30' times 36 /. is		1080	00	0
30 times 15 s. is		22	10	0
30 times 8 d. is		1	00	0
	Summ	1103	10	- !
•	-			_

That is, 36 l. Annuity forborn 20 Years will at the End of that Term amount to 1103 l. 10 s. o d

The Use of the third Table is thus, suppose a Gentleman hath 300 l. by him, with which he's willing to purchase an Annuity for 20 Years. What Annuity will that purchase at 6 per Centum? For Answer, I look against 20 Years, and find under Woat Annuity 1 l. ready Money, &c. 1 s. 8 d. 3 q. which shews that I l. ready Money will purchale an Annuity of 1 s. 8 d 3 q. for 20 Years, which I multiply by 300 l. thus,

	 ,	s.	d.	
300 Shillings are	35	00	ο.	:
300 times 8 d. is	10	00	0	
300 times 3 q. is	´ co	18	9	,
n en de vers de la la la la la la la la la la la la la		╼		
Sur	n m 25	18	9.	

That is, 300 l. ready Money will purchase an Annuity of 25 l. 18 s. 9 d. for 20 Years at 6 per

RENTS of Assis were the certain and deter-

were to called, because they were affiled, and made The Use of these Tables aforegoing is easie, as certain; and so distinguished from Reddicus Mobiles, or such variable Rents as did rise and fall, like the Corn-rent now referved to Colleges.

RENTS Refolute, are accounted among the Fee Farm-Rents, to be fold by the Statutes of 22 Car. 2. c. 6. And are such Rents or Tenths as were anciently payable to the Crown from the Lands of Abbies, and Religious Houses: And after their Diffolution, tho' the Lands were demited to others, yet the Rents were still Reserved, and made payable to the Crown.

REPELLING Force: That there is such a thing in Nature, see Attraction towards the End.

REPLEVISH, Signifies in our Law the letting any one to Main Prife, upon Surety, 3 E. 1. 11.
REPOSE, is a Term in Painting, fignifying the Place where the Masses, or great Lights and Shadows are affembled: And this being well under-thood hinders the Confusion of Objects; suffering not the View to be contracted altogether, but so proceed gradually and successively without Diíturbance.

REPOSITION of the Forest, was an Act whereby certain Forest Lands being made Purlion upon View; were on a Second View laid to the Forest a-gain. Menwood, ph. 1. p. 178.

REP Silver. The Ancient Servile Tenants were

bound to reap their Lord's Cera: But to be acquitted from this Duty, they iometimes paid an Acknowledgment or Composition in Money, which Money was called by this Name of Rep-Silver.

REPULSE or Reaction. It is one of the Laws of Nature, (Sir IJ. Newton's third) that Requ'se or Realtion is always equal to Impulse or Action. That is, the Action of two Bodies one upon another, is always equal, but with a contrary Direction: in other words, the same Force with which one Body strikes upon another, is returned back by that other on it, and the Forces are impressed with Directions directly contrary. Thus if one Body press or draw another, its just as much prest or drawn by it: If a Man press a Stone with his Hand, the Stone equally presses his Hand; if a Horse draw forward any Weight by a Rope, the Weight equally draws back the Horse: for the Rope being equally stretch'd both ways, acts upon both equally: So 'tis in all Blows and Strokes, the thing struck (suppose with a Hammer) strikes the Hammer with equal Force. The Iron draws the Hammer with equal Force. Load stone as much as the Load stone draws it; as will appear by Experiment, if you make them both flote in Water. Thus also in the Descent of heavy Bodies the Stone attracts the Earth, as much as the Earth the Stone; or the Earth gravitates as, much towards the Stone, as it doth towards the Earth. For the Motions produced by both these Gravitations are equal in both: Only the Stone being very inconsiderable in respect of the Bulk of the Earth, the Velocity of the Earth towards the Stone must be so too, and consequently insensible, in comparison of the Motion of the Stone rowards And so it is Universally, in all the Actions of Bodies: For if one Body act on another, and change its Motion any manner of way, that other Body will make the same Change in the Motion of this Body, but with a contrary Direction: So that by these Actions there are made equal Chanmined Rents of Ancient Tenants, and were paid ges, not of the Velocities but of the Motion: For in a set Quantity of Money or Provisions: They the Changes made on the Velocities in contrary DirectiDirections, are in a Reciprocal Proportion to the needs be another Sort of Resistance, if the Pores

REQUESTS, See Court of Requests in Vol. 1 the Emperour in answer to particular Persons who enquire the Law of him: But it it be sent to a Santtion

RESEISER, is taking (or resuming) of Lands again into the Hands of the King, whereof a gencral Livery, or Ouster le Maine, was formerly misfued, contrary to the Order and Form of Law: Stanif. Prerog. 26. sec Resumption.

The in-RESISTENCE of a Fluid Medium, comparable Sir Is. Newson ar the End of the Lat. Edit. of his Opticks, Qs. 20. saith that the Resistence of Fluid Mediums arises partly from the Assistion of the Parts of the Medium; and partly from the Vis Inertia Materia, or Inactivity of Matter. And supposing a Body to be perfectly spherical, the Resistence arising from the Former of these two, or from the Attrition of the Parts of the Medium, is as the Rectangle under the Diameter, and the Velocity with which the Body moves. But the Reliftence ariting from the Vis Inertia, is as the Square of that Product. And by this difference may the two Kinds of Relistence in all Me diums be distinguished: And since the Kinds are shus diftinct, it will appear that the Refistence of Bodies which are of a proper Magnitude and Velocity, whether they move in Air, Water, Quick-filver, or in any other Fluid, will almost all arile from the Vis Inertie of the Parts of the Fluid.

smaller Particles, and those also to be rendred more equally dense with Water, they could not have a smooth and slippery. But that Part which arises much less Resistence than it: If they were as from the Vis Inertia answers in Proportion to the Denfity of the Matter, and can neither be diminished by dividing the Matter into smaller Parti cles, nor by any other Means, than by the Dimi-

nution of the Density it self.

Whence it is, that Denfity of Fluid Mediums becomes very nearly proportionable to the Resistence.

Medium, would lose above half of its Motion, before it could move 3 of its own Diameters in length. And Density, as Water, Spirit of Wine, Oil of Turage and such like here. pentine, warm Oil of Olives, and such like, have very little difference also as to the Force of Resi frence. Water being 13 or 18 Times lighter, and confequently rarer than Quick-silver, hath its Resistence less than that of Mercury in the same Proportion, as he tried by the Experiment of Pendulums swimming in those two Fluids. The common of the Planets and Comets. That Fistitious Sub-Air such as we usually breath in, is about 8 or 9 he found the Resistence in Air to be less in that tion of the Phanumena of Nature; since the Mo-Ratio, by the same Kind of Trials. And in a tions of the Planets and Comers may be much thinner and rarer Air, the Refistence must still be better explained without by the Laws of Gravity; less; till at last in the Thoughts of all, it will grow and Gravity it self hath never yet been well ac-insensible. A Feather in the exhausted Receiver counted for by that Subtile Matter. In Reality, descends with equal Celerity as a Stone or a Piece that Subele Matter can only serve to obstruct and of Lead, the in the open Air it find a very great difturb the Motions of the Heavenly Bodies, and Refiftence to its Descent: And by all the Experi if there were any such thing would destroy and ments he could make he found the Refistence of all overthrow the Course and Order of Nature. And Fluid Mediums to depend only on their Density if you suppose it interspersed also within the and a little on their Tenacity: But there must bidden Pores and Measus of Bodies, it will do no-

of all Fluids were filled with another, yet more Subtle Matter or Fluid. Now if the Relistence in the Exhausted Receiver of the Air-Pump, should RESCRIPT in the Civil Law, is a Letter of be only a 100 Times less than in the common Air, it would be a Million of Times less than that of Quick-filver: But it is certainly much less than Corporation or any Publick Body of Men who that, and much less yet in the Celeftial Spaces or have consulted him, then they call it a Pragmatick Regions at 2 or 300 Miles in height above our Earth. For the Honourable Mr. Boyle hath shewn that Air may be rarified in Glass Vessels to above 1 0000 Times its natural State, and the Celestial Regions must be much more empty of Air, than any Space which we can here evacuate by an Air-Pump: Because since our Air is here compressed by the weight of the Incumbent Atmosphere, and its Density proportionable to that compressing Power; it will follow by Calculation, that the Air, at 7 Miles above the Earth's Surface will be 4 Times as rare, as here; at the Distance of 14 Miles 16 Times as rare; and so on in the same Ratio: So that at the Distance of 210 Miles from the Earth, the Air will be 10000000000000000000 or 10 Millions of Millions of Millions of Times thinner or rarer than 'tis here.

We find that Heat conduces much towards the Fluidity of many Bodies, by diminishing their Tenacity; for it tenders many Bodies (as all Metals and some Minerals) Fluid, which are not naturally so; and it increases the Fluidity of Tenacious Liquors, such as Oil, Balsams, Honey, and by that Means diminishes the Power of their Resistence. And yet it doth not much diminish the Resistence of Water; which it must certainly do if any considerable Degree of the Resistence of that Fluid arose from the Astricion or Tenacity For that Part of the Resistance of any Medium of its Particles. And therefore we may fairly con-which arises from Friction, Attrition, or Tenaci-clude that the Resistance of Water arises chiefly ty of the Particles of the Fluid, may be diminished from the Vis Increise of its Matter. And conseed, by supposing the matter to be divided into quently, if the Celestial Regions or Spaces, were dense as Quick silver, they would have a Resstence near as great as that: And if they were perfectly and completely dense, or full of Matter without any Pores or Vacuities at all interspersed, they would have a much greater Resistence than Quick-silver. A Globe perfettly folid, in such a tile Matter therefore with which some have filled hundred Times lighter, and rarer than Water, and the Heavens, is by no means useful for the Soluthing there but stop and obstruct the Kibrating Motions of the Particles of Matter, in which their Heat and all their Energy and Active Power confifts. And as it is of no use but to do Mischief, fo there are no good Reasons at all to induce us to believe the Existence of any such thing as a Materia Subtilis in their Sense.

RESISTANCE of the Air to the Motion of Projects, In Phil. Trans. N. 186. There is the Meafure of this given very largely and accurately by Dr. Wallis: He lays down at first this Lemma. That the Resistance of Bodies is proportional to their Celerity; and then branches out into all the particular Varieties that can well be imagined, and at last computing different Mediums one with another, he concludes their different Resistances to be as their Specifick Gravities, obstructed from the Viscidity of the Particles of some Fluids: And also that the Specifically Heavier Project once in motion (being equally iwift with another that is lighter, Gc.) will move through the same Mediium more strongly in proportion to its greater Intensive or Specifick Gravity.

In the Acta Eruditorum Lipsia for July 1684, Mr.G.G. Leibnitz proposes some New Demonstrations about the Resistances of Solid Bodies; which

are very Geometrical and Curious.

And in the Leipsick Acts for January 1689. Ho reduces his Thoughts on this Subject into a Differtation. Entitled, A Discourse concerning the Resistance of Mediums, and the Motion of Projects in resisting Mediums.

As to the Geometrical Considerations of the Refistance of Bodies of different Figures in one and the same Medium: Mr. James Bernouli in the Asta Lipsia for May 1693. gives these Rules.

1. If an Isoceles Triangle be moved in the Fluid according to the Direction of a Line which is Normal to its Base; First with the Vertex foremost; and then with its Base; the Resistances will be of the Leggs, and as the Square of the Base, and as the Summ of the Leggs.

2. The Refistance of a Square moved according to the Direction of its Side, and of its Diagonal, is as the Diagonal to the Side.

3. The Relistance of a Circular Segment (less 'than a Semi-circle) carried in a Ditection perpendicular to its Basis, when it goes with the Base foremost, and when with its Vertex foremost (the same Direction and Celerity continuing, which is all along supposed) is as the Square of the Diaof the Segment.

Cor. Hence the Resistances of a Semi-circle when its Base, and when its Vertex goes foremost, are to one another in a Sesquialteral Ratio.

4. A Parabola moving in the Direction of its Axis, with its Basis, and then its Vertex foremost, hath its Resistances, as the Tangent to an Arch of a Circle whose Diameter is equal to the Parameter, and the Tangent equal to half the Basis of the Parabola.

5. The Refistances of an Hyperbola, or a Semi-Ellipsis; when the Base and when the Vertex goes

Axis, and Latus Rectum; is to the Transverse Axis: So is the Square of the Latus Rectum, to the Square of the Diameter of a certain Circle, in which Circle apply a Tangent equal to half the Basis of the Hyperbola or Ellipsis. Then say again, as the Summ and Difference of the Axis and Parameter, is to the Parameter; so is the aforesaid Tangent to another Right-line. And further, as the Summ (or Difference) of the Axis and Parameter, is to the Axis: So is the circular Ark corresponding to the aforesaid Tangent, to another Arch. This done, the Resistances will be as the Tangent to the Summ (or Difference) of the Right-line thus found, and that Ark last menti-

6. In General, the Resistances of any Figure whatsoever going now with its Base foremost, and then with its Vertex, are as the Figures of the Ba-fis to the Summ of all the Cubes of the Elementa of the Basis divided by the Squares of the Elementa of the Curve-line.

All which Rules he thinks may be of Use in the Fabrick or Construction of Ships, and in perfecting the Art of Navigation universally. As also for determining the Figures of the Bobs of Pendulums for Clocks.

RESPECTU Computi Vice-Comitis habendo : Is a Writ for the Respiting a Sherist's Accounts, on just Occasion delivered to the Treasurer and the Barons of the Exchequer. Regist. fol. 139 & 179.

RESPIRATION. How such Globules of the Blood as by uniting together in the Veins, from others too large for any Secretion, and are therefore necessarily afterwards broken on the Lungs by the Force of Respiration, Dr. Keil shews in his Animal Secretion, p. 24, &c. And to estimate the Force by which the Air is thrust out of the Lungs in Exspiration he took a thin Hog's Bladder which he could eafily blow up with the Breath of one Exspiration; and having moistened it, that it might neither resist the Air in blowing up, nor the Weights which were laid upon it : Hefix'da finall Tube, whose Diameter was The part of an Inch, to the Neck of the Bladder; and then filling the Bladder with Air, he put a Weight of 216. 42. on the Top of it: And repeating the Experiment feveral Times he found that this Weight squeezed all the Air out of the Bladder, through the small Tube in the Space of 25 Vibrations of a Pendulum, fwinging Seconds, and by a Calculation which he meter, to the same less; of the Square of the Base there gives, he found the Force by which the Air is forced out of the Lungs at every Exipiration to beequal to 100 lb. Weight: And therefore, Action and Reaction being Equal, the Pressure of the Air upon the Lungs every Expiration must be equal to the Pressure of 100 lb. Weight. That is, suppoling the Gravity of the Air to be always the same, and the Diameter of the Trachaa the same also in every Exspiration. But since we find by the Barometer, that there is 3 Inches difference between the greatest and the leastGravity of the Air, which is the Tenth-part of its greatest Gravity; there must be likewise the Difference of 10 lb. Weight in its Pressure upon the Lungs at one Time more than at another. He thinks no one can doubt but that this Pressure of the Air on the Lungs in the Summ (or Difference) of the Transverse Blood, and to dissolve all the Cohesions they might Vol. II. foremost, may be thus computed: Let it be, as breathing, is sufficient to break the Globules of the

contractin their Circulation through the Veins and Arteries. And when the Blood is thus dissolved and thrown out by the Heart into the Aorta; tis evident that the Re-union of the Particles requires more or less Time, according to their several Attractive Powers, even though they all moved with the same Velocity, and in the same Direction.

But neither doth this happen, for a Fluid moves through a Cylinder or Conical Vessel (such as the Arteries are) with a greater Velocity at the Axis, than at the Sides. And again, the Blood is thrust into the Aorta, by the whole Force of the Heart: And Fluids when they are pressed, pressundequaque; by which means the Arteries are dilated, and the Blood moves not only forwards, but likewise presses perpendicular on the Sides of the Arteries: And as the Sides of the Arteries (being Elastick) return, they press the Blood from them every way, which must produce an Intestine Motion, and so hinder the Attraction of the Particles; and by this frequent and strong Cohesion of the Particles of the Blood against the Sides of the great Arteries, the Cohesions of the Particles, if any of them happen to unité, will be immediately dissolved.
Again, this Intestine Motion must greatly increase
on the Account that many of the Particles of the Blood are Elastick: For by this Resistance of the Sides of the Vessels, they must necessarily hit one against another, and being Elastick, reflect from one another, and so increase the Intestine Motion of the Blood.

On this Intestine Motion of the Blood its Heat depends; which therefore is every where proportional to the Impetus of the Particles against the Sides of the Vessels; supposing the Elasticity of the Particles every-where the same. But the Impetus of the Particles against the Sides of the Vessels decreases, as the Summ of the Cavities of the Vessels increases: And consequently where the Summ of the Cavities of the Vessels is greatest, there the Intestine Motion of the Blood is least, and the Attractive Power of the Particles (cateris pa-

ribus) is greatest.

RESTITUTIO in Integrum, is a Writ of Refitution to put a Person into Re-possession of such Lands and Tenements, as whereof he had been

wrongfullly differzed.

RETENTION, is a Faculty of the Human Mind, whereby in Order to a farther Progress in Knowledge it keeps or retains those Simple Ideas, which it before received by Sensation or Resection; and this is done two ways. First by keeping the Idea, which is brought into the Mind, for some Time actually in view, which is called Contemplation: And Secondly, by Reviving again in our Minds those Ideas, which after imprinting have disappeared, or have been as it were laid out of sight: And this we do, when we conceive Heat or Light, Yellow, or Sweet, the Object in which those Qualities are, being removed: And this is called Memory; which is as it were the common Store-houseot all our Ideas. And our Ideas being nothing but Astual Perceptions in the Mind, which cease to be any thing, when there is no Perception of them; This Laying up of our Ideas in the Repository of the Memory, signifies no more than this: That the Mind hath a Power in many Cases, to revive Perceptions which it once had, with this Additional Perception annexed to them, That it hath had them before. And in this sense it is, that

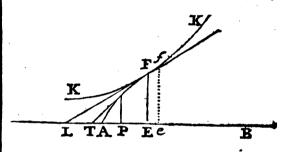
our Ideas are faid tobe in our Memory; when indeed they are actually no where: But only there is an Ability in the Mind, when it will to revive them again; and as it were paint them a-new on it felf.

RETRAXIT; in the Law, (so called from being the Estectual Word in the Entry,) is where the Plaintist or Desendant comes into Court; and declares he hath with-drawn his Suit, and will proceed no surther; and this is a Bar of all other Actions of a like or inserior Nature. The Disserence between a Retraxit and a Non suit, is that the former supposes the Plaintist or Desendant to be actually present in Court; whereas a Non-suit is upon a Demand made, when he should appear, and he makes default. A Retraxit also is a Bar, but not a Non-suit; for then he may commence a New Action of the like Nature.

RETROGRADATION of a Planet. See an Account of the Reason of this Phænomenon, un-

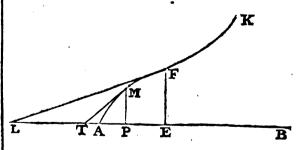
der the word Direct. in Vol. II.

RETROGRESSION of Curves: The fame with what is otherwise called contrary Flexion; and is thus? when a Curve-line AFK is partly



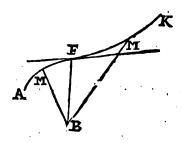
Concave and partly Convex, in respect of the Right-line A B, or in respect of the determinate Point B; the Point F which separates the Concave part of the Curve from the Convex, or which is the end of the one, and the beginning of the other, is called the Point of contrary Flexion, when the Curve is continu'd from F towards the same side as before. But when the Curve is continu'd backwards towards A, then F is call'd the Point of Retrogression.

179. If we suppose the Ordinate P M to move from A-towards B, and consider the various As-



fections of the Fluxions thereof, as it moves along, it will be an easie matter to determine the Point of contrary Flexion or Retrogression.

pository of the Memory, signifies no more than this: That the Mind hath a Power in many Cases, Curve-line AMK; and let the Ordinate PM, EF to revive Perceptions which it once had, with this Additional Perception annexed to them, That it hath had them before. And in this sense it is, that



Intercepted Diameter encreases continually, and the Portion of the Diameter AT Intercepted between the Tangent MT, and A the beginning of the Abscissa increases also, till the point P arrive at E, and afterwards decreases again; and hence 'tis plain, that the Portion of the Sub-tangent AT becomes a Maximum, when the points P and M fall in E and F.

180. But when the Curve AMF is continu'd backwards from F towards A, then the Sub-tangent AT increases continually; but the intercepted Diameter increases only, until the point T arrive in L, or until the Ordinate PM co-incides with EF; and atterwards it decreases again.

Hence to find a general Form which shall serve to Investigate the Points of contrary Flexion and Retrogression.

Suppose $AE = \alpha$, $EF = \gamma$; then is AL = 0

-011US 5 and the Fluxion thereof -

be = o, and by Transposition, and Division

(by x, supposing x an Invariable Quantity)

Infinity; and multiplying by and dividing by

-y, we have y = 0, or *Infinity*: which for the future will ferve for a General Form to find the points (F) of contrary Flexion and Retrogression; for the Nature of the Curve AFK being given, it

Fluxion of that Value (supposing *, to be Inva-

riable) we shall have the Value of y in x2, which being put equal to nothing or Infinity, will serve in either of these Suppositions, to find such a Value of AE, that the Ordinate EF shall intersect the Curve AFK in F the point of contrary Flexi- gative in F, the point of Inflexion or Retrogressia on or Retrogression.

181. The point A the beginning of x may be

so situated, that AL shall be:

Vol. II.

- x, and that AL or AE may be a mini-

mum instead of being a maximum, but because the consequence is still the same, and that this can create no difficulty, it shall be sufficient to observe,

That AL can never be =x+-; for when

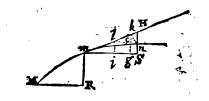
the point T falls on the other side of P in respect

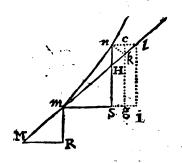
of the beginning of x, then the Value of - will

be Negative, and consequently, the Value of .

- will be Positive, and therefore in such a Case

182. The point of contrary Flexion or Retrogreffion may be found otherwise, in this manner:





we find the Value of 7 in x, and again find the It is evident that if x be supposed invariable, and that the Ordinate y be a flowing Quantity, then S n is less than SH or R m, when the Curve is Concave towards the Axis: and S n is greater than SH or R m, when the Curve is Convex towards the Axis. Whence it follows, that the Va-

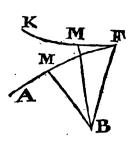
lue of H n or n from being Positive becomes Ne

on; that is y is = 0, or Infinity.

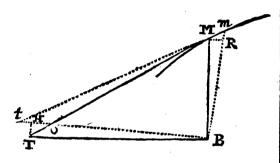
183. And if the Curve AFK respect a single point B, then draw the Ordinates BM, BF, BM, instead all concurring in the given point B. Then if you draw any Ordinate as BM, and the Tangent MT

D d d d 2

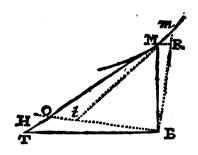
inter-



intersecting BT perpendicular to BM in T, and if the point m be taken infinitely near to M, and the Ordinate BM, Bt a perpendicular thereto, and the Tangenr mt be drawn; 'tis evident (if we suppose the Ordinate BM to increase as it comes to Bm) that in F the concave part of the Curve, Bt surpasses BO, (o being the point where MT intersects Bt) and in the part of the Curve which is Convex towards B, Bt is less than BO; whence 'tis manifest that in F the point of contrary Flexion or Retrogression, the Value of Ot passes from being Positive to be Negative.



184. These things being premis'd: If on the Center B, and with the Radii BT, BM, the little Arches TH, MR be describ'd; then the Triangles



MRm, MBT and THO are fimilar, and the little Sectors BMR, BTH are also similar; whence

(fuppofing EM = y, MR = \dot{x} , RM = \dot{y} ,) m R

$$(y): RM(x)::BM(y):BT = -\frac{yx}{2}$$

$$:: MR_{j}(x): TH = \frac{x^{j}}{y}:: TH \left(\frac{x}{y}\right)^{j}$$

And if we take the Fluxion of BT $\left(\begin{array}{c} y \dot{x} \\ - \end{array}\right)$

supposing & to be an Invariable Quantity, then is

$$Bt - BT = Ht = \frac{y \times - y \times y}{\text{and OH}}$$

 $Ht = \frac{x^3 + x - y xy}{1 + x - y xy}$ Now because in the

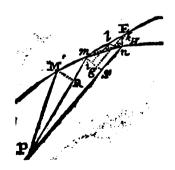
point of contrary Plexion or Retrogression, O t is either =0, or Infinity, therefore in the said point

$$x^3 + y^3 \times -y \times y$$
 is $= 0$, or Infinity, and multi-

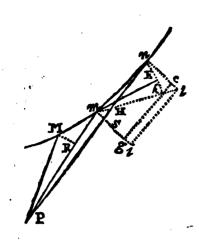
plying by y^2 , and dividing by x, we have $x^2 + y^2 - y = 0$, or Infinity; whence if the Nature of the Curve A FK be given, then the Value of y may be found in x, and the Value of y in x^2 ; and if the faid Values be substituted in the general Form, there will remain one unknown Quan-

tity (x) and the Equation thus cleared, will ferve to find such a Value of BF, that setting one foot of your Compasses in B, and with the other, at the distance BF, describing a Circle, it will cut the Curve in F, the Point of contrary Flexion or Retrogression; which was required to be done.

185. And to determine the said points another way, it must be observed, that in the Concave Part, the Angle P m E, is greater than the Angle P m n, and contrarily, in the Convex Part, the



Angle P m E is less than P m n, and consequently that the Angle P m E — P m n = E m n, or the Arch E n, from being Positive becomes Negative in F the point of contrary Flexion or Retrogression. And taking x for an invariable Quan-



tity, the right angled Triangles H m S, Hin k are fimilar; therefore Hm (=z): mS(x): H n (-j) : nk = --j; and here it must be observed, that H n is Negative, because while B m (1) Increases, m R (1) Decreases. Now because the Sectors P m S, m E k are similar, it is Bm(y):mS(x)::mE(z):Ek=-; and therefore E k + k n is =

21) because of the right angled Triangle m S n, x'+y'-y, which passes from being Positive to be Negative, in the point of contrary Flexion or Retrogression.

And if we suppose y to be Infinite, then the Terms x2, and y2 vanish, and are equal to nothing in respect of yy, and consequently the form $x^2 + y^2 - yy = 0$, or Infinity, will become -77=0, or Infinity, that is to say, dividing by first case; and this ought to be so, because the Ordinates BM, BF, BM are then parallel to one another.

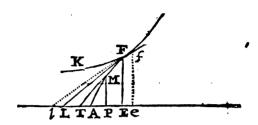
Confectary 1.

186. When 9=0, then tis evident that the Fluxion of AL is nothing in respect of x the Fluxion of AE; and that the two Tangents FL, fL being infinitely near each other, ought to make but one streight Line fF L.

Consestary 2.

And when y = Infinity, then the Fluxion of AL ought to be infinitely great in comparison of that of AE, or which is the same thing, the Flu-

xion of AE (or x) is infinitely little in respect of that of AE; and consequently we may draw



two Tangents FL, Fl, to the same point F, comprehending the infinitely little Angle L F f.

Consectary 3.

In like manner, when $x^2 + y^2 - yy = 0$, 'tis evident that, ot ought to be equal to nothing in respect of MR; and consequently, that the two Pangents MT, mt, infinitely near each other, must Co-incide, when the point M is the same with the point of contrary Flexion or Retrogression.

Confectary 4.

And when $x^2 + y^2 - yy = Infinity$, then o t is infinite in respect of MR, or which is the same thing, MR is infinitely little in comparison of at, shall have $a^2 - yy$, or (substituting $a^2 + y^2$ for and consequently the Points M and m must Coincide; that is when the Point M is the Point of Inflexion or Retrogression, we may draw two Tangents through M, comprehending an Angle infinitely little.

Confectary 5.

Hence it is evident also, that the Line which touches the Curve in the Point of contrary Flexion or Retrogression, being prolonged, touches and cuts the Curve A F K in one and the same Point,

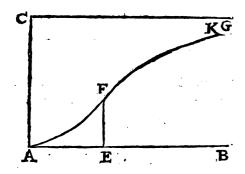
If the Curve-line AFK begiven, and its Diame-ter AB; and if the Relation of the Abscilla AE (x) to the Ordinate EF(y) be expressed by this Equation a x x = x x y + a a y; 'tis requir'd to find the Value of AE, so that the corresponding Ordinate E F shall interfest the Curve AFK in the Point of contrary Hearton F.

187. The Equation Curve is
$$y = \frac{x + x}{x + ax}$$
 and

and taking the Fluxion of this QuanQuantity, and supposing & invariable, and putting the said Second Fluxion equal to nothing; we

have 2 e3 x2 x x x + a a2 8 a3 x2 x2 x x + a a

= 0, and multiplying by $x x + a a^{2}$, and dividing by $2a^3 x^2 \times x x + aa$, we have x x + aa -4xx = 0. And 3xx = aa, that is x (AE) $= a\sqrt{\frac{1}{3}}$.



If we substitute i a a in place of x x in the Equation of the Curve y = , then y= $z = \pm a = EF$; so that we may determine the |z = z + - z|, and consequently z = z + - zPoint of Inflexion F, without supposing the Curve AFK to be described.

If AC be drawn parallel to the Ordinate E.F. and equal to the given Line a, and if CG be drawn parallel to AB, it will be an Affymptote to the Curve AFK. For if we suppose x to be infinite, then the Equation of the Curve y - will become $y = \frac{a \times x}{-} = a$, fo that the Ordinate of the Curve E F cannot be = a = A C, before the Abscissa A E be infinite.

Corollary.

188. If the Equation of the Curve be y- $-\frac{2}{3} \times x$, and p =(supposing x invariable)

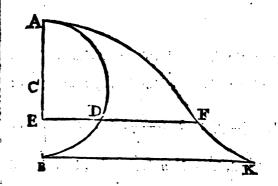
= 0. Then $= 6 x^2$ is = 0; which because it makes nothing for the Resolution of the Question, therefore I put

ty; whence the Denominator 25 V x - ar is = and confequently, the unknown Quantity x (AE) have bx - ar - br = 0, and by Transposition is $= a_{c}$

Prop. 2.

If AFKbea protracted Semi-cycloid whose BaseBK is longer than the Semi-circumference of the generating Circle ADB, whose Centre is C;'tis requir'd to find the Point E in the Diameter AB, so that the Ordinate EF shall cut the Semi-cycloid in F the Point of contrary Flexion.

189. Suppose the known Quantities ADB = 4, BK=b, AB=2r, and the unknown Quanti-



ties $A \to x$, ED = x, the Arch AD = u; and EF=1; then by the Property of the Cycloid

by the Property of the Circle z = $\sqrt{2r}$ and consequently, z= ix 2,

- and 🐱

tuting for z and y their respective Values, we

have y =

and the Fluxion there-

of (fuppposing x invariable) is, y = 0

2rx — xx x 🗸 2rx — xx

-=0, whence brx-arr

 $-ib^{-1}b^{-1} \times x^2$ is = 0, and dividing by $x^2 \times r$, we

$$bx = ar + br$$
, and $x = r + \frac{ar}{b}$, and confe-

quently
$$C = \frac{ar}{b}$$
.

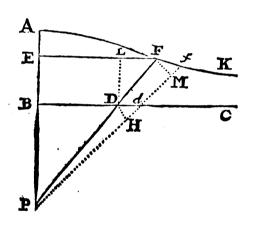
Hence'tis manifest, that to have a Point of contrary Flexion F, b must be greater than a; for if b, be less than a, then CE would exceed CB.

Prop. 3.

Let it be requir'd to find F the Point of contrary Flexion in Nichomedes's Conchoid A F K.

190. Let BC be the Assymptote, and P the Pole of the Conchoid; then the Property of the Conchoid is, that if you draw straight Lines from the Pole P to the Curve AFK, as PF, PA, then the Segments between the Assymptote and the Curve v. g. AB, DF are always equal to a given Line a.

Draw PA perpendicular, and FE parallel to BC, and suppose the known Quantities AB=FD=a; BP=b; and the unknown Quantities BE=x, EF=j, and draw DL parallel to BA, then because the Triangles DLF, PEF,



are fimilar; it is DL(*): LF($\sqrt{aa-*x}$)

$$:: PE(b+x): FE = y = \frac{b+x\sqrt{aa-xx}}{aa-xx}$$

and confequently $y = \frac{x^3 x + aabx}{}$. And $y = \frac{}{}$

2 a b -- a a x 3 -- 3 a a b x x x x = 0, whence

44x1-x1 x 1/44-x2

by Reduction there will arise $x^2 + 3bxx - 2$ aab = 0, and one of the Values of the Root x

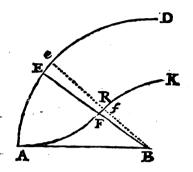
will be = PF, which was required.

If a be = b, the preceeding Equation will be changed into this other, x + 3 a x - 2 a = 0, which being divided by x + a the Quotient is x x + 2 a x - 2 a = 0, and confequently x is = a + 4 3 a a.

Prop. 4.

Let AED be an Arch of a Circle, and B its Center, and let the Property of the Curve-line AFK be fuch, that drawing any Ray BFE at pleafure, the Square of FE be equal to the Rectangle comprehended under the Arch AE and a given Right-line a. 'Tis requir'd to find the Point (F) of contrary Flexion.

191. Suppose the Arch AE=z, the Radius BA=r, and the Ordinate BF=y; then by the Property of the Curve a z=rr-2ry+yy, and



consequently $z = \frac{2yy - 2ry}{} = Ee$; and be

cause the Sectors B E e, B F R are similar, it is

BE
$$(r)$$
: BF (j) :: Ee $\left(\frac{2jj-2rj}{r}\right)$

$$FR = \frac{2}{4} = \frac{2}{9} =$$

thereof (supposing * invariable) is 47 j=24 j= +2777-2477=0. And consequently j

Values of x^2 and y in the general Theorem $y = x^2 + y^2$, there will arise this Equation

y—a which by Reduction, is 4 y — 12 r y + 12 r r y

 $-4r^3yy + 3rraay - 2r^3aa = 0$. And one of the Values of the Root y will be = BF required.

Scholium 1.

That the Curve AFK, which we may call a Parabolical Spiral, has a Point of contrary Flexion, may easily appear.

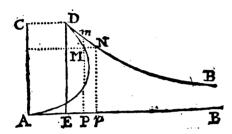
For the Circumference AED not differing fenfibly near A, from the Tangent in A, its plain from

must be concave towards that Tangent, and that afterwards the Curvature of the Circumference about its Centre becoming more and more sensible, the faid Curve must be concave towards the said Centre B.

Scholium 2.

The Points of Retrogression of Curves may be found by help of first Fluxions in this manner,

192. If the Curve AMDB be fuch that the Ordinates PM m intersect the same in two Points M and m, then that Curve must have a Point of Re-



trogression, viz. the Point D; and to determine the same it must be observ'd that if (the Abscissa) who supposed invariable, then the Fluxion of the Ordinate (when it is greatest) which passes thro' the Point of Retrogression D, is equal to nothing; whence we may find the Value of A E the Abscissa corresponding to the same.

RETURNS of a Trênch in Fortification, are the Turnings and Windings which runs from the Lines of the Trench, and are, as near as can be, parallel to the Place attacked, to avoid being enfiladed.

REVE alias Gereve, fignifies with us the Bailiff of a Franchise or Mannor, especially in the Western Parts of England: Hence Sire-Reve or Sheriff.

REVEILLE. For the Drum to beat the Reveille in any Army, is to give notice that 'tis Day-break, and that the Soldiers should rise, and the Centries forbear challenging.

REVERSIONS, or Estates in Reversion. In the little Book of Tables for Renewing and Purchasing College and Church-Leases, Printed at Cambridge 1700, and recommended by Sir Is. Newton.

There is also shew'd the Construction and Use of the following Table of Reversions, which is calculated for several Rates of Interest. The Table flews the Decrease of 1 l. yearly, according to the said several Rates; or which is the same thing, it shews you what one Pound due at the End of any Number of Years to come (not exceeding 40, which is the longest Term such Lands can be leased for) is now worth in Ready Money at 5, 6, 7, 8, 10, and 12 per Cent. per Ann.

And first, What is 1 l. due a Tear hence, worth in Ready Money now?

The Rule is this: Let 100 L with the Interest of a Year added to it, be the first Term in the Rule of Three; 100 l. the Second, and 1 l. the Third. (For as 100 l. with its Interest going on to the End of the Year, is to a bare 100 l. then

from the Nature of the Parabola, that the Curve due: So must 1 1. with its growing Interest, be to the Decrease of I l. at the Years End. (Then at 61. and 101. per Cent. the Work will stand

As 106. 100:: 1. .94339 or 18s. 10d. \(\frac{1}{4}\).

From whence it appears that 1 l. in a Years Time at 61. per Cent. decreases to 18 s. 10 d. + and at 10 l. per Cent. to 18 s. 2 d. So that 18 s. 10 d. 4 Ready Money isworth 20 s. to be paid a Year hence at 6 l. per Cent. and 18 s. 2 d. Ready Money is worth 20s. to be paid a Year hence at 10l. per Cent. And reckoning thus by a continual Geometrical Proportion decreasing, it comes to pass that 20 s. to be paid 21 Years, hence, is worth but 5 s. 10 d. \(\frac{1}{2}\) Ready Money. That is, 5 s. 10 d. \(\frac{1}{2}\) paid now, will in 21 Years at 6 l. per Cent. per Ann. compl. Interesting to just 20 s. But at 10 l. per Cent. 20 s. in 21 Years decreases to 2 s. 8 d. \(\frac{1}{2}\) So that at the Rate: of Interest 2 s. 8 d. 1 to be paid now, will amount to 20 s. in 21 Years Time.

In order therefore to renew a Leafe of 21 Years that hath but one Year lapsed, at the Rate of 104! per Cent. 1 look into the Table of Reversions below, and under the Rate of Interest mentioned, and right against 21 Years in the common Angle of meeting, I have 2 s. 8 d. 1, which is the Fine to be paid to renew one Year lapsed in the said Leafe, and supposing the Rent to be il. per Ann. for it is 21 Yearse're the Lease is compleated; in which Time the Fine of 2s. 8d. : will amount to 20 s. and therefore by paying that Fine, the Lease may fairly be made up again.

Supposeagain there be two Years lapsed in such Lease, allowing the same Rate of Interest. Looking into the following Table of Reversions I find 20 s. to be paid 20 Years hence, i is now worth in Ready Money 2 s. II d. \frac{1}{2}, add this Summ to the former of 2 s. 8 d. \frac{1}{2}, and their Summ which is 5 s. 8 d. is the Fine to be paid to make the Leafe to 21 Years again, supposing the Rent to

Suppose an, Estate in Fee-Simple, whose teal Value is 100 l. But that it is Mortgaged, or Leased our for 20 Years: What is the Reversion of it worth now, at 6 l. per Cent. Interest?

By the Table of Reversions I find 1 l. to be paid 20 Years hence, is worth but 6 s. 2 d. 1/4, and multiplying that by 100, I find,

•	l.	5.	đ.
100 times of s. is	30	CO	0
100 times 2 d. or 200 d. makes	•	10	O
And 100 times $\frac{3}{4}$, or 300 q . makes		્	. 3
Summ		<u>.</u>	
Summ	j٠	4	11

Wherefore 31 l. 2 s. 11 d. is the true present Value of 100 l. to be paid 20 Years hence.

How to value the Reversion of any Lease or Annuity: See in the Renewing of Leafes.

A Table of Reversions shewing what 1 l. due any Number of Years hence, under 41 is worth in ready Money at 5. 6, 7, 8, 10, and 12 l. per Cent.

																		—,
Years.	5 pe	rce	nt.	6 p	er ce	nt.	7 pe	r ce	nt.	8 p	rce	12 £.	10	o. ce	nt.	12/	o.cen	ıt.
rs.	s.	d.	q.	s.	d.	q.	s.	d.	q.	ş.	d.	q.	s.	d.	q.	s.	d.	q.
1 2 3 4 5	19 18 17 16	0 1 3 5 8	2 2 1 1 0	18 17 16 15	10 9 9 10	I I 2 O I	18 17 16 15	8 5 3 3 3	0 2 3 0 1	18 17 15 14 13	6 1 10 8 7	1 1 5 0	18 16 15 13	2 6 0 8 5	01000	17 15 14 12	10 11 3 8 4	I I O 2 O
6 7 8 9 10	14 14 13 12	11. 2 6 10	0 2 1 2 1	14 13 12 11	1 6 10 2	0 2 2 0 0	13 12 11 10	4. 7. 10 2	0 1 1 1 0	12 11 10 10 9	7 8 9 9	00000	11 10 9 8 7	3 4 5 8	20032	10 9 8 7 6	1 0 1 2 5	33020
11 12 13 14 15	10 10 10 9	8 7 1 7	0 2 1 0 2	10 9 98 8	6 11 4 10 4	I I 2 0	988 7 7	(A) (A) (A) (A) (A) (A) (A) (A) (A) (A)	00 m-m-00	8 7 7 6 6	6 11 4 9 3	3 1 0 2 2	7 5 5 4	o 4 9 3 9	0 2 2 0 1	5 5 4 4 3	9 1 7 1 7	02003
16 17 18 19 20	988 77	2 8 4 11 6	0 2 0 0 1	77766	10 5 0 7 2	2 0 0 0 3	δ δ 5 5	9 4 11 6	1 0 0 I	5 5 4 4	10.4073	0 70 1 71	4 7 7 7 7 7	4 11 7 3	I I O O 2	3 2 2 2 2	3 11 7 4 1	0 0 0
21 22 23 24 25	7 6 6 6 5	2 10 6 2	0 0 1 3	5 5 4 4	10 6 3 11 8	2 0 1 0	4 4 3 3	10 6 2 11 8	0 2 1	33333	11 8 4 1	30.30	2 2 2 2	8' 5 2 10	`2 2 3 1 1	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	10 8 5 3	0 0 2 3 0
26. 27 28 29 30	5 5 4 4	7 4 1 10 7	1 1 0 1 2	4 4 3 3 3 3	4 1 10 8 6	3 3 1 1	3 3 3 2 2	5 2 0 9 7	I 2 0 2 2 2	2 2 2 2 1	8 6 3 1	I 0 3 3 3	1 1 1 1	8 6 4 3	0 I 2 0 3	1	0 11 10 9	2 0 0 0
31 32 33 34 35	4 4 4 3 3	5 2 0 9 7	1 0 2 2	3322	3 0 10 8 6	1 2 1 3 2	2 2 2 2 1	5 3 1 0 10	1 2 2 0 2	1 1 1 1	10 8 6 5 4	0 1 3 1	1	8 00 11 11	0 I I I 2		7 6 5 4	0 1 2 1
33 34 35 36 37 38 39 40	33322	5 3 1 11 10	1 2 3 0	2 2 2 2 1	5 3 2 0 11	1 2 0 0 0	I	9 7 6 5 4	0 2 2 0 0	III	3 2 1. 0 11	0000		77655	3 1		4 3 3 3 2	O I O O 2

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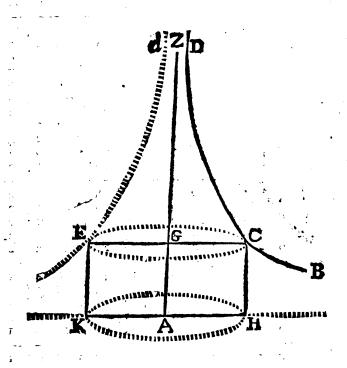
REVER-

REVERSION of Series in Algebra, is a Method to find a Number from its Logarithm, being given; or the Sine from its Ark: The Ordinate of an Elleptis, from an Area given to be cut off from any Point in the Axis.

REVOLUTION: In Geometry the Motion of any Figure quite round a fixt Line (which is called therefore its Axis) is called the Revolution of that Figure; and the Figure is moving is faid cellius Hyperbolicum Acutum, tho'its self (as he Revolution generates, is Infinite.

demonstrates) be Finite; is yet formed by the Revolution of an Infinite Area: As in the Figure an-

Let A be the Centre of the Apollonian common Hyperbola DCB. A Z one of the Affymptotes, GC an Ordinate equal to the Abscissa GA. Compleat the Square GH. And supposing Z to be atan Infinite Distance, imagine the Space DCHAZ of that Figure; and the Figure is moving is faid to Revolve about the Affymptote ZA, generating to Revolve. Thus a Right-angled Triangle revolutions round one of its Legs, as an Axis, generates by that Revolution a Cone. And to instance in a Finite and exactly Equal to the Cylinder EKHC: Case very wonderful; the Body called by Torri- But yet the Assumptionick Space GCD, which its



GC or GA. Then will the Fluent of the Space = Infinite: And the Fluent of the Body dEGC is ** -xyy= to the Cylinder EH.

RHANDIR in the Division of the Country of In 3 3 Wales before the Conquest; what they called a at 30 Cantres contained an hundred Towns, under which lings. were fo many Commots: Each Commot had 12 Mannors or Circuits, and two Townships: There were 4 Townships to every Mannor; and every Township comprehended 4 Gavels: And every Ga-welhad 4 Rhandirs, and in every Rhandir were 4 Tenements. Taylor's Hist. of Gavel Kind, p. 69.

For let a Unit, or 1. represent the Ordinate Pound-weight of Gold of the old Standard, was coined into 45 Rials going for 10 Shillings a piece, or a proportionable Number of half Rials going at five Shilling apiece: Or,

> RIALS Farthings? which went at 2 s. 6 d. In 1 H. 8. The Golden Rial was ordered to go at 113. 3 d. In 2 Eliz. Golden Rials were coined at 15s. a piece, when a Pound-weight of old Standard Gold was to be coined into 48 Rials. In 3 Jac. 1. The Rose Rials of Gold were coined at 30 s. a piece, and the Spurr-Rials at 15 Shil-

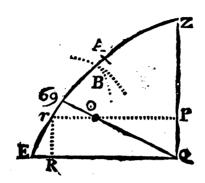
> RIBBING Nails are fuch as are used to fasten the Ribbing, ortokeepthe Ribs of a Ship in their Place.

RIDING Clerk, one of the fix Clerks in Chan-RIAL, A Piece of Gold current, for ten Shillongs: In 1 H. 6. by Indenture of the Mint, a Great Sealthat Year. Comel.

RIGHT

RIGHT Ascension of the Sun. To find this by ving taken E 5; from the Chords = 23° 30', and the Projection of Part of the Analemma readily; so draw n EQ) will find of for the Sun's place; having given either his Place, or Declination.

or having the Point of O first, if through it you In the Quadrant E Q Z, draw rp representing present Declination. This done, $\odot p$ will be the Parallel of the Sun's Declination; which (has Sine of the Sun's right Ascension to the Radius rp



Wherefore (by the Sector) say as rp, to p: label from Mr. James Hodgson, the Worthy Ma-EQ to a 4th Term; which will be the true Sine of the Sun's right Ascension: But you may find it in the Diagram thus. Set rp from Q to R, on which Point R as a Centre, and with percentIweep an Ark as B: Then a Ruler laid from Q, just to touch the Convexity of that Ark B, will find the Point A in the Limb. Then will E A, measured on the Chords be the Degrees of right Ascension of the Sun, from the next Equinoctial

Here follow Tables of the Sun's Right Ascenfion, Declination, and Place in the Ecliptick, which lection of this Nature.

Ensuing Year 1710, and will serve without any sensible Errour for about Twenty Years to come. Their Use is so easie that it needs no Description; and their Benefit and Advantage is so Univerfally and so previously necessary in all Astronomical Calculations, that they must have a Place in a Col-

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A Table of the Sun's Right	Ascension in Hours and Minutes	for the Year, 1709.

• 5	Fanuary.	February.	March.	1	I Ap	ril.	M	.1y.	7:	ne.	1 7
Days	h. m.	h. m.	h. m.		h.	m.	h.	m.	h.	m.	Days
-	l'			l .	1	22	, , , ,			_	
2	19 36	21 44	23 29 23 33		1	25	3	16 20	5 5	21	ı,
3	19 44	21 52	23 36	Ι΄.	1	29	3	24	5	25 29	3
4	19 49	21 56	23 40	ŀ	1	33	3	27	Ś	33	4
1 '5	19 53	22 00	23 44	1	1	37	3	31	5	37	5
6	19 57	22 4	23 48	ı	1	40	3	35	5	42	6
7	20 I	22 7	23 51	l	I	44	3	39	Ś	46	7
8	20 5	22 11	23 54	ì	I	48	3	43	5	50	8
9	20 9	22 15	23 58	1	I	51	3	47	5	54	9
10	20 14	22 18	0 2	i	<u> </u>	55	3	51	5	58	10
11	20 18	22 22	, 0 5	ł	I	59	3	55	6	3	11
12	20 22	22 26	0 00	1	2 2	2 6	3	59	6	7	12
13	20 27 20 31	22 30	0 13		2	10	4	3	6	11	13
14	20 35	22 38	0 20		2	14	4	7	6	15 19	14 15
16	20 39	22 41		S.A.	2	17			6		16
17	20 44	22 45	0 24	~	2	2 [4 `	15	6	23 28	10
18	20 48	22 49	0 31		2	25	4	23	6	32	18
19	20 52	22 53	0 34		2	ં, ૩૦	4	28	6	36	19
20	20 56	22 56	0. 38	1	2	` 83,	4	32	6	40	20
21	2 I 00	23 00	0 42	†	2	30	4	36	6	44	21
22	21 4	23 4	0 45		2	40	4	40	6	48	22
23	21 8	23 8	0 49	1	2	44	4	44	6	52	23
24	21 12	23 11	0 53	1	2	.48	4	48	6	5 5	24
25	21 16	23 15	0 56	1	2	52	4	53	7	00	25
25	21 20	23 10	1. 00	1	2	56	4	56	7	5	26
27	21 24	23 22	1 3		2	59 .	5	.00	7	9	27
28	21 28	23 26	1 7	1 .	3	3	5	4	7	13	28
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Dayı	July.	Angust.	September.	T	l ——	ober.		mber.	Dece		Day
Days	h. m.	h. m.	h. m.		h.	m.	h.	m.	h.	m.	Days
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1 2	h. m. 7 25 7 29	h. m. 9 27 9 31	h. m. 11 21 11 24		h. 13	m. 10	h. 15	m. 10 14	h. 17 17	m. 18	1 2
1 2 3	h. m. 7 25 7 29 7 33	h. m. 9 27 9 31 9 35	h. m. 11 21 11 24 11 28		h. 13 13	m. 10 13	h. 15 15	m. 10 14 18	h. 17 17 17	m. 18 22 26	1 2 3
1 2 3 4	h. m. 7 25 7 29 7 33 7 38	h. m. 9 27 9 31 9 35 9 38	h. in. 11 21 11 24 11 28 11 32		h. 13 13 13	m. 10 13 17	h. 15 15 15	m. 10 14 18 22	h. 17 17 17 17	m. 18 22 26 31	1 2 3 4
1 2 3 4 5	h. m. 7 25 7 29 7 33 7 38 7 42	h. m. 9 27 9 31 9 35 9 38 9 42	h. m. 11 21 11 24 11 28 11 32 11 35		h13 -13 -13 -13 -13 -13	m. 10 13 17 21 25	h. 15 15 15 15 15	m. 10 14 18 22 26	h. 17 17 17 17 17	m. 18 22 26 31 35	1 2 3 4 5
3 4 5 6	h. m. 7 25 7 29 7 33 7 38 7 42 7 46	h. m. 9 27 9 31 9 35 9 38 9 42 9 46	h. m. 11 21 11 24 11 28 11 32 11 35 11 39		h. 13 13 13 13 13 13 13	m. 10 13 17 2Ĭ 25	h. 15 15 15 15 15	m. 10 14 18 22 26	h. 17 17 17 17 17	m. 18 22 26 31 35	1 2 3 4 5
3 4 5 6	h. m. 7 25 7 29 7 33 7 38 7 42 7 46	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50	h. m. 11 21 11 24 11 28 11 32 11 35 11 39		h. 13 13 13 13 13 13 13	m. 10 13 17 2Ĭ 25 28 32	h. 15 15 15 15 15	m. 10 14 18 22 26 30 34	h. 17 17 17 17 17 17	m. 18 22 26 31 35 40 44	1 2 3 4 5 6 7 8
3 4 5 6 7 8	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58	h. m. 9 27 9 31 9 35 9 38 9 42 9 46	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50		h. 13 13 13 13 13 13 13 13 13 13	m. 10 13 17 2Ĭ 25	h. 15 15 15 15 15 15 15 15	m. 10 14 18 22 26	h. 17 17 17 17 17	m. 18 22 26 31 35 40 44 49 53	1 2 3 4 5 6 7 8
3 4 5 6	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53		h. 13 13 13 13 13 13 13 13 13	m. 10 13 17 21 25 28 32 36	h. 15 15 15 15 15 15 15	m. 10 14 18 22 26 30 34 38	h. 17 17 17 17 17 17 17	m. 18 22 26 31 35 40 44 49 53 58	1 2 3 4 5 6 7 8
3 4 5 6 7 8 9	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53		h. 13 13 13 13 13 13 13 13 13 13	m. 10 13 17 21 25 28 32 36 40 43	h. 15 15 15 15 15 15 15 15 15 15	m. 10 14 18 22 26 30 34 38 43	h. 17 17 17 17 17 17 17 17 17 17 17 18	m. 18 22 26 31 35 40 44 49 53	1 2 3 4 5 6 7 8 9 10
3 4 5 6 7 8	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53		h. 13 13 13 13 13 13 13 13 13 13 13	m. 10 13 17 21 25 28 32 36 40 43 46 51	h. 15 15 15 15 15 15 15 15 15 15	m. 10 14 18 22 26 30 34 38 43 47 51	h. 17 17 17 17 17 17 17 17 17 17 18 18	m. 18 22 26 31 35 40 44 49 53 58	1 2 3 4 5 6 7 8 9 10 II 12
3 4 5 6 7 8 9 10 11 12	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1 8. 6 8. 10 8. 14	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 4		h. 13 13 13 13 13 13 13 13 13 13 13 13	m. 10 13 17 21 25 28 32 36 40 43 46 51 54	h. 15 15 15 15 15 15 15 15 15 15 15 15	m. 10 14 18 22 26 30 34 38 43 47 51 55 00	h. 17 17 17 17 17 17 17 17 17 17 18 18 18	m. 18 22 26 31 35 40 44 49 53 58	1 2 3 4 5 6 7 8 9 10 11 12 13
3 4 5 6 7 8 9 10 11 12 13	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 45 7. 49 7. 58 8. 1 8. 6 8. 10 8. 14 8. 18	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 4 12 8		h. 13 13 13 13 13 13 13 13 13 13 13 13 13	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58	h. 15 15 15 15 15 15 15 15 15 15 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11	1 2 3 4 5 6 7 8 9 10 11 12 13 14
3 4 5 6 7 8 9 10 11 12 13 14 15	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1 8. 6 8. 10 8. 14 8. 18 8. 21	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15 10 19	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 1 12 4 12 8 12 12		h. 13 13 13 13 13 13 13 13 13 13 13 14	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58	h. 15 15 15 15 15 15 15 15 15 16 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4 8	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11 16 20	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
3 4 5 6 7 8 9 10 11 12 13 14 15	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 58 8. 1 8. 6 8. 10 8. 14 8. 18 8. 21 8. 25	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15 10 19	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 1 12 4 12 8 12 12 15		h. 13 13 13 13 13 13 13 13 13 13 13 14	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58 1	h. 15 15 15 15 15 15 15 15 15 16 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4 8	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11 16 20 24	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 15
3 4 5 6 7 8 9 10 11 12 13 14 15	h. m. 7. 25 7. 29 7. 33 7. 38 7. 42 7. 46 7. 49 7. 54 7. 58 8. 1 8. 6 8. 10 8. 14 8. 18 8. 21 8. 25 8. 29	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15 10 19 10 22 10 26	h. m. 11 21 11 24 11 28 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 1 12 4 12 8 12 12 12 12 15		h. 13 13 13 13 13 13 13 13 13 13 14 14	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58 1	h. 15 15 15 15 15 15 15 15 15 16 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4 8	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11 16 20 24 29	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 15 15 17
3 4 5 6 7 8 9 10 11 12 13 14 15	h. m. 7 25 7 29 7 33 7 38 7 42 7 46 7 49 7 54 7 58 8 1 8 6 8 10 8 14 8 18 8 21 8 25 8 29 8 33	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15 10 19 10 22 10 26 10 30	h. m. 11 21 11 24 11 32 11 35 11 39 11 42 11 46 11 50 11 53 11 57 12 1 12 4 12 8 12 12 12 15 12 19 12 22		h. 13 13 13 13 13 13 13 13 13 13 14 14 14	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58 1	h. 15 15 15 15 15 15 15 15 15 16 16 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4 8	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11 16 20 24 29 33	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 15 17 18
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	h. m. 7 25 7 29 7 33 7 38 7 42 7 45 7 49 7 54 7 58 8 10 8 10 8 14 8 18 8 21 8 25 8 29 8 33 8 37	h. m. 9 27 9 31 9 35 9 38 9 42 9 46 9 50 9 54 9 57 10 1 10 4 10 8 10 11 10 15 10 19 10 22 10 26 10 30 10 33	h. m. 11 21 11 24 11 32 11 35 11 35 11 35 11 50 11 53 11 57 12 1 12 4 12 8 12 12 12 15 12 19 12 22 12 26		h. 13 13 13 13 13 13 13 13 13 13 14 14 14 14	m. 10 13 17 21 25 28 32 36 40 43 46 51 54 58 1 6 9 13	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16	m. 10 14 18 22 26 30 34 38 43 47 51 55 00 4 8 13 17 21	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18	m. 18 22 26 31 35 40 44 49 53 58 2 7 11 16 20 24 29 33 38	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 15 17 18 19
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A Table of the Sun's Right Ascension in Hours and	l Minutes for the Year. 17	'T T

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 43	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 17 10 21 10 25 10 28 10 36 10 39 10 43	h. m. 11		m. 3 8 3 11 3 15 3 23 3 26 3 30 3 34 3 34 3 34 3 34 4 53 3 45 4 60 4 4 8 4 12 4 16 4 20 4 24 4 28	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 58 2 6 10 15 19 23 27 36	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 51 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 55 9 55 9 59 10 3 10 6 10 17 10 21 10 25 10 28 10 36 10 39 10 43 10 46	h. m. 11		m. 3 8 3 11 3 15 3 19 3 23 3 26 3 30 3 34 3 38 3 47 3 45 3 45 3 47 4 49 4 49 4 16 4 20 4 28 4 92	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 10 15 19 23 27 36 41	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 51 7 55 7 59 8 3 8 11 8 15 8 15 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 54	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 17 10 21 10 25 10 28 10 36 10 39 10 43	h. m. 11		m. 3 8 3 11 3 15 3 19 3 23 3 26 3 30 3 34 3 38 3 47 3 45 3 45 3 47 4 49 4 49 4 16 4 20 4 28 4 92	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 10 15 19 23 27 36 41	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 53	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 51 7 55 7 59 8 3 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 54	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 14 10 17 10 21 10 25 10 25 10 36 10 39 10 43 10 46 10 50	h. m. 11	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	m. 3 8 3 11 3 15 3 23 3 26 3 30 3 34 3 34 3 34 3 35 3 45 3 45 3 45 4 49 4 49 4 16 4 20 4 28 4 36	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 58 2 6 10 15 19 23 27 36 41 45	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 9 13 18 22 26 31 35 40 44 49 53 57 2	1 2 3 4 5 6 7 8 9 10 II 12 I3 14 1.5 I5 17 18 19 20 21 22 23 24
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 51 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 43 8 54 8 58	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 14 10 17 10 21 10 25 10 28 10 36 10 39 10 43 10 46 10 50 10 54	h. m. 11	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	m. 3 8 3 11 3 15 3 19 3 23 3 26 3 30 4 33 3 47 3 45 3 45 3 45 4 49 4 16 4 20 4 28 4 16 4 20 4 28 4 36 4 49	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 27 36 41 45 49	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 9 13 18 22 26 31 35 40 44 49 53 57 2	1 2 3 4 5 6 7 8 9 10 II 12 I3 14 1.5 15 17 18 19 20 21 22 23 24 25
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 55 7 55 8 38 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 54 8 58	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 11 10 17 10 21 10 25 10 28 10 36 10 36 10 39 10 43 10 46 10 50 10 54	h. m. 11	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	m. 3 8 3 11 3 15 3 23 3 26 3 30 3 34 3 34 3 34 3 35 3 45 3 45 4 49 4 16 4 20 4 28 4 16 4 20 4 28 4 36 4 49	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 10 15 19 23 27 36 41 45 49 53	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 18	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 53 57 2	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23 24 25 26
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 51 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 54 8 58	h. m. 9 25 9 29 9 33 9 40 9 44 9 48 9 52 9 55 9 59 10 6 10 10 10 14 10 17 10 21 10 25 10 36 10 39 10 46 10 50 10 54	h. m. 11		m. 3 8 3 11 3 15 3 23 3 26 3 30 3 34 3 34 3 34 4 49 4 49 4 44 4 48 4 48	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16	m. 8 12 16 20 24 28 32 36 41 45 49 53 58 49 53 58	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 53 57 2 6 11	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23 24 25 26 27
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 58 9 6 9 10	h. m. 9 25 9 29 9 33 9 36 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 10 10 17 10 21 10 25 10 28 10 36 10 36 10 39 10 43 10 46 10 57 11 1	h. m. 11		m. 3 8 3 11 3 15 3 23 3 26 3 30 3 34 3 38 3 45 3 34 4 53 5 57 4 4 8 4 12 4 16 4 20 4 28 4 36 4 49 4 48 4 52	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16 17	m. 8 12 16 20 24 28 32 36 41 45 49 53 58 2 58 2	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 57 2 6 11 15	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 15 17 18 19 20 21 22 23 24 25 26 27 28
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 59 8 3 8 7 8 11 8 15 9 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 54 8 58 9 6 9 10 9 14	h. m. 9 25 9 29 9 33 9 36 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 11 10 21 10 25 10 36 10 39 10 43 10 46 10 57 11 5 11 5 11 5	h. m. 11		m. 3 8 3 11 3 15 3 19 3 23 3 30 4 33 3 47 3 45 3 45 3 45 4 49 4 48 4 16 4 20 4 48 4 82 4 48 4 52 4 48 4 52 4 48 4 52 4 48 5 56	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 17 17	m. 8 12 16 20 24 28 32 36 45 49 53 6 10 15 19 23 27 32 36 45 49 53 88 2 7	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 57 2 6 11 15 19	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23 24 25 26 27 28 29
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 59 8 3 8 7 8 11 8 15 8 19 8 23 8 27 8 31 8 35 8 39 8 43 8 47 8 51 8 58 9 6 9 10	h. m. 9 25 9 29 9 33 9 36 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 11 10 21 10 25 10 28 10 32 10 36 10 39 10 43 10 46 10 57 11 1 11 5 11 8 11 12	h. m. 11		m. 3 8 3 11 3 15 3 19 3 23 3 30 3 34 3 34 3 34 3 34 3 34 4 4 4 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8	h. 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 16 17	m. 8 12 16 20 24 28 32 36 41 45 49 53 58 2 58 2	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 53 57 2 6 11 15 19 24	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 15 17 18 19 20 21 22 23 24 25 26 27 28
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 55 7 55 8 39 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 27 8 31 8 23 8 24 8 25 9 26 9 10 9 14 9 18	h. m. 9 25 9 29 9 33 9 36 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 11 10 21 10 25 10 28 10 32 10 36 10 39 10 43 10 46 10 57 11 1 11 5 11 8 11 12	h. m. 11		m. 3 8 3 11 3 15 3 19 3 23 3 30 3 34 3 34 3 34 3 34 3 34 4 4 4 4 8 4 8 4 8 4 8 4 8 4 8 4 8 4 8	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 17 17	m. 8 12 16 20 24 28 32 36 45 49 53 6 10 15 19 23 27 32 36 45 49 53 88 2 7	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19 19 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 53 57 2 6 11 15 19 24	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	h. m. 7 23 7 27 7 31 7 35 7 39 7 43 7 47 7 55 7 55 7 55 8 39 8 23 8 27 8 31 8 35 8 39 8 43 8 43 8 54 8 58 9 2 9 10 9 14 9 18	h. m. 9 25 9 29 9 33 9 36 9 40 9 44 9 48 9 52 9 55 9 59 10 3 10 6 10 10 10 11 10 21 10 25 10 36 10 39 10 43 10 46 10 57 11 5 11 5 11 5	h. m. 11		m. 3 8 3 11 3 15 3 23 3 26 3 30 4 33 3 47 3 45 3 45 3 47 4 48 4 16 4 28 4 16 4 28 4 48 4 52 4 48 4 52 4 48 5 56 90	h. 15 15 15 15 15 15 15 15 15 15 16 16 16 16 16 16 16 16 17 17	m. 8 12 16 20 24 28 32 36 45 49 53 6 10 15 19 23 27 32 36 45 49 53 88 2 7	h. 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 19 19 19 19	m. 16 20 24 29 32 38 42 47 51 55 00 4 9 13 18 22 26 31 35 40 44 49 57 2 6 11 15 19	1 2 3 4 5 6 7 8 9 10 II 12 13 14 1.5 15 17 18 19 20 21 22 23 24 25 26 27 28 29

A Table of the Sun's Right Ascension in Hours and Minutes for the Year, 1712.

D	January.	February.	March.	1	April.	Ma	y.	7,	ne.	D
Days	$\frac{1}{h}$. m .	h. m.	h. m.	h.	m.	h.	m.	h.	m.	Days
1	19 33	21 41	23 30	1		3	16	5	22	1
2	19 37	21 45	23 34	1	_	3	20	5	26	2
	19 41	21 49	²³ 37	1	30	3	24	5	30	3
3 4	19 45	21 53	23 41		34	3	28	5	34	4
5	19 50	21 57	23 45			3	32	5	38	5
6	19 54	22 1	23 49 23 52	1	41 45	3	36	5	43	6
7 8	19 58	22 4	23 52 23 55	;	49	3	40 44	5 5	47 51	7 8
9	20 6	22 13	23 .59	I	52	3	48	5	55	9
10	20 11	22 16	0 3	1	56	3	52	6;	00	ló
11	20 15	22 19	0 6	2	. 00	3	56	6	4 8	II
12	20 19	22 23	0 10	2	3	4	0 0	6		12
13	20 24	22 27	0 14	2 2	7	4	4	6	12	13
14	20 28 20 32	22 31	0 I7 0 2I	2	11 15	4	8 12	6	16 21	14
16	20 36	22 38	0 25	3	18	4	16	6	45	16
17	20 41	22 42	0 28	2		4	20	6	29	17
18	20 45	22 46	0 32	2	26	4	24	6	33	۱8
19	20 49	22 50	0 35	. 2	30	4	29	6	37	19
20	20 53	22 53	0 39	2	34	4_	33	6	41	20
21	20 57	22 57	0 43	2	37	4	37	6.	45	21
22	21 1	23 I	0 46 0 50	2 2	41 45	4	41	6	49	22
23 24	2I 5 2I 9	23 5	0 54	2	49 49	4	45 49	6	53 57	23 24
25	21 13	23 12	0 57	2	53	4	53	7	2	25
26	21 17	23 16	1 1	2	57	4	57	7	6	26
27	21 21	23 19	1 4	3	00	5	í	7	Io	. 27
28	2E 25	23 23	I 6	3	4	5	5	7	14	28
29	2E 29	23 27	I 12 I 16	3	8 12	5	9	7	18	29
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Days	July.	Auguit.	Septemeer,		Anber.	Novem h.		Decen		Days
Days	h. m.	h. m.	h. m.	h.	m.	h.	m.	h.	m.	Days
1	h. m.	h. m.	h. m.	h.	m.	h.	m. 11	h.	m.	1
1 2	h. m. 7 26 7 30	h. m. 9 28 9 32	h. m.	h.	m.	h.	m.	h.	m. 19 23	1 2
1 2 3 4	h. m. 7 26 7 30 7 34 7 39	h. m- 9 28 9 32 9 36 9 39	h. m. 11 21 11 24 11 28 11 32	h. 13 13 13	m. 11 15 18	h. 15 15 15	m. 11 15 19 23	h. 17 17 17	m. 19 23 27 32	1 2 3 4
1 2 3 4 5	h. m. 7 26 7 30 7 34 7 39 7 43	h. m- 9 28 9 32 9 36	h. m. 11 21 11 24 11 28	h. 13 13 13 13	m. 11 15	h. 15 15 15 15	m. 11 15	h. 17 17	m. 19 23 27	1 2 3
2 3 4 5	h. m. 7 26 7 30 7 34 7 39 7 43 7 47	h. m- 9 28 9 32 9 36 9 39 9 43 9 47	h. m. 11 21 11 24 11 28 11 32 11 36 11 39	h. 13 13 13 13 13	m. 11 15 18 22 26	h. 15 15 15 15 15	m. 15 19 23 27	h. 17 17 17 17 17	m. 19 23 27 32 36 41	1 2 3 4 5
1 2 3 4 5 6 7	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51	h. m. 11 21 11 24 11 28 11 36 11 39 11 43	h. 13 13 13 13 13 13	m. 11 15 18 22 26 29 33	h. 15 15 15 15 15 15	m. 11 15 19 23 27 31 35	h. 17 17 17 17 17 17	m. 19 23 27 32 36 41 45	1 2 3 4 5
2 3 4 5 6 7	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46	h. 13 13 13 13 13 13 13 13 13	m. 11 15 18 22 26 29 33 37	h. 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44	h. 17 17 17 17 17 17 17	m. 19 23 27 32 36 41 45 50	1 2 3 4 5 6 7 8
1 2 3 4 5 6 7	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46	h. 13 13 13 13 13 13 13 13 13 13	m. 11 15 18 22 26 29 33 37 41	h. 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44	h. 17 17 17 17 17 17	m. 19 23 27 32 36 41 45 50	1 2 3 4 5
1 2 3 4 5 6 7 8 9	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 58 8 2 8 6	h. m· 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46 11 50 11 54	h. 13 13 13 13 13 13 13 13 13	m. 11 15 18 22 26 29 33 37 41 44	h. 15 15 15 15 15 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44 48	h. 17 17 17 17 17 17 17 17 17 17 17 18	m. 19 23 27 32 36 41 45 50	1 2 3 4 5 6 7 8 9
1 2 2 3 4 5 6 7 7 8 9 10 II	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58 8 2 8 6 8 10	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2 10 6 10 9	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46 11 50 11 54	h. 13 13 13 13 13 13 13 13 13 13 13 13	m. 11 15 18 22 26 29 33 37 41 44	h. 15 15 15 15 15 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44 48 52 56	h. 17 17 17 17 17 17 17 17 17 17 18 18	m. 19 23 27 32 36 41 45 50 54 59	1 2 3 4 5 6 7 8 9
1 2 2 3 4 5 6 7 7 8 9 10 II	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58 8 2 8 6 8 10 8 14	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2 10 6 10 9 10 13	h. m. 11 21 11 24 11 24 11 32 11 36 11 39 11 43 11 46 11 50 11 54 11 57 12 1	h. 13 13 13 13 13 13 13 13 13 13 13 13 13	m. 11 15 18 22 26 29 33 37 41 44 48 52	h. 15 15 15 15 15 15 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44 48 52 56 1	h. 17 17 17 17 17 17 17 17 17 17 18 18	m. 19 23 27 32 36 41 45 50 54 59 3 7	1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10 11 12 13	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58 8 2 8 6 8 10 8 14 8 18	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2 10 6 10 9 10 13 10 17	h. m. 11 21 11 24 11 24 11 32 11 36 11 39 11 43 11 46 11 50 11 54 11 57 12 1	h. 13 13 13 13 13 13 13 13 13 13 13 13 14	m. 11 15 18 22 26 29 33 37 41 44 48 52 56 00	h. 15 15 15 15 15 15 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44 48 52 56 1	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 19 23 27 32 36 41 45 50 54 59 3 7 12	1 2 3 4 5 6 7 8 9 10 11 12 13 14
1 2 3 4 5 6 7 8 9 10 11 12 13	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58 8 2 8 6 8 10 8 14 8 18 8 22	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2 10 6 10 9 10 13 10 17 10 20	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46 11 50 11 54 11 57 12 11 12 5 12 8 12 12	h. 13 13 13 13 13 13 13 13 13 13 14 14	m. 11 15 18 22 26 29 33 37 41 44 48 56 00 3	h. 15 15 15 15 15 15 15 15 15 15 15 15 15	m. 11 15 19 23 27 31 35 39 44 48 52 56 1 5	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 19 23 27 32 36 41 45 50 54 59 3 7 12 17 21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 5
1 2 2 3 4 5 6 7 8 9 FO II 12 13 14 15 16	h. m. 7 26 7 30 7 34 7 39 7 43 7 47 7 50 7 54 7 58 8 2 8 6 8 10 8 14 8 18 8 22 8 26	h. m- 9 28 9 32 9 36 9 39 9 43 9 47 9 51 9 55 9 58 10 2 10 6 10 9 10 13 10 17 10 20 10 24	h. m. 11 21 11 24 11 28 11 32 11 36 11 39 11 43 11 46 11 50 11 54 11 57 12 1 12 5 12 8 12 12	h. 13 13 13 13 13 13 13 13 13 13 14 14 14	m. 11 15 18 22 26 29 33 37 41 44 48 52 56 00 3	h. 15 15 15 15 15 15 15 15 15 15 15 16 16	m. 11 15 19 23 27 31 35 39 44 48 52 56 1 5 9	h. 17 17 17 17 17 17 17 17 17 17 18 18 18 18	m. 19 23 27 32 36 41 45 50 54 59 3 7 12 17 21	1 2 3 4 4 5 6 7 8 9 10 11 12 13 14 5 15
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A Table of the Longitude, Latitude, Right Ascension and Declination of above 50 of the Principal Stars of the First, Second and Third Magnitude: For the Year 1710.

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The Pole-Star	2	n	24	3	3	37	66	3	00	N.	9	9	8 1	37	46	15	
he First Star of Aries	4	$\overline{\gamma}$	29		9	18	7	10	2	N.	24	2 5	40	17	52	2	N.
ne second Star of Aries ————	3		29	- 5	6.	42	8	28	45	N.	24	41	20	2 <	28		N.
he bright Star of Aries	2	ਠ	3	3	7	55	9	57	43	N.	27	44	28	22	ζ,	40	N
he Southern Horn of Capricorn	了 i		00	÷	0	ائ.		<u> </u>	اارو	7	01	<u>.</u>	- l				اج
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RIGLET

ly certain Servitors, which held their Land by ferving their Lord on Horse-back; or attending him in his Progress or Travels on the Road.

ROME-Scot was formerly here an annual Tribute of a Penny for every Family, and paid to Rome at the Feast of St Peter ad Vincula, being

the First of August.

Cambden tells us it was first granted by Offa; but others attribute its Original to Ina, King of the West Saxons; who being in Pilgrimage at Rome, A. D. 725. gave it as an Alms. It amounted to three hundred Marks and one Noble yearly. Of this Mark of Slavery to Rome, our Ancestors frequently complained as a Burden and Scandal to the English Nation! It was first for bidden to be paid by Edw. 3. Tho' before complained of in Parliament as a Grievance in K. John's Time, This Payment was abrogated 25 A. D. 1206. H. 8. 25. But servilely restored again 1 and 2 as is plain from the following Table, where the Phil. and Mary; and at last utterly abolished, Numbers are so removed without their Letters, 1 Eliz. 1.

ROOT Binomial: To raise (easily) a Binomial Root up to any Power assign'd.

Suppose a + b. (1.) If it be a - b 't is called a Residual; and the Powers of such a Residual will be the same with the like Powers railed from a Binomial (affirmative) as a + b; except, that as the Signs of the Powers of a Binomial are all affirmative: Those of the Residual have the Signs - alternately annexed to every other Term; as will easily appear from multiplying a -b by it felf, and then the Square so found by the Root again, &c.

2. The Indexes of the Powers of the Leading Quantity, or First Name a, in all the Powers of the Binomial a + b do continually decrease, and that in an Arithmetical Progression; asthole of b, the other Names do after the same Manner encrease.

So that if the Indexes of the Powers of a + bonly were required, when that Binomial is to be raised up to the seventh Power, you will easily perceive that it must stand thus.

 $a^7 + a^6b + a^5b^2 + a^4.b^3 + a^3b^4 + a^3b^5 + ab^6 + b^7.$ young Mathematicians Guide, p. 157, 158.

3. Where 'tis easy to observe that the first and last Term are pure Powers of the single Quanti-Row of the Table above, and prefix them to the ties a and b, and are both of the same Height: several and proper Letters in the 7th Power of a+b, As also that the Summ of the Indexes of any two Letters joined together in any of the Intermediate ral Uncia, and it will stand thus; Terms, do always make up the Index of the highest Power.

4. The next Work therefore is only to find the

RIGLET, is any square, stat, thin, Piece of Wood, like those which are designed to make the Frames of small Pictures of; which are so called, and then removing the said Power, when 'tis so before they are Molded. before they are Molded.

RINÆUS, a Muscle of the Nose, otherwise ther to the Right or Left-hand. Thus aa + 2ab called Nasalis; which see

ROD Knights. alias Rad-Knights were ancienttound by joining to a + b each Letter of a + b, and removing the Powers to the Right or Lefthand thus; a joined to a makes a a; a joined to b makes a b; and b joined to a makes another ab; and b joined to b makes bb; and it will

fland thus; aa + ab + bb or aa + 2ab + bb. Now

from hence it will follow, (3) That the Unciæof the second Term in any such Power will always be the Summ of so many Units added together (more 1.) as there hath been Multiplications of the First Root; which will always be determined by the Index of the first Term in the Power!

And because the Uncia of all the Intermediate Terms are only removed along with their Letters; it also follows, that if they are added together, their respective Summs, must produce the true Unciae of the intermediate Terms in the new raised Power,

7 are the 2 Uncia of a + b and a + b. I These added in the Order as they 15 stand, produce the next Rank.

7 The Uncia of the Square, and these added again produce the next Rank or Uncia of the Cube, &c.

Unciæ of the Cube.

The Uncia of the Biquai \ drate.

1) The Unciæ of the fifth 5 10 10 5 Power. 5 10 10 5

The Uncia of the 1 fixth Power. б 15 20 15 б I 1 6 15 20 15 6

The Uncie of the 7 21 35 35 21 7 feventh Power, and so on, as Mr. Ward hath well observed in his

If therefore you take the Numbers in the last you will compleat all the Terms with their feve-

 $a^{7} + 7a^{6}b + 21a^{5}b^{5} + 35a^{6}b^{7} + 35a^{7}b^{6} + 21a^{7}b^{5} + 7ab^{6} + b^{7}$

Uncia; which may be done by confidering,

(1) That the Uncia of every fingle Letter, and of every fingle Power, how high foever it be, is an Unit, or (1), which neither multiples nor divides. Binomial, are a Series of Units, whose Summ (2) That all the Powers of any Binomial are native every where the Uncia of the second Term; are a Series of Units and that the Uncia of the second Term; are a Series of Units and that the Uncia of the second Term; are a Series of Units are a Series of Units. turally raised by multiplying the Preceeding Power and that the Uncia of the second Term, are a Seinto the Original Root: Which in Algebraick Multies of Numbers in natural Arithmetical Progres-Gggg

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fion; as 1,2,3,4,5,6,7, &c. Whose Summ is every where the *Uncia* of the next Superior Power in the Third Term, &c. He deduces this General Rule for finding the Uncia of any Power of a

Binomial, Viz.

Multiply the Index of the First Letter of any Term into its own Uncia, and divide the Product by the Number of Terms to that Place, and the Question will be the Uncia of the next Subceeding Term, forward. Thus in the last Example,

1. The Index of a7 (the First Term) will be the Uncia for 7 as b, the Second Term.

2. Then
$$\frac{7 \times 6}{2}$$
 = 21. That is the Index of a^{6} in

the Second Term multiplied by its Uncia 7; and the Product 42, divided by 2, the Number of Terms to that Place, quotes 21, the Uncia of the

Term, and $\frac{35 \times 4}{4}$ = 35, will be the Uncia of the

4 You may observe here that the Uncia do increase, only 'till the Indeces of the Two Letters become equal, or change Places; and then the Rest of the *Uncia* do decrease, as the former increased: So that 'tis enough to find the *Uncia* of half the Number of Terms in any Power, and then

the Rest may be easily prefixed.

And when all this is considered, the Value and Expeditiousness of that Short Theorem of Sir Isaac Newton, for finding the Uncia of a Binomial, will

be understood and admired, Viz.

Suppose m the Exponent of any Power: Then

will
$$1 \times \frac{m-0}{1} \times \frac{m-2}{2} \times \frac{m-3}{3}$$

will $1 \times \frac{m-5}{1} \times \frac{m-6}{3} \times \frac{m-6}{3}$

Discoveries to see the Light.

Not long since (viz. A. D. 1690.) that excellent Person M. Joseph Raphson, F. R. S. Publish'dhis U. niverfal Analysis of Equations, and illustrated his Method by plenty of Examples; by all which he has given Indications of a Mathematical Genius, from which the greatest things may be expected.

By this Example, M. de Lagney, an Ingenious Professor of Mathemanicks at Paris, was encou-

As, Suppose you would have the *Unciæ* for the 7th Power of a+b. Then m=7, and by the

Theorem 1 x
$$\frac{m-0}{1}$$
 = 7 will be the *Uncia*,

and that
$$7 \times \frac{m-1}{2} = 21$$
 will be the *Uncia* for

Also that
$$35 \times \frac{m-3}{4} = 35$$
 will be the *Uncia* of makes

And the Root of the 5th Power as $+b$, here

the Uncia of the two Remaining Terms must be 21, 7, and 1.

A New, Exact and Easie Method, of finding the Roots of any Equations generally, and that without any previous Reduction. By Mr. Edm. Halley, Geometry Professor at Oxford.

The principal Use of the Analytick Art, is to bring Mathematical Problems to Equations, and to exhibit those Equations in the most simple Terms that can be. But this Art would juftly feem in some degree desective, and not sufficient-ly Analytical, if there were not some Methods, by the help of which, the Roots (be they Lines or Numbers) might be gotten from the Equations that are found, and so the Problems in that re-spect be solved. The Ancients scarce knew any thing in these Matters, beyond Quadratick Equations. And what they writ of the Geometrick Conftruction of solid Problems, by the help of the Parabola, Ciffoid, or any other Curve, were only particular things defign'd for some particular Ca-les. But as to Numerical End S But as to Numerical Extraction, there is every where a protound Silence; so that whatever we perform now in this kind, is entirely owing to the Inventions of the Moderns.

And first of all, that great Discoverer and Reftorer of the Modern Algebra, Francis Vieta, about 100 Years fince, thew'd a general Method for extracting the Roots of any Equation, which he publish'd under the Title of, A Numerical Refolution of Powers, &c. Harriot, Oughtred, and others, as well of our own Country, as Foreigners, ought to acknowledge what soever they have written upon this Subject, as taken from Vieta. But what the Sagacity of Sir Is. Newton's Genius has perform'd in this Business, we may rather conjecture (than be fully assur'd of) from that short Specimen given by Dr. Wallis in the 94th. Chapter of his Algebra. And we must be forc'd to expect it, 'till his great Modesty shall yield to the Interaction of his briends, and suffer these arrives of his briends. treaties of his Friends, and suffer those curious Discoveries to see the Light.

By this Example, M. de Lagney, an Ingenious Professor of Mathemanicks at Paris, was encourag'd to attempt the same Argument, but he being almost altogether taken up in extracting the Roots of pure Powers (especially the Cubick) adds but little about assected Equations, and that pret-ty much perplex'd too, and not sufficiently demonstrated. Yet he gives two very compendious Rules for the Approximation of a Cubical Root; and that $7 \times \frac{m-1}{2}$ = 21 will be the *Uncia* for Ex. gr. that the fide of the Cube aa + b, is be-

and that
$$7 \times \frac{}{2} = 21$$
 will be the *Uncia* for the Fourth Term. Ex. gr. that the fide of the Cube $a \cdot a \cdot a + b$, tween

$$\frac{m-2}{3} = 35$$
 will be the *Uncia* for the Fourth Term.

$$\frac{ab}{3aaa+b}, & \sqrt{\frac{1}{4}aa+b} = \frac{1}{2}a.$$

the Fifth Term; and consequently by going backwards (as in Art. 4. above) you will find that
$$\frac{1}{2}a + \sqrt{V_{\frac{1}{4}}a^{1} + b} - \frac{1}{4}a = (\text{ where note,} \\
5a + \sqrt{V_{\frac{1}{4}}a^{1} + b} - \frac{1}{4}a = (\text{ where note,} \\
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5a + \sqrt{V_{\frac{1}{4}}a^{1} + b} - \frac{1}{4}a = (\text{ where n$$

that 'tis \(\frac{1}{4} a a \), not \(\frac{1}{2} a a \), as 'tis erroneously Printed in the French Book.). These Rules were communicated to me by a Friend, I having not seen the Book; but having by Trial found the goodness of them, and admiring the Compendium, I was willing to find out the Demonstration. Which having done, I presently found that the same Method might be accommodated to the Resolution of all forts of Equations. And I was the rather inclin'd to improve these Rules, because I saw that the whole thing might be Explain'd in a Synopsis and that by this means, at every repeated step of the Calculus, the Figures already found in the Root, would be at least Trebled, which all other ways, are increased but in an equal Number with the given ones. Now, the fore-mention'd Rules are easily demonstrated from the Genesis of the are cally demonstrated from the Genesis of the Cube, and the 5th Power. For, supposing the side of any Cube = a+e, the Cube arising from thence, is aaa+3aae+3aee+eee. And confequently, if we suppose aaa the next less Cube, to any given Non-cubick Number, then eee will be less than Unity, and the Ramaindar ato any given Non-cubick Number, then eee wind be less than Unity, and the Remainder b, will = the other Members of the Cube, 3aae + 3aee + eee. Whence rejecting eee upon the account of its smallness, we have b = 3aae + 3aee. And since aae is much greater than aee, the

quantity will not much exceed e; so that

putting $e = \frac{b}{3 a a}$ then the quantity $\frac{b}{3 a a + 3 a e}$

(to which e is nearly equal) will be found

$$= \frac{b}{3aa + 3ab} \text{ or } \frac{b}{3aa + b} \text{ that is} \frac{ab}{3aa + b}$$

And so the side of the Cube a a a + s will be

$$a + \frac{ab}{3aa + b}$$
, which is the Rational Formula of

M. de Lagney. But now, if a a a were the next greater Cubick Number to that given, the fide of the Cube a a a - b, will after the same man-

ner be found to be
$$a = \frac{ab}{3aa - b}$$
. And this eafy

and expeditious Approximation to the Cubick Root, is only (a very small matter) erroneous in point of defect, the quantity e, the Remainder of the Root thus found, coming something less than really 'tis.

As for the Irrational Formula, 'tis derived from the same Principle, viz. b = 3aae + 3aee, or

$$\frac{b}{-=ae+ee}, \text{ and fo } \sqrt{\frac{1}{4}aa+b} = \frac{1}{2}a+e, \text{ and}$$

$$\sqrt{\frac{1}{4}aa+b}+\frac{1}{2}a=a+e$$
, the Root fought.

manner, will be found to be $\frac{1}{2}a + \sqrt{\frac{1}{4}aa - b}$

And this Formula comes fomething nearer to the Scope, being erroneous in point of excefs, as the other was in defect, and is more accom-modated to the Ends of Practice, fince the Restitution of the Calculus, is nothing else but the continual Addition or Substraction of the

4 e e - according as the quantity e can Quantity be known. So that we should rather write

$$\sqrt{\frac{1}{4}a + b - eee}$$
 + $\frac{1}{2}a$, in the former case, and in

the latter,
$$\frac{1}{2}a + \sqrt{\frac{1}{4}aa + eee - b}$$
. But by either

of the two Formula's, the Figures already known in the Root to be extracted, are at least Tripled; which I conclude will be very grateful to all the Students in Arithmetick; and I congratulate the Investor months Account of his Different Inventor upon the Account of his Discovery.

But that the Use of these Rules may be the better perceiv'd, I think it proper to subjoin an Example to two. Let it be propos'd to find the fide of the double Cube, or aaq+b=2

the fide of the double Cube, or
$$aaa+b=2$$

$$b$$
Here $a=1$, and $a=\frac{1}{2}$, and fo $\frac{1}{2}+\sqrt{\frac{7}{12}}$, or 1, 26,

will be found to be the true side nearly. Now, the Cube of 1, 26, is 2, 000376, and so 0, 63 +

$$\sqrt{3969}$$
, or 0, 63 + $\sqrt{39680052}$

ab

a + ______, which is the Rational Formula of 3 aa + b

Rut now. if a a a were the next

But now. if a a a were the next

The France of the Guare Root; when as and the Extraction of the square Root; when as by the common way of working, how much pains it would have cost, the Skilful very well know. This Calculus a Man may continue as far as he pleases, by encreasing the Square by

the Addition of the Quantity _____, which Corre-

ction, in this case will give, but the encrease of Unity in the 14th Figure of the Root.

Exemp. 2. Let it be propos'd to find the fides or a Cube equal to that English Measure commonly call'd a Gallon, which contains 231 folid Ounces. The next less Cube is 216, whose side 6 = a, and the Remainder 15 = b; and so for the first Approximation, we have

is 3, 1358..., 'tis plain that 6, 358 = a + e.

Also the side of the Cube a a a - b, after the same Now, let 6, 1358 = a; and we shall have then for Vol. II.

Gggg 2

itsCube 231, 000853894712, and according to the Rule, 3,0679 + 4 9,41201041 -,000858394712

18, 4070

is most accurately equal to the side of the given Cube, which within the Space of an Hour, I determin'd by Calculation to be 6. 1357924 5966195897, which is exact in the 18th Figure, defective in the 19th. And this Formula is deservedly perferable to the Rationale, upon the Account of the great Divisor, which is not to be manag'd without a great deal of Labour; whereas the Extraction of the square Root, proceeds much more easily, as manifold Experience has taught me.

But the Rule for the Root of a pure Sursolid, or the 5th Power, is of something a higher Enquiry, and does much more perfectly yet do the business; for it does at least Quintuble the given Figures in the Root, neither is the Calculus very large or operose. Though the Author no where shews his Method of Invention, or any Demonstration, although it seems to be very much wanting, especially since all things are not right in the printed Book, which may easily deceive the Unskilful. Now the 5th power of the side a + e is composed of these Members, $a^5 + 5$ a^4 e + 10 a^3 $e^3 + 10$ a^3 $e^3 + 5$ a $e^4 + 10$ a^3 $e^3 + 10$ a^3 $e^3 + 10$ a^3 $e^3 + 10$ a^3 $e^3 + 10$ a^3 $e^3 + 10$ a^3 e^3

Whence
$$\frac{b}{5a} = a^3 e + 2 a^2 e^3 + 2 a e^3 + e^4$$
, and

adding on both fides $\frac{1}{4}a^4$, we shall have $\sqrt{\frac{1}{4}a^4+b}$

= $\sqrt{\frac{1}{4}}a^4 + a^3e + \frac{1}{2}a^2e^2 + 2ae^3 + e^4 = \frac{1}{2}aa + ae + ee$. Then fubstracting taa from both tides,

$$\frac{1}{2}a + e$$
 will $= \sqrt{\frac{1}{4}a^4 + b - \frac{1}{4}aa}$; to which if

$$\frac{1}{2}$$
 a be added, then will $a+e=\frac{1}{2}a+\sqrt{\frac{1}{4}a^2+b^2+4aa}$

= the Root of the Power $a^3 + b$. But if it had $a^3 - b$ (the quantity of a being too great) the

Rule would have been thus,
$$\frac{1}{2}a + \sqrt{\frac{1}{4}a^4b^{-\frac{1}{4}}aa}$$

and this Rule approaches wonderfully, so that there is hardly any need of Restitution.

But while I confidered these things with myself, I light upon a General Method for the Formula's of all Powers whatsoever, and (which being handsome and concise enough) I thought I would not conceal from the Publick.

These Formula's, (as well the Rational as the Irrational ones) are thus.

$$\sqrt{aa+b} = \sqrt{aa+b}$$
, or $a + \frac{ab}{2aa+\frac{1}{2}b}$.

$$\sqrt{a^{3}} + b = \frac{1}{2}a + \sqrt{\frac{1}{4}}aa + \frac{1}{3}aa + \frac{1}{3}aaa + b}$$

$$\sqrt{a^{4}} + b = \frac{1}{3}a + \sqrt{\frac{1}{3}}aa + \frac{1}{6}aa + \frac{1}{4}a^{4} + \frac{1}{2}b}$$

$$\sqrt{a^{5}} + b = \frac{3}{4}a + \sqrt{\frac{1}{16}}aa + \frac{1}{10}a^{2}} + \sqrt{\frac{1}{2}a^{4}} + \sqrt{\frac{1}{2}aa + \frac{1}{2}aa $

And so also of the other higher Powers. But if a were assumed bigger, than the Root sought (which is done with some Advantage, as often as the Power to be resolved, is much nearer the Power of the next greater whole Number, than of the next less) in this case, Mutatis Mutandis, we shall have the same Expressions of the Roots, Viz.

$$\sqrt{aa-b} = \sqrt{aa-b}$$
, or $a = \frac{ab}{2aa-\frac{1}{2}b}$.

 $\sqrt{a^2-b} = \frac{1}{2} + \sqrt{\frac{1}{4}aa - \frac{b}{3}}$, or $a = \frac{ab}{3a^3-b}$.

 $\sqrt{a^2-b} = \frac{1}{3}a + \sqrt{\frac{1}{3}aa - \frac{b}{10a^3}}$, or $a = \frac{ab}{4a-\frac{1}{2}b}$.

 $\sqrt{a^2-b} = \frac{1}{3}a + \sqrt{\frac{1}{3}aa - \frac{b}{10a^3}}$, or $a = \frac{ab}{5a^3-2b}$.

 $\sqrt{a^2-b} = \frac{1}{3}a + \sqrt{\frac{1}{3}aa - \frac{b}{15a^3}}$, or $a = \frac{ab}{7a^2-3b}$.

Aud within these two Terms, the true Root is ever found, being something nearer to the Irrational than the Rational Expression. But the quantity e found by the Irrational Formula, is always too great, as the Quotient resulting from the Rational Formula, is always too little. And consequently, if we have + b, the Irrational Formula gives the Root something greater than it should be, and the Rational something less. But contrary-wise if it be — b.

And thus much may suffice to be said concerning the Extraction of the Roots of pure Powers: which notwithstanding, for common Uses, may be had much more sailly by the help of the Logarithms. But when a Root is to be determined very accurately, and the Logarithmick Tables will not reach so far; then we must necessarily have recourse to these, or such like Methods. Farther; the Invention and Contemplation of these Formula, leading me to a certain Universal Rule, for adjected E-

quations (which I hope will be of use to all the Students in Algebra and Geometry) I was willing here to give some account of the Discovery, which I will do with all the perspecuity I can, I had given at No. 188 of the Transactions, a very eahe and general Construction of all adtected Equations, not exceeding the Biquadratick Power; from which time I had a very great desire of doing the same in Numbers. But quickly after Mr. Raphson seem'd in great Measure to have satisfied this Desire, till Mr. Lagney by what he had perform'd in his Book, intimated that the thing might be done more compendiously yet. Now, my Method is thus

Let z the Root of any Equation, be imagin'd to be compos'd of the parts a + or - e, of which let a be assum'd as near z as is possible; which is not with standing not necessary, but only commodious. Then from the Quantity a + e or a - e, let there be form'd all the Powers of z, found in the Equation, and the Numerical Co-efficients be respectively affix'd to them: Then let the Power to be resolv'd, be substracted from the Summ of the given Parts (in the first Column where e is not found) which they call the Homogeneum Comparationis, and let the difference be +b. In the next place, take the Summ of all the Co-efficients of e in the fecond Column, to which put = s.

Laftly, in the third Column let there be put down the Summ of all the Co-efficients of ee, which Summ call t. Then will the Root & stand thus

in the Rational Formula, viz. z = a +

and thus in the Irrational Formula, viz.

4+½35±4/438+ bt; which perhaps it

may be worth while to Illustrate by some Examples. And instead of an Instrument, let this Table serve, which shews the Genesis of the several Powers of a + e, and if need be, may easily be continued farther; which for its Usel may rightly call a General Analytical Speculum. The forementioned Powers wished from a continued Mainting tioned Powers arifing from a continual Multiplication by a + e = z come out thus with their adjoined Co. efficients: See the Table. But now, if it be a - e = z, the Table is compos'd of the same Members, only the odd Powers of e, as e, e', e', e are Negative, and the even Powers, as of the Co-efficients of the Square ee = t, the Summ of the Co-efficients of the Square ee = t, the Summ of the Co-efficients of $e^{t} = u$; of $e^{t} = v$ be enquir'd, all the Powers of e, will be much less than the correspondent Powers of a, and so far the first Hypothesis; all the superior ones may be rejected; and forming a new Equation, by fubfituting a+e=z, we shall have (as was faid) +b=+se+tee. The following Examples will make this more clear.

Example 1.

Let the Equation $z^4 - 3z^5 + 75z = 10000$, be propos'd. For the first Hypothesis, let a = 10, and so we have this Equation,

```
21= + a1 4 a1 e + 6 a2 e1 4 a e1 + e10
 ·dzi=-dai da e-
+cz=+cace
 + 10000
          4000 e + 600 e e
             бое —
      300
      750
   - 10000
```

+ 450 - 4015 e + 597 ee - 40 e1 + e1 = 0

The Signs + and - with respect to the Quantities e and e', are left as doubtful, 'till it be known whether e be Negative or Affirmative; which thing creates some Difficulty, fince that in Equations that have several Roots, the Hermogenea Comparationis (as they term them) are oftentimes encreased by the minute quantity a, and on the contrary, that being increased, they are diminished. But the Sign of e is determin'd from the Sign of the Quantity b. For taking away the Refolvend from the Homogeneal form'd of a; the Sign of se (and consequently of the prevailing Parts in the Composition of it) will always be contrary to the Sign of the difference b. Whence twill be plain, whether it must be +e, or -e; and consequently whether a be taken greater or less than the True Root. Now the quantity e is $=\frac{1}{2}s$

 $\frac{1}{4}$ ss — bt, when b and t have the same Sign,

but when the Signs are different, eis = 4 + ss + bs

- 責 5. But after it is found that it will be let the Powers e, e, and e', &c. in the Affirma-tive Members of the Equation be made Negative, and in the Negative be made Affirmative; that is, let them be written with the contrary Sign. On the other hand, (if it be + e) let those fore-mention'd Powers be made Affirmative in the Affirmative, and the Negative in Negative Members of the Equation.

Now we have in this Example of ours, 10450 instead of the Resolvend 10000, or b=+ 450, whence it's plain that a is taken greater than the Truth, and consequently, that 'tis -e. Hence the Equation comes to be, 10450 — 4015 e + 597 e e — 403 + e = 10000. That is, 450 — 4015 e

or
$$\frac{s}{at}$$
 $\frac{s}{4tt}$; that is in the present case,
 $\frac{2007^{\frac{1}{2}}}{4t}$ $\frac{3761406^{\frac{1}{4}}}{4t}$, from whence we have

the Root fought, 9, 886, which is near the Truth. But then substituting this for a second Supposition, there comes a + = z, most accurately o, 8862603936495 scarce exceeding the Truth

by a in the last Figure, viz. when $\sqrt{\frac{1}{2}}s+bt$

 $-\frac{1}{2}$ size. And this (if need be) may be yet much tarther verified, by fubstracting (if it be +e)

the quantity $\frac{\frac{1}{2}ue^{s} + \frac{1}{2}e^{s}}{\sqrt{\frac{1}{4}ss + tb}}$, from the Root before

found; or (if it be
$$-e$$
) by adding
$$\frac{\frac{1}{2}ue^{3}-\frac{1}{2}e^{4}}{\sqrt{\frac{1}{4}ss-tb}}$$

to that Root. Which Compendium is so much the more Valuable, in that sometimes from the first Supposition alone, but always from the second, a Man may continue the Calculus (keeping the same Co-efficients) as far as he pleases. It may be noted, that the fore-mentioned Equation, has also a Negative Root, viz. z = 10,26... which any one that has a Mind, may determine more accurately.

Example II.

Suppose $z^3 - 17z + 54z = 350$, and let a = 10. Then according to the Prescript of the Rule,

$$+z^{1} = a^{1} + 3 a^{1} e + 3 a^{2} + e^{2}$$

$$-dz^{1} = da^{1} - 2 da^{2} - da^{3}$$

$$+ cz = ca + ce$$

That is,
$$+ 1000 + 300e + 30e^{2} + e^{2}$$

 $- 1700 - 340e - 17e^{2}$
 $+ 540 + 54e$
 $- 350$

Or, — 510 + 14e + 13ee + e³ = 0. Now, fince we have — 510, it is plain, that a is affuned less than the Trnth, and consequently that e is Affirmative. And from (the Equation)

510 = 14e + 13 e³, comes e =
$$\sqrt{bt + \frac{1}{4}ss - \frac{1}{2}s}$$

$$= \frac{\sqrt{6679-7}}{\sqrt{12}}.$$
 Whence $z = 15, 7...,$ which

is too much, because of a taken wide; therefore Secondly, let a = 15, and by the like way of

Reasoning, we shall find $e = \frac{1}{2}s - \sqrt{\frac{1}{4}}ss - tb$

$$=\frac{109\frac{1}{2}-\sqrt{11710\frac{1}{2}}}{28}, \text{ and confequently } z=$$

14, 954068. If the Operation were to be repeated the third time, the Root will be found conformable to the Truth as far as the 25th Figure; but he that is contented with fewer, by writing $tb+te^3$ instead of tb, or substracting or adding

$$\frac{\frac{1}{2}e^{s}}{\sqrt{\frac{1}{4}ss+tb}}$$
 to the Root before found, will

presently obtain his End. Note, the Equation proposed, is not explicable by any other Root, because the Resolvend 350, is greater than the

Cube of
$$\frac{17}{3}$$
, or $\frac{d}{3}$.

Example III.

Let us take the Equation $z^4 - 80z^7 + 1908$ $z^5 - 14937z + 5000 = 0$, which Dr. Wallis
uses Cap. 62 of his Algebra, in the Resolution of
a very difficult Arithmetical Problem, where by
Vieta's Method he has obtain'd the Root most accurately; and Mr. Raphson brings it also as an
Example of his Method, Page 25, 26. Now this
Equation is of the Form, which may have several
Affirmative Roors, and (which increases the Difficulty) the Co-efficients are very great in respect
of the Resolvend given.

But that it may be the easier manag'd, let it be divided, and according to the known Rules of Pointing, let $-z^4 + 8z^3 - 20z^4 + 15z = 0.5$ (where the quantity z is $\frac{1}{10}$ of z in the Equation proposed) and for the first Snpposition, let a = 1. Then $+^2 - 5e - 2e^2 + 4e^3 - e^4 = 0.5$ 5 = 0; that is, $1\frac{1}{2} = 5e + 2ee$; hence e = 1

$$\frac{\sqrt{\frac{1}{4}ss+bt-\frac{1}{2}t}}{t}$$
 is $=\sqrt{37-5}$, and so $z=$

1, 27; Whence 'tis manifest that 12, 7, is near the true Root of the Equation proposed. Now Secondly, let us suppose z = 12, 7, and then according to the Directions of the Table of Powers, there arises

That is, + 298, 6559—5296 132 e + 82, 26 e + 29, 2 e = -e = 0; And so — 298, 6559 = -5296, 132 e + 82, 26 e e, whose Root e (accord-

ing to the Rule) =
$$\frac{1}{2}s - \sqrt{\frac{1}{4}ss - bt}$$
 comes to

that it may be corrected, 'tis to be confider'd that $\frac{1}{2}u e^3 - \frac{1}{2}e^4$, or is, 00000099,

And if you defire yet more Figures of the Root, from the e corrected let there be made tue?—tee=0, 43105602423..., and

$$\frac{1}{2}s - \sqrt{\frac{1}{4}}ss - bt - tue^s + te^4$$
 or which is all one,

,05644179448074402 = e; whence a + e = z the Root is most accurately 17, 75644179448 074402... as Dr. Wallis sound in the forementioned Place; where it may be observed,

that the repetition of the Calculus does ever triple the true Figures in the assumed a, which the

first Correction, or
$$\frac{\frac{1}{2} u e^3 - \frac{1}{2} e^4}{\sqrt{\frac{1}{4} s s - b t}}$$
, does quintuple;

which is also commodiously done by the Logarithms. But the other Correction after the first, does also double the Number of Figures, so that it renders the assumed altogether Seven-fold; yet the first Correction is abundantly sufficient for Arithmetical Uses, for the most part.

But as to what is faid concerning the Number of Places rightly taken in the Root, I would have it understood so, that when a isbut 1 part distant from the true Root, then the first Figure is rightly assumed; if it be within - part, then the two first Figures are rightly assumed; if within - and then the three first are so; which consequently manag'd according to our Rule, do presently become nine Figures.

It remains now that I add fomething concern-

ing our Rational Formula, viz.
$$e = \frac{s b}{s s \pm t b}$$

which seems expeditious enough, and is not much inferior to the former, fince it will triple the given Number of Places. Now having formed an Equation from a + e = z, as before, it will pre-fently appear, whether a be taken greater or less than the Truth; fince se ought always to have a Sign contrary to the Sign of the Difference of the Refolvend, and its Homogeneal produced from a. Then supposing +b+se+a-tee=o, the Divisor is ss-tb, as often as t and b have the fine Signs but it is that the when they have same Signs; but it is 33 + bt, when they have different ones. But it seems most commodious for

Practice, to write the Theorem thus, e + - fince this way the thing is done by one Mul-

tiplication and two Divisions, which otherwise would require three Multiplications, and one Division.

Let us take now one Example of this Method, from the Root (of the fore-mention'd Equation)

$$2e^{s}-e^{s}=o$$
, and fo $\frac{b}{s}-\frac{tb}{s}=e$; that is, let

it be as s to t, fo b to $\frac{50}{5}$ = 5296, 132). 298,

6559 into 82, 26 (4, 63875... wherefore the

Divisor is
$$s = \frac{tb}{s} = 5291, 49325 \dots$$
 298,

6559 (0,056441....= e, that is, to five true plied by the Circular Base: and he gives this In-Figures, added to the Root that was taken. But stance: Suppose the Ratio of a Square to the Cirthis Formula cannot be corrected, as the foregoing Irrational one was; and so if more Figures of the cle inscribed be as -: the Equation, expressing the

Root are defired, 'tis the best to make a new Supposition, and repeat the Calculus again: And then a new Quotient tripling the known Figures of the Root, will abundantly satisfie even the most Scrupulous.

ROOTS of Plants are, either

- Fibrous, which fend out only small Strings from the Bottom of the Plant, distinct from each other.
- 2. More thick or Gross, which have a Body thick and gross, either branched out into Subdivisions or Arms; or else sending out Fibres from it all along.

These last are either

Carnous, which are either (I. Broad and Swelling.

(2. Long and Slender, which commonly are more hard and woody.

The Broad and Swelling are I. Bulbous, which confift but of one Globe or Head, and fend out Fibres from the Bottom, and are either

Squammose, or Scaly, as Lilies or Martagon.

(Coated, which are involved in Skins or Coats, as Cepa, Hyacinthus, Allium, &c.

2. Tuberous, which are of a carnous, solid, and like-continued Consistence; and these ei-

1. Simple, with but one Globe or Head, as Rapa, Crocus, &c.

(2. Manyfold, as Asphodelus, Pæonia,&c.

Long Roots are either -1. Sarmentous (i. e.) Twiggy or Branching, which shoot or creep out transverse, or in breadth: Of these some are Geniculata, Knotty, or Jointy, as Couch-Grass, Mints,

2. Cauliformes (i.e.) Stemmy or Stalky which shoot down deep directly; though often shooting out Fibres and Strings from the great Stem; which also itself is sometimes divided or branching.

ROTATION, is a Term commonly used in Geometry for the Circumvolution, or Motion of any Surface round a fixt and immoveable Line, which is called the Axis of its Rotation. How Solids which are thus, by the Rotation of a Plane round an Axis generated, may be Measured or Cubed: The ingenious Mr. Abr. de Moivre shews very expeditiously in his Specimens of the Use of the Doctrine of Fluxions, Printed in Phil. Trans. N. and in Vol. 2. of the Miscellanea Curiosa, P. 131 thus: For the Fluxions of such Solids take the Product of the Fluxion of the Abiciffa multi-plied by the Circular Base: and he gives this In-

Nature

ter is d; is y y=dx-xx. Theref.

4 d x x'.

And the Circumscribed Cylinder is

Therefore the Portion of the Sphere is to the Circumscribed Cylinder, as $\frac{1}{2}d - \frac{1}{2}x$ to d - x.

ROTHERNAILS, or Rudder-Nails, are such as have a very full Head; and are used to fasten

the Rudder-Irons in Ships.
ROUNDNESS, The round Globular or Spherical Form, which Pebbles, Fruits, Berries, &c. are adorned with; and which Drops of Water or Quick-filver, &c. Bubbles of Air under Water or tome fuch Liquor, melted Oil, &c. do generally put on, feems to arise from the Incongruity of their Particles, with those of the ambient Fluid; which prevents them from coalescing together, and by pressing upon them, and environing them all round equally, turns them into a round Form. This feems plain, as Dr. Hook hath long ago well observed from the way of making small round Shot of several Sizes, without casting the Lead into any Molds, from Drops of Rain being formed in their falling into round Hail-stones; and med in their falling into round Hail-stones; and from a Drop of Water falling upon small Sand, or Dust, which will strait producean Artificial round Stone: And from the small round red-hot Balls (easily seen with a Microscope) which are formed by the Collision and Fusion of the Flint and Steel in striking Fire, and perhaps the Principle of Gravitation, is principally concerned in this Matter.

ROUNDS, in a Garrison, is a Night-Watch commanded by an Officer that goes round the Rampart of the Garrison, in order to listen if any thing be stirring without the Works, to see that the Centries are watchful, and upon Duty, and that all things be in good Order. In strict Garrisons, the Rounds go every quarter of an Hour, that the Rampart may be still furnished. The Centries ought to challenge at a Distance; and to test their Arms as the Rounds pass, and to let no one come near them. When the Round is near the Corps degarde, the Centry calls aloud, Who comes there? And when the Answer is The Round, he says, Stand; and then calls for the Corporal of the Guard, who draws his Sword, and calls also, Who comes there? And when 'tis answered, The Rounds; he that hath the Word must advance, and deliver the Word to the Corporal who receives it with his Sword pointed at the Giver's Breast.

ROUT, in the Law-Tense, is an Assembly of three or more Persons, who are going forcibly to commit an unlawful Act, though they do it not: For if it be done 'tis a Riot.

RUDDER of a Ship: The French Author of a late Book about the handling or working of Ships at Sea, in Chapt. 7. Proposes to demonstrate what the Angle is, which the Rudder of a

Line of Geometrick Proportion, divided first inShip ought to make with her Keel, in order to
Stay or Bear up, the soonest that is possible: And
these are marked with the p Digits, 1, 2, 3, 4, 5, 30. he faith the Tiller of a Rudder ought to make with

Nature or Property of any Circle, whose Diame-the Keel an Angle of nearly 55 Degrees. And in order that this may be precisely done, he advises to put a Cleat on the Sweep in the Gun-Room, and to dispose it so, that the Arch contain'd be-tween the Keel and Cleat may be of this Numis the Fluxion of a Portion of the Sphere; and ber of Degrees; and that the Tiller of the Rudconfequently the Portion it felf $4\frac{1}{2} dx \dot{x} - \frac{1}{3} x x x$, der ought to be some-how stopt, so that it cannot go beyond this Mark; for if it passes it, it will do more hurt than good.

> RULE-Sliding. Of this useful and ready In-strument there are several Sorts made; as one by Partidge, another by Everard, a third by Hunt: The Ground and Reason of all which is one and the same; as may be seen in the several Treatises written by the Authors above-named; to explain and shew the Use of their several Rules. I shall give you here in short the several Uses and Ad-

vantages of all of them.

Seth Partidge calls his the Double Scale of Proportion; because the Scales or Lines upon it are all Double, which are the Lines usually call'd the Ar. tificial Lines, of Numbers, Sines, and Tangents; whose Invention and Use is owing to Mr. Gunter: These you will find described, and their Nature explained in this Lexicon, under these words. On the Sides of his Double-Scale, are usually set a Line of Inches; or of Foot and Inch-measure; and there may be put a Gage-Line, a Meridian-Line, and a Scale of Equal Parts; Lines of Chords; and for Board or Timber-Measure, according as any one pleases, or his Occasions require.

Everard's and Hunt's Sliding-Rules, are thicker and squarer, so that there are two Sliding-Pieces, which can be fitted to either Face of the Rule; on one of which there are usually Two Double Lines of Numbers, made to slide against such another Double Line placed above them marked o, and a Single Line of Numbers placed below mark'd D. These in Everard's, which I shall describe, marked with B and C, and on the Back of this Sliding-Piece, is a Treble Line of Numbers marked E, together with a Line of Segments.

The other Sliding-Piece hath on one Side a Line of Artificial Sines and Tangents, to slide against two such other on the Sides; and on the other Side is another such Line of Sines, and a Line of versed Sines. Either of these Sliders are Line of versed Sines. made to fit in, on each Face of the Rule.

On one Edge or Side of the Rule, are usually placed the Natural Lines of Chords, Sines, Tangents and Secants, for Spherick Projection, with a finall Scale of Equal Parts; and one of Latitudes, Hours, and Inclination of Meridians for Dialling: As also a Line of Rumbs, and M. L. for Navigation: and on the other Side or Edge, befides Inches and Foot-Measure, is a large Scale of Equal Parts, with a Meridian Line placed by, tograduate Sea-Charfs, &c. The Uses of all which, you will find under their Names.

The first Thing to be learned on the Scale, or Rule, is how to count or number, in the several Lines of Numbers; for as for Sines, Tangents, Cc. there all is easie.

Each of these Primes is subdivided into ten other

Parts, called Tenths: And each Tenth is either divided, or supposed to be so, into 10 other Parts which may be called Centesms, or Hundredth-

In Everard's Rule, the Line D being about 11 Inches long, hath each Tenth in the first Prime, divided actually into 10 Parts. But between 2 and 4 each Tenth is divided into but five Parts; each of which there is one Fifth of an Hundred, or 20. Between 4 and the End of the Line, every Tenth is divided only into Two Parts, fo that each Part is 50, or the Half of an Hundred. You may imagine or suppose also that each Centesm is subdivided into Ten Parts; which

therefore will be Thousandths, &c.
The Figures 1, 2, 3, 4, 5, &c. by which the
Primes are diffing uished, are all Arbitrary Points; Primes are diffunguished, are an Albertally 2000 and may each of them represent so many entire Units, Tens, Hundreds, Thousands, &c. or so many Tenths, Hundredths, Thousandths, or Set 1, on the Line A, against 26, on B, and then against 68 on A, you will find the Pro-

z. Wherefore in Whole Numbers, if 1, at the beginning of the Line D fignifie an Unit: Then 2, 3, 4, and 5, &c. will also fignifie or stand for so many Units , and the Tenths, and Centesms, both be accordingly Decimal, or Centesimal Parts. It i, then represent Ten Units, then the Primes 2, 3, 4, &c. will fignifie 20, 30, or 40. If 1, stand for 10, or 100. Accordingly, the other Figures, will be 200, 300, 400; or 2000, 3000, 4000, &c.

. In Decimals, If 10 in the Line D represent 1, then each Prime reckon'd backwards towards the Left-hand, will be (1) one Tenth; and in those Primes each Tenth will be .01, and in those Tenths, each Centesm will .001, Gc. Part of

an Unit.

To explain this a little further, draw out the Sliding-piece B: Till 1, at the beginning of B, ftand exactly at 10, at the End of the Line A, for then you will have a Line of Numbers, 4 times repeated; of which let 1, at the beginning of A, standfor 1, or Unity. Then will the next 1, in the Middle of the Line A, fland for 10, and To at the End of A, or beginning of B, will represent 100, (1) in the Middle of B, will be 1000; and 10 at its End will stand for 10000.

On the contrary, if you suppose 10 at the End of the fourth Radius in B, to represent (1) then each Prime in that Fourth Radius, will be .r (one Tenth,) in the Third Radius't will be . or; as the Second .001, and in the First, .001 Parts

of an Unit.

So also 2, in the First Radius will be .0002; in the Second Radius.002, in the Third.02, and

in the Fourth .2 of an Unit.

. All which being well understood, and confidered, which a little Practice will render easie : 'twill be easie to distinguish that Point on the Line where any Number given, Integer, or Deci-mal Part, is represented. Thus you will find that the Point ag, on the Line D, represents 1895 Units; and the Point wg, represents 1715. But on a Line of this Length, you can't distinguish any Number, if it have above four Places, to any exactness: For all the Figures further will be represented at the same Point: Thus, if 189562 were required, you can have on the Rule only 1895. Vol. II.

All Numbers which after the first Figure have only Cyphers, are represented at the same Point: As 20, 200, 2000, &c. are all represented by 2. If a Number of three Places, hath a Cypher for the Middle Figure: As suppose 308; you must count 3 on the Line (at the Third Prime) and then counting no Tenths, for the last Figure 8, you must reckon 8 Centesms, or Hundredth-parts.

If two Cyphers are in the Middle of a Number of 4 Places; as suppose 4005: after 4, you must neither go on to account Tenths, nor Hundreds, but for the last Figure 5, you must reckon

to many Thoufandth-parts.

Of the Uses of the Sliding-Rule.

1. To multiply one Number by another; As,

dust 1768, on B.

You may begin with either Factor, as a Multiplicator; and the Product will have as many Places as are in both Factors; except the two first Figures exceed, or are greater than the least Factor: And then it will have one less, as in multictor: Aug. plying 68 by 14, As 1. 14 :: 68. 952.

Where the Product 952 hath but three Places; because the Figures 1 and 4 in 14, are both less than 9 and 5 in 952.

2. To multiply Decimal Fractions, or Mixt Numbers;

As 27. 8 and .8.

Make the Mixt Number, or Whole one (if such there be,) the Multiplicator; and setting it on B, against i: in A: Seek the Product towards the Left-hand against .8 on B; which will be 22 in A.

3. To divide one Number by another; as 750 by 25.

In Division, As 25. 1:: 750. 30, the Quotient.
Set 25 on B, against 1 on A; and then against
750, on B, will be 30, the Quotient upon A.

N. B. These Examples will instruct you, that at one fetting of the Rule, you do both Multiplyand Divide.

As suppose 25 a Multiplicator; set 1, on B, against 25, on A; and then against any Multipli-cand in B, you have the Product on A.

And without moving the Rule, if you suppose 25 to be a Divisor against any Dividend on A, you will have a proper Quotient in B.

4. Having, Two, Three, Four, &c. Numbers given, to find a Third, Fourth, Fifth, &c. in Geometrical Proportion to them: Let the Numbers be 2, and 4.

Set 2 in B; against 4 in A, and then you will find against 4 in B, there will be 8 in A; against 8 in B, 16 in A; against 16 in B, 32 in A, Gc. and so you may go on either torward or backward, as far as you please. 5. To Hhhh

As, suppose $\frac{6}{84}$.

Set 84 in B, against 63 in A; and then against 1 in B, you will have .75, the Decimal required.
And 'tis .75, not 75 because 'tis on the Lest-hand of Unity, or 1 in A.

6. To reduce .7625 a Decimal Fraction to the known Parts of an Integer.

First let the Decimal of a Pound be reduced to Shillings, Pence or Farthings.

Set 1 in the Middle, or 10 at the End of B, against 20 (the Shillings in a Pound) in A; and then against .7625 in B, you will have 15. 25 in A: That is 15's. 3'd.

If you would have reduced it to Pence, you must have set I in B, against 240 (the Pence in a Pound) in A, you would have had 183, the Pence in .7625

If you would have the Farthings, set 960 (the Farthings in a Pound) in B, against 1 in A, and then against the Decimal .7652 in B, you have

732, the Farthings contained in it, on A.

It .7625 were the Decimal of an Ale Barrel, Set 32 (the Gallons in a Barrel of Ale) in B, a. gainst i at the beginning of A; and then against .7625 in A, will be 24. /4. the Gallons in that Fraction.

7. To work the Rule of Three, or Three Numbers. being given to find a Fourth Proportion, either Directly or Inversely.

1. Directly.

If 6 Quarters of Malt make 18 Barrels of Beer, how much will 30 make?

Set 6 on B, to 18 on A, and then against 30 on B, you will have the Fourth Term, 9 on A.

2. Inversely.

16 8 Men can do a Peice of Work in 9 Days, in how many Days would 12 Men dispatch the fame Work?

Set 12 on A, to 8 on B; and then against 9 on A, will be 6 on B, which is the Fourth Number fought.

3. If the Question had been in how many Days could of Men have done the same Work? then 'twould have been, as 6 on B, to 8 on A:: So 9 upon B, to 12 upon A.

8. Between two Numbers given to find a mean Geometrical Proportional.

Suppose 50 and 72.
Set 50 in C, against 50 in D, and then against 72 in C, will be 60 in D, the mean required; or fet 72 on C, against 72 on D; and then against 50 on C, will be 60 on D.

9. To extract the square Root of any Number under 1000000.

of C be against 1 in D, and then will the Square

5. To reduce Vulgar Fractions to Decimals: | Root of any Number in C, be found by Inspection against it in D.

Only observe when the Number of Places in the given Number is even, i. e. when the Number consists of 2, 4, 6, or 8 Figures (being Integers) you must find it in the Second Radius of the Line C; and against it you have the Root in D: Thus against 16 in C, you will find 4 in D, against 81 in C, 9 in D.

Against 2304 in C 48 in D; and against 784996 in C, you will have 886 in D, as well as those Numbers can be expressed on the Rule: And in this Case the Root will always consist of half as many Figures as the Number given.

But if the Integers in the Number given are odd, as t, 3, 5, or 7; then it must be sought in the First Radius on C, and against it in D will be the Root sought. So bring 1 at the beginning of C, to 1 in the Middle of D; and then against 576 in C. C, will be 24 in D, and against 20736 in C, will be its Square Root 144 in D.

10. To extract the Cube-Root of any Number under 1000000000.

Apply the Triple Line of Numbers E against D, as C was in the Square Root; and then against any Numbers in E, are the corresponding Cube-Roots in D.

N. B. When the Number confifts of 1, 4, or 7 Places, you must find it in the First Radius in E.

But when it hath 2, 5, or 8 Places, it must be found in the Second Radius of E.

As if it have 3, 6, or 9 Integers, it must be found in the Third Radius.

11. Either the Diameter or Cicumference of a Circle being given to find the other.

When the Diameter is 1 Inch, Yard, Foot, &c. the Circumference is 3. 1415 of fuch Inches, Yards,

Wherefore as 1, to 3. 1415 :: So is the Diameter of any Circle to its Circumference.

Set therefore 1, on A, to 3. 1415 on B; and then against any Diameter in A, you have the corresponding Circumference in B, and vice werfa.

12. Having the Diameter to find the Area of a Circle.

Set 1 on D, to .7854 on C; and then against the Diameter in Inches on D: (Suppose 20,) you will have the Area in Square Inches, (viz. in this Case 314. 15.) on C; and so against any Diameter in D, you will have a corresponding Area in C.

13. To Three Numbers given to find a Fourth in Triplicate Proportion.

Ifa Bullet whose Diameter is 4 Inches, weigh olb. What will one of the same Matter weigh, whose Diameter is 8?

Apply the Lines C and D; so that to at the End Set 4 in A against 8 in B; and then against 9 in A you have 18 in B, against 18 in A 36 in B;

and against 36 in A 72 in B; which Third Number in continual Proportion from 18, is the Number sought, shewing the Weight of such a Bullet to be 72 lb.

, Simple Interest.

14. Given Principal, Time, and Rate, required the Amount.

What doth 15 1. 5 amount to in 12 Years Time at 6 per Centum?

Set I in A to 6 in B; and then against 12 in A, you have 72 in B; which because it was .06, will be .72 the Interest of one Pound for 12
Years at 6 per Cent. Then set .72 in B, against terest?

1 in A; and you will have against 15. 5 in A,

26. 66 the Amount in B. And so from any
For you - Three of these given, you may find the Fourth.

15. Given an Annuity, Time, and Rate; to find the Amount.

What is the Amount of an Annuity of 62 Pounds per Annum, at 6 per Cent. at 4 Years End?

- 1. Set I on B to 6 on A; and then against 62 in B will be 3. 72, the Interest of 62 1. for one
- a. Set I on B to 3. 72 in A; and then against 2 in B (viz. half the Time given) will be 7. 44, the Interest of the Annuity for half the Time
- 3. Set I on B to 7. 44 in A; and then against 3 in B (then all the given Years but one) to 22. 32 the Interest of the Annuity in A.

To which adding 248, (the Summ of the 4 Annual Payments) the Summ will be 270. 32. The whole Amount.

Compound Interest.

In Compound Interest the Respective amounts for each Respective Year, are so many Geometrick Mean Proportional Numbers.

For as 1001. at the End of the First Year is 1061. at 6 per Cent. and that is now become a Principal; and at the Second Years End will amount to 112 l. 36. and this being made a Principal will at the Third Years End amount to 119 l. 10 16; and these 4 Numbers 100. 106. 112. 36, and 119. 10 16, are in Geometrick Proportion continued.

Wherefore 'tis easie by the Rule to solve this

Problem.

16. Of any Summ of Money to find the Amount in any Time, and at any Rate of Compound Interest.

As suppose the Amount of 100 l. for 5 Years at 6 per Cent. Compound Interest.

to the First Years Amount at any Rate of Interest) and then against 100 on B, you will Vol. IL

have 112 1. 36. the Amount in Two Years; and against 112. 36. on B, will be 119 1. 10 16 on A, the Amount in Three Years; and against 119. 10 16 in B, will be 126. 247, the Amount in 4 Years. And lastly, against 126. 247 in B, you will have 133 1. 822 on A, which is the whole Amount at the Five Years End. And from it 'twill be easie to answer this Que-

17. What is a Summ worth now in Ready Money, which is due at any Time to come, and at any Rate of Interest?

As what is the present Value of 1331. 822 due Five Years hence, at 6 per Cent. Compound In-

For you need only reverse the former Practice: Ser therefore 100 on A against 100 on B; and then against 133 l. 822 on A, you will have 126. 247 on B; which is the Worth of 133. 822 at the End of the First Year: Then against that on A, you will have 119. 1016 on B, for the present Worth at the End of the Second Year; and against 110. 10 16 on A, you will have 112. 36 on B, for the Third Year; and against that Number on A, you will have 106 on B for the Fourth Year; and at last against 106 on A, you will have 1001. on B; which is the present Worth of 133 l. 822 due Five Years hence at Compound Interest of 6 per Cent.

18. What are the Arrears due on an Annuity or Rent of 9 l. per Annum, and forborn 12 Tears, at the Rate of 6 per Cent. Compound Interest?

Set 6 in A to 100 in B; and then against 9 in A will be 150 in B; which is a Principal whose Interest is 9 l. Then work as in Problem 16 above, to find the Amount of 150 l. in Twelve Years, which will be 301 l. 828; from which you must deduct 150 l. (the principal first found) and the Remainder 151. 828 answers the Question, and is the Summ of the Arrears fought.

19. What is the Ready Money worth of a Rent or Anunity of 9 l. per Annum to continue for Twelve Years only; allowing the Buyer to have 6 per Cent. for his Money, Compound Interest?

By the last Question the Arrears of a Rent of 9 l. per Ann. and forborn for Twelve Years were

151 % 828. And the present Worth of 151 l. 828. (by Quest. 17.) due at the Endof Twelve Years, is 75.1. 443. Wherefore so much may be given for an Annuity of 9 l. per Ann. to continue for Twelve Years.

N. B. If the Annuity is not to commence till after a certain Number of Years; as suppose 6 are expired: Then you must add that Term to the Twelve Years, which makes it 18. Then seck what the Arrears, of 151 l. 828 being forborn Set 100 on Bagainst 106, (or 108, &c. according Eighteen Years are now worth in Ready Money, which (by Quest. 18.) you will find 53 l. 185, which is the Answer; So that a Yearly Rent of 9 l.

Hhhh 2

to begin Six Years hence, and to continue Twelve of Latitude in Miles: : And so Sine of the Course Years, is in Ready Money worth but 531. 185; whereas if it were to commence immediately, 'twere worth 73 /. .443.

Purchastry of Annuity.

20. What Annuity, to continue Twelve Years will 300 l. buj; allowing the Bujer 6 per Centum, Compound Interest for his Purchase Money?

By Quest. 19. Ifind that 75 l. 443 will purchase 9 l. per Ann. for Twelve Years, (or you may find the Value of any other Annuity in Ready Money) and then say as the present Worther Value, is to the Annuity taken: So is the Summ proposed to the Annuity required.

Set therefore 75 l. 443 on B to 9 on A; and then against 300 L on B, will be 35 l. 776, or 35 l. 15 s. 6 d. and such an Annuity to continue Twelve Years to come, is worth now in Ready Money 300 %

21. What is the Value of a Free-hold Estate of 751. per Ann. allowing the Bujer 6 per Cent. for his Money, Compound Interest?

As the Annual Interest of 1 l. is to 1 l.:: So will the Annual Rent be to the Summ required.

Wherefore against .00 on B, set 1 on K; and then against 78 on B, you will have 1300 on A, the Value of the Estate required.

In Trigonometry.

It will be very easie to work any Cases or Questions by this Sliding-Rule, in either Plain or Spherick Triangles; of which one Instance in each will be sufficient.

Suppose the common Case in Plain Sailing.

22. Where Course and Distance are given; and Difference of Latitude and Departure are required. (See Plain-Sailing in Vol. I.)

Miles:: So Co-Sine of the Course to Difference Minutes each Point contains.

to Departure in Miles.

Bring then 90° in the Line of Sines against 108 (the Distance run) in A; and then against 50° 15' (the Co-Sine of the Course) in the said Line. of Sines, you will have you in A, the Difference of Latitude in Miles.

If you would have the Departure. Bring as before 90' in the Line of Sine against

108 in A; and against 33° 45' (the Angle of the Course) in the Sines will be 60 Miles in A, the Departure required.

Suppose 2dly. The Sun's Place in the Eeliptich to be 30° of Υ , and his greatest Declination to be 20° 30', I require his present Declination.

The Canon is, As Rad. Sine of the Sun's Lon-gitude or Diffance from γ :: So Sine of greatest Declination to Sine of the present Declination.

Set therefore 90° in the Sliding-Line of Sines against 30° in the fixt one; and then against 23° 30' in the Sliding-Line, you will find 11° 30' in the fixt Line of Sines; which is the Sun's Declination fought.

In Dialling.

23. To calculate the Horary Distances from the Meridian, in either Horizontal or particular Dials.

The Canon is, As Rad. to Tangent of 15 (one Hours Equinoctial Diftance) :: So is the Sine, or Co-Sine, of the Latitude, suppose 51° 30' of the Place, to the Tangent of the Distance fought 11° 51'.

Set 90° in the Sliding-Sine to 15° in the fixt Tangent; and then against 51° 30' in that Sine, will be 11° 51' in the Tangent.

RUMBS; Here is a Table of Rumbs or Points The Canon is, As Rad. to Distance run in of the Compass; shewing how many Degrees and

A Table

A Table of RUMBS.

The 1	Distance	of th	e Ru Meri	mbs, or I idian.	Points from	s the
North	South	D.	M.	South	North	Point.
N by E	S by E	2 5 8 LI	-49 38 36 36	S by W	N by W	1
NNE	SSE	14 16 19 22	4 53 41 30	SSW	NNW	2
NE by N	SE by S	25 28 30 33	19 8 36 45	<i>SW</i> by <i>S</i>	<i>NW</i> by <i>N</i>	**
NE	SE	36 39 42 45	34 23, 31, 00	sw	NW	4
<i>NE</i> by <i>É</i>	SE by E	41 50 53 56	49 37 16 15	<i>SW</i> by <i>W</i>	<i>NW</i> by <i>N</i>	5
ENE	ESE	59 61 64 67	4 52 41 30	wsw	WNW	6
E by N	E by S	70 73 75 78	7 56 45	W by S	W by N	7
Eaj	3	84 84 87 90	34 22 11	<i>14</i>	લ્ફ્ર	

RUMB

RUMB-Scale; how the Scale of Rumbs is made, you will find under the Word Plain-Scale, in Vol. I.

How to find the Rumb between two Places by Calculation, and Geometrically, Mr. Collins shews in his Navigation, pag. 39. Thus:

As the Radius: Is to the Co-sine of the Middle Latitude :

So is the Difference of Longitude: To the whole Departure from the Meridian in the Course between the two Places proposed::

And in the Second Proportion:

As the Radius: Is to the half Summ of the Cosmes of both Latitudes::

Or rather for Geometrical Schemes.

As the Diameter: Is to the Summ of the Cofines of both Latitudes : :

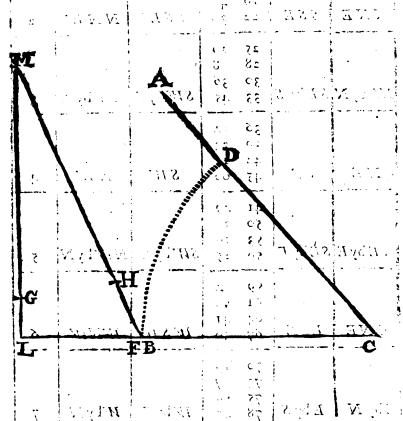
So is the Difference of Longitude: To the De-parture from the Meridian, in the Course between the two Places::

The latter Proportion of this Division, of which we make no use, is:

As the Difference of Latitude: Is to the aforesaid Departure from the Meridian: So is the Radius: To the Tangent of the Rumb::

An Example of the former Proportion.

Let the Rumb be required between Cape Fint-fire, Latitude 43 Degrees, Longitude 7 Degrees 20 Minutes, and St. Nichdlas Isle, Latitude 38 Degrees, Longitude 352 Degrees, the Middle Latitude is 40 Degrees 30 Minutes, the Complement is 40 Degrees 30 Minutes, and the Difference of Longitude is 15 Degrees 20 Minutes, or 33 Cen



Out of the leffer equal Parts, prick down 15 Deg. the greater Chord is almost 22 Degrees, the Com23 Centesms from C to L, and describe the Arch
BD with 60 Degrees of the Chords, and make it
equal to 40 Degrees 30 Minutes, and draw C D
Places, which is 6 Points and about 30 Minutes
continued further to A, from L take the nearest
Distance to A C, which is equal to L M; and Finistre West South-West, half a Degree more
make it one Leg of a Right-angled Triangle:
Make the other Leg the Difference of Latitude 5
Degrees, which prick from the Equal Parts from

If the two Places hadbeen both in the Latitude Degrees, which prick from the Equal Parts from

If the two Places had been both in the Latitude

If the two Places had been both in the Latitude

of 40 Degrees 30 Minutes, having the same Diffefaid Parts, sheweth the Distance to be 13 Degrees

30 Centesins, which allowing 20 Leagues to a

Degree, is almost 268 Leagues; with the Radi
us C B setting one Foot at M, cross the Rumb

Leagues to a Degree, is 233 Leagues and a half,

and thus we supply the want of the Scale of Lon-

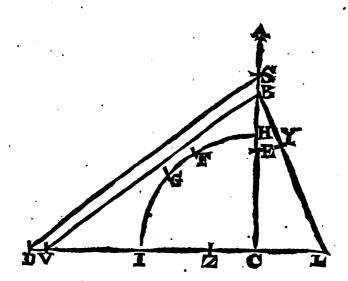
Triangle at G and H, which Extent measured on and thus we supply the want of the Scale of Lon-

gitudes, in finding the Distance of Places that Distance between the Lizard and the Bermu-bear East and West, as those that are in the same das. Mr. Norwood in his Sea-man's Practice, p. Latitude must needs do.

An Example of the latter Proportion.

Let it be required to find the true Rumb and be 55 Degrees.

110, maketh the Latitude of the Lizard to be 50 Degrees, and of the Bermudas 32 Degrees 25 Minutes, or 32 Degrees 41 Centerms, and the Difference of Longitude between these Places to



Draw the Lines A C and C D at Right-angles, the former Proportion by the middle Latitude, the now for want of room I use the lesser Chord, Rumb would have been 67 Degrees 2 Minutes and with 60 Degrees thereof I describe the Qua- from the Meridian, and the Distance 902 Leagues, drant H I, and prick the Radius from I to D, if you make C A equal to C V, then a Line so is CD the Diameter, then count both Lati- joining LA should be the Course and Distance tudes from H to F and G, the hearest Distance according to the same Longitudes and Latitudes from F to CI, is the Co-fine of Bermudas Latitude, which prick from C to E: Again, the nearest Distance from G to C I, is the Co-sine of the Lizard's Latitude, which place from C ever when two Places are laid down true at first to S, so is C S the Summ of both Co-sines; in their Rumb, Distance and Latuides on the draw D S, and prick down 55 Degrees the Difference of Longitude from C to V, out of the greatest equal Parts, and draw V B parallel to D S, so is C B the Departure from the Meridian in the Course hat making the Places of the pl in the Course between both Places, then making that one Leg of a Right-angled Triangle, prick down 17 Degrees 50 Centesms, the Difference of Globe, and how to Delineate it there, and in a Latitude between those Places out of the same Chart Mr. Collins shews in the same Book, page Equal Parts from C to L, and draw B L, which 55, and 64. represents the Course and Distance truly between the Lizard and Bermudas, and the Extent L B measured on the same Equal Parts, shews the Distance to be 44 Degrees 31 Centesms, which allowing twenty Leagues to a Degree, is 886

Then to find the Course: with 60 Degrees of Stomachs. the Chords, fetting one Foot in L, with the other make a Mark at Y and Z, then the Extent Z Y Inward. This receives the Meat flightly chewed, measured on the Chords, sheweth the Rumb to retains it a while, and then delivers it back again

laid down on the Plain Chart, and thereby the Course should be 72 Degrees 17 Minutes from the Meridian, and the Distance 1155 Leagues; how-

What the Nature of this Rumb Line is on the

RUMINANT Animals, are fuch as chow the Cud; and these are Quadrupeds, Hairy and Vi-viparous, and in general, Mr. Ray observes of them, that some have hallow and perpetual Horns; others Deciduous ones, or fuch as are shed every Year; and all the Horned Ruminant Animals have four I. The Koinia Mejan of Aristotle; be 66 Degrees 37 Minutes from the Meridian, into the Mouth, which is what we call the Cud, to which is almost 6 Points, and in this Example the Proportion doth noterr any thing from the Truth, according to Mercators Chart, whereas if you use the Honey-Comb; from its Internal Coat, being divided

divided so into Cells like Honey-Combs. 3. The 'Exro, which Er. Ray thinks hath been wrong Translated, Omasus; and therefore he would have it called the Echinus: This is so difficult to tlear, that our People throw it away, and call it the Manifold. 4. The Houses of Aristotle, by Church, Arch-Presbyters, as well as Arch-Deas. tlear, that our People throw it away, and call it the Manifold. 4. The Housest of Aristotle, by Gazacalled the Abomasus. The Stomach in Calves is that which contains the Acid Ferment, which we call the Runnet, and is used to coagulate

RUNCINUS, and Runcilus, in Doomsday-Book is used for a Load-Horse: Sumpter-Horse, or Cart-

cons; and they were called Rural-Deans. Our Diocesses are still divided into Deanries, and he who under the Bishop and Arch-Deacon, had the who under the Bishop and Arch-Deacon, had the Milk into Cheese.

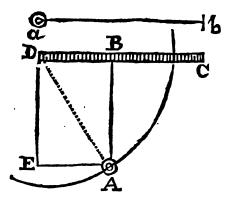
Also all Horned Ruminant Animals want the Dentes Primores, or broad Teeth in the Upper Jaw. These Kind of Animals have also that Kind of Fat which we call Suet; Sebum, \(\sigma rage, which is much harder and firmer, and less liquifiable in them, than the Adeps of other Animals. SAC or Sacha, or as some write it, Saccha and gard to a Surfaceon which it is to strike, must be Saucha (according to Minsbew) was anciently after one of these three ways, either Perpendicular,

SACK of Wool is a determinate Quantity, containing just 26 Stone, and every Stone is fourteen Pounds, by 14 E. 3. Stat. 1. c. 2. But in Scot-land a Sack is 24 Stone, and each Stone contains 16 Pounds.

SAFE Conduct, is a Secutity given by the Sove-raign under the Great Seal of the Kingdom to any Person, for his quiet coming into, or passing out of the Realm.

SAFE Pledge, is a Security given for a Man's Appearance at a Day affigned.

SAGIBARO, or perhaps Sachbaro, anciently fignified the same as Justiciarius, from Sac causa: So that Sac-baro is as much as the Cause-hearer, or the Man that hears Caufes.



SAILS and Sailing of a Ship. In order to compute the Force of the Water against a Ships Rud-Fluid Bodies, as the Air or Water, &c. as being composed of little Bodies or Particles, which

a Royalty or Privilege touching Plea, or Correction on of Trespasses of Men within a Mannor: The Saxon word, Sac, signifying as much as Causa in the Line A B be Perpendicular to it, describing Latin (whence our English Sake; for whose sake the direct Impusse of the Body A upon it; this Cic. but in the Laws of Edward the Confessor, it plain here that the Body A strikes upon it with all in Sake at and the Saxon word. is faid, Sacha eft quod si quilibet aliquem nominatim, de alique College and this Force may be called Absolute, and may be expressed by the Line AB, which the evenerit, forisfadura Probationis vel Nagationis (see evenerit) fuaerit. From some old Manuscripts, it appears also that Saka was a liberty of Holding Pleas, and Imposing Mulets and Forseitures on Transgressors in the Court of any Lordship or Man
Transgressors in the Court of any Lordship or Man
Transgressors in the Court of any Lordship or Man
Transgressors in the Court of any Lordship or Man-Transgressors in the Court of any Lordship or Man-rtis plain the Line of Motion ab will not affect the nor; though Rastal, and some others will have Sac Surface at all because it is no way opposed to it; to fignifie the Forfeiture it felf.

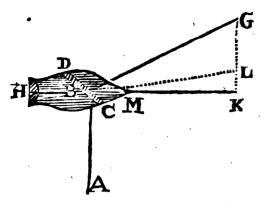
SACCUS cum Brochia, was anciently a Service or Tenure of finding a Sack and Broach for the King for theuse of his Army. Bracton, lib. 2.

But late at an occause it is no way opposed to it; to fignifie the Forfeiture it felf.

In or can the moving Body strike upon it, or touch it. (4.) If the Line of Motion AD be Oblique to the Surface DC, so that the Angle of Incidence the King for theuse of his Army. Bracton, lib. 2. Line AD, may be resolved into two Forces, viz. into AE, or DB, and into AB, (See Composition of Motion.) But the Direction or Line of Motion AE, being Parallel to the Surface DC, cannot affect it at all; fo that the whole Motion of the Body A in that Oblique manner of Striking on the Surface, will be expounded by the Perpendicular Line AB. And if DA be made the Radius of a Circle, whose Centre is at D, B A will be the Sine of the Angle of Incidence ADC, and consequently, you may conclude that the Force of a Particle of Air or Water, as A, striking against the Surface DC, which may represent either a-Sail, or the Rudder of a Ship, in the Oblique Direction AD, will be to the Perpendicular Force there, as BA is to DA:: that is, as the Sine of the Angle of Incidence is to Radius. And fince what is thus true of one Particle singly confidered, will be true of all the Particles of any Fluid Body Collectively; it will follow, that the force of the Air or Water falling Perpendicularly upon a Sail or the Rudder, to the force of the same in any Ob-lique Impingency, will be as the Square of the Radius, to the Square of the Sine of the Angle of Incidence: And consequently, that all Oblique Forces of the Wind against the Sails, or of the Water against the Rudder, will be to one another as the Squares of the Sines of the Angles of Incidence. Here is no regard had to the different Degrees of Velocity, with which the Wind or Water may impinge against the Sail or Rudder; but only of the *Position* of the Surface so struck, with regard to the Impinging Force : But when that Matter is der, Stem or Side; or the force of the Wind against her Sails, a late Author, whose Book is
Printed at Paris by the French King's express Command, and called the Theory of the handling or
Working of Ships at Sea, and lately Englished,
Sail: And it being also, saithhe, indifferent, whether you consider the Motion of a Solid in a Fluconfidered, it will be found that the different Forther you consider the Motion of a Solid in a Fluid, whose Particles are at rest, or of those Particles moving all Parallel against a Solid that is at when they act upon, or move against any Surface, do all move parallel one to another, or strike against the Surface after the same manner.

2. He

Velocities in the same Fluid Matter (as suppose confiders that the Motion of any Body, with re- Water) the different Resistances which it will receive from that Water, will be in the same Proportion as the Squares of the Velocities of that Bo-



Let H M represent a Ship, CD the Position of the Sail, AB the Course of the Wind blowing towards B. Draw BG Perpendicular to the Sail DC, and GK Perpendicular to the Line of the

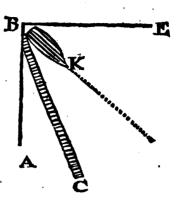
Keel produced H M K.

By what he hath said above, the Sail CD will be driven by the Wind A B, according to the Direction of the Line BG: So that if she could divide the Water every way with the same Facility, as she doth with her Head, the Ship would go directly to the Point G, along the Line BG. And if H K represent her direct Course, she would have got torward the length B K, and sideways she would have gone the Quantity G K. But as her Length is much greater than her Breadth, so she will divide the Water, or make her way in it much more difficultly with her Side, than with her Head or Stem; on which account, she will not run fideways so far as KG, but fall short of it in Proportion to the said Difficulty of dividing the Water with her Side: That is, if the Resistance The finds in paffing thro' the Water sideways, be to that of passing lengthways, suppose as 10 to 1, then will not the Ship get sideways above a 10th part of the Line G K. Wherefore if K G can be found to G L, in the Ratio of the Resistance of the Side to that of the Stem, and the Line B L be drawn, the Ship will go to the Point L, along the Line B L, in the fame time as it would have gone to G, if it could have divided the Water every way equally. This Part K L is called the Drift, or Lee-way of a Ship, and the Angle KB Lisher

Degrees of Lee-way; as the Angle AB K expreffes how near the Wind she lies. [Now from
hence it follows, saith our Author, That if we could but find the Ratio between these two Resibut rare, most, soft, and watery at the Surface. stances of a Ship's dividing the Water sidewise and lengthwise, we might determine the Line of a Shipstrue way.] But as this is very difficult to be done, from the knowledge of a Ship's Figure and Proportions, so he gives another Method, whereby he saith, it may be effected, as you may find in Art. 2. of Chap. 2.

After this he undertakes to demonstrate in Art. 3. of Chap. 4. That the best Position or Situation of a Ship, so that she may make the best Leeway, but go to Windward as much as is possible, is this: Let the Sail have what Situation it will the Ship must always be in a Line bissecting the Complement of the Winds Angle of Incidence upon the Sail. That is, let the Sail be in the Position BC, the Wind blowing from A to B, and consequently selves all manner of ways and to part and sepa-

the Angle of the Winds Incidence on the Sail ABC, therefore its Complement will be CBE; then mnst the Ship be put into the Position B K. or more in the Line B K, bisseding the Angle CBE.



And that the Angle which the Sail ought to make with the Wind or the Angle ABC, ought to be but of 24 Degrees. That being the most advantageous Situation to go to Windward the most that is possible, and in order to bring this to bear in Practice, he directs to put Marks to the Sheets, Braces and Bowlines of the lower Sails, to know when they are in their best Situation; and then, even in the Night, when the Marks of a Brace, or of a Sheet shall come to the Cleat, one may be

pretty well assured that the Sail Trims well.

SALT, Sir If. Newton shews that Salt is compounded of a dry Earth, and an Aqueous Acid joyned together by Attraction, and that Earth can't be turned into Salt, unless by the mixture of so much of an Acid, as may make it capable of a Dissolution in Water. And as it is owing to the Force of Gravity, that the Sea flows round the more denie and ponderous Globe of the Earth, so will the Principle of Attraction (see that word) occasion that the Aqueous Acid may flow round the more compact Terrestrial Particles, and so compose the Particle of Salt. For by no other way (faith he) can we account for Acid, being in place of a Mean, between Earth and common Water, in order to render Salt dissolvable in the latter. And as in the great Terraqueous Globe, the most dense Bodies will by their Gravity subside in Water, and do always tend towards the Centre of the Globe, so in os, dense, hard, dry, and earthy at the Centre, but rare, moist, soft, and watery at the Surface. And hence it appears, Salts are of so durable and lasting a nature as they are: for they can scarce be destroy'd, unless the Aqueous Parts be either drawn off by a great force, or by Putrefaction and a moderate Heat, permitted to get down into the Occult Meatus, or Pores of the Central Earthy Parts, and at last dissolve them by cutting them into fmall pieces.

If Salt in a small quantity be dissolved in a great deal of Water, the Saline Particles, tho' specifi-cally heavier, will not subside, but distuse them-selves equally throughout all the Water, and render it equally Salt in all places; which seems to shew that the Parts of the Salt do mutually recede

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Tate as far as the space will permit: And this En- they take off just upon the boiling of the Pans, odeavour shews that they have some kind of Repel- therwise it boils in and spoils the Salt. The older ling Force, by which they fly from one another, or the Blood is the better, cateris paribus, when the at least are more strongly attracted by the Parts of wards the Earths Centre than the Parts of the Water; so all the Particles of Salt which swim in Water, and are less attracted by any one Particle place to the Water, which is more forcibly attra-

When a Liquor impregnated with Salt, hath its Moisture so far Evaporated by Heat, that a Pellicle, Cuticle, or little Skin appears upon its Surface, if then it beset to cool, the Salt will shoot into Chrystals, which will be of some regular Fito Chrystals, which will be of some regular Fi-gure: From whence it appears, that the Saline Particles before their Concretion, were placed in The Brine thus sufficiently Boiled and Evapothe Liquor in some certain Order, and at equal Distances or Intervals; and consequently that they did act one upon another by some kind of Force, which is equal at equal Intervals, and unequal at unequal Diftances. For the Supposition of some such Force will occasion their being disposed every where into fuch Orders; but without it they would ramble about and be dispersed, persectly irregularly in the Fluid.

In the French Memoirs of the Academy of Sci ences for the Year 1699, there is a Method, by Mr. Homberg, of finding the exact quantity of the Volatil Acid Salt that any Liquor contains.

(2) Their way of making Salt at Nant-wyche in Chesbire, is thus, (faith Mr. Ray) The Salt-spring, or as they call it the Brine-pit is near the River, and is so plentiful, that were all the Water boiled out that it will afford, it is thought it would yield Salt enough for all England.

The Brine-pits belong not all to one Lord; but fome have one Lead-walling, fome two, three, four, Ce. A Lead-walling, is the Brine of 24

Hours boiling for one House.

Two hundred and fixteen Lead-wallings. thereabouts, belong to all the Owners of the Pits. No Tradesinan, Batchellor, or Widower, can Rent more than 18 Lead-wallings.

They have 4 Sworn Officers chosen Annually, which they call Occupiers of Walling; whose Duty it is to see equal Dealing between Lord and Tenant, and all Persons concerned, to appoint how many Houses shall work at a time (which is 12 at most) to appoint a Crier (when Salt is to be made;) to make Proclamation so, that all Parties concerned may put to their Fires at the same time, and so also when they shall cease: which is, at a determinate Hour: And he that doth not leave off then hath his Salt spoiled, by throwing Dirt,

In the Town are about 50 Houses, and every House hath 4 Pans, which the Officers are to see must be all exactly of the same Measure.

The Salt Water taken out of the Brine-pit, in boiling 2 Hours 1, will be Evaporated, and boiled

up into Salt.
When the Liquor is more than luke-warm, they take Strong-ale, Bullock's-blood, an Egg-shell full, the White of one Egg, and of Ale a Pint: This Mixture is put into a Pan of 24 Gallons, or thereabouts; the Whites of Eggs, and the Blood serve then pouring Water upon it, they make a Lee or to Clarifie the Brine, by railing the Scum; which Lixivium, and the Water draining thro' the Sand,

Liquor boils too fast, they don't put in any Blood, the Water, than by one another. For as all Bodies ascend in Water, which do gravitate less tofay, will diminish their Salt; and they say, the Ale serves to harden the Corn of the Salt

After one hours boiling, the Brine will begin to of Salt, than they are by the Water it self, must Corn, or Granulate. Then they take a small quan-necessarily recede from that Particle, and give tity of clear Ale, of which they sprinkle about an Egg-shell full into the Pan, but if you put in too much Ale, it will make the Liquor boil over the Pan; a little whilebefore they put in the last Ale, they cause the Pan to boil as fast as they can; but after that very gently, till the Saltbe almost dry, For they do not Evaporate quite, ad siccitaten,

> rated, they take out the Salt and pour it into Conical Baskets (which they call Barrows) and in them let the Water drain from it an hour, moreor less, and then set it to dry in the Hot-house behind the Furnace.

A Barrow containing 6 Pecks, is fold there for 16 Pence.

Out of 2 Pans of 48 Gallons they expect 7 Pecks

of Salt, Winchester Measure.

The House in which the Salt is boiled, they call the Wyche-house; the Vessel whereinto the Brine is by Troughs conveyed from the Brine-pit, is calledthe Ship. 'Tis raised out of the Pit by a Pump. Between the Furnace and the Chimney-tunnels, which convey the Smoke, is their Hot-house, where they set their Salt to dry; along the Floor where-of run 2 Funnels from the Furnaces, almost Parallel to the Horizon, and then they arise Perpendicularly; in these the Flame and Smoak running along from the Furnaces, heat the Room by the

AtlDroitwyche in Worcestersbire, the Salt is

boiled in shallow Leaden-pans.

They first put in the Salt-water out of the Brine-pits, and then after an hours boiling they fill up the Pan with the Water that drains from the Salt let to dry in the Barrows, and after a second hours boiling, they fill up the Pans again with the same. In five hours boiling the Pan grows dry,

and then they take out the Salt.

In 24 hours they boil out 5 Pans, and then draw out the Ashes; after which they put in the Whiteof an Egg to make the Scum arise (which is partly Dust and Ashes, falling into the Pan when they are taking out the Ashes.) The Scum they take off with a Scummer, and after 4 hours they begin to take out the Salt, and once in 24 hours they take out a Cake which sticks to the bottom of the Pan, and which they call Clod-Salt, o-therwise the Pan would melt. They use there neither Blood nor Ale, and the Salt made there is extraordinary fine and white.

In Lancasbire they make Salt of Sea-Sand, thus, They pare off in dry Summer-weather, the upper part of the Sand in the Flats and Washes (which are cover'd at Full-Sea, and bare when the Tide is

out) and lay it up on great heaps.

Of this Sand they put into Troughs, bored with holes at the bottom, a sufficient quantity, and liii 2

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carries the Salt with it down into Veilels placed paid at the Feast of St. Martin, by the Servile Teunderneath. As long as this Liquor is strong enough to bear an Egg, they keep pouring more Water still upon the Sand in the Troughs, but as foon as the Egg begins to fink, they cait the Sand out of the Troughs, and put in new from the

This Water thus impregnated with Salt, they boil in Leaden-pans, wherein (as above) the Wa-

ter Evaporating leaves the Salt behind.

At Newcastle, Preston-pans, in Scotland, Whitehaven in Cumberland, and other Places, they make Salt in great Plenty, by Boiling and Evaporating the Sea-water, and in the Operation they make

use of Ox's Blood, as at Nantwyche.

From Dr. Jackson's Account of the Salt-works and Springs in Cheshire, in the Philosophical Transactions, I find that now they have changed their 6 Leaden-pans into 4 Iron ones, something better than Yard square, and about 6 Inches deep; which are ser upon Iron-bars, and made up on all sides very close, to hinder the Flame or Smoke to break thro', with Clay and Bricks. Their Fewel is Staffordsbire Pit-coal. They never cover their Pans at all, during the whole time of boiling; and their Houses are like Barns, open up to the Thatch, with a Louvre-hole or two to carry off the Steam, which is fo great, that probably it would warp Boards, and ruft Nails, fo that no Timber covering would last long; what Tiles would do, no one yet hath tried there.

The Sweepings of fuch Salt as is shed and scarter'd about on the Floor, takes up withit a good deal of Dirt, and is called Grey-Salt. This fells but at half the Price of white Salt, and is only used by the Poor to Salt Cheese, Bacon, &c. Catts of Salt are made of the worst Salt, when yet wet-tish from the Pans, 'tis molded and made up with some Cummin-seed and Asses, and so baked into Lumps at the Mouths of their Ovens; they are only used in Pigeon-houses. But Loaves of Salt

are the finest of all for Table use.

At Droitwyche in Worcestersbire, they use no Blood, but only Whites of Eggs (a quarter of one White to a Gallon of Brine) to Clarify their Brine;

half a hundred Weight.

The way of making Bay-Salt in France, is described in Philosophical Transactions, N. 51, with Figures. The Water is let in from the Sea into a first and second Receptacle, and then into a third, which is called the Marish. In these Beds or Marisbes the Water is not above an Inch and halfdeep; each Bed of the Marish is 15 Foot long, and 14 Broad. When it rains much on any day, no Salt can be made in 3 or 4 days after, and then from the Fire of the opposite Bastion.

they have Stops to hinder the Sea-water from SAPHETA, in Architecture, is the Board over coming into the Marisbes. But if it rain for 5 or the top of a Window, and placed Parallel, and 6 days, they are necessitated to empty all the Water out of the Beds by a peculiar Channel, which cannot be opened but at Low-water.

The hottest Years make the most Salt, and in the hottest part of Summer, Salt is made in France even in the Night: Less Salt is made in Calm then in Windy Weather, and the West and Northwest Winds are best for that Purpose. The People draw the Salt every day, and each day more than

an hundred Pound weight.

nants to their Lord, by way of Commutation, for the Service of carrying their Lord's Salt from Market to his *Lardar*.

SALVAGE-Money, is a Recompence allowed by the Civil Law, in lieu of all Damages sustained by that Ship, that faves or rescues another which was fet upon or taken by the Enemy, or by Pi-

SALUTE, SALUS, was a Coin of Gold, Stampt by K. Henry 5. in France, after his Conquests there, it had on it the Arms of England and

France quarterly

SANCTUARY, was formerly a Place Privileged by the Prince for the Safeguard of Mens Lives that were Capital Offenders: Our ancient Kings of England, permitted the Sanctuaries to protect Traytors, Murderers, &c. if within 40 Days they acknowledged their Fault, and submitted themselves to Banishment: And during that time, if any Layman Expelled them he was Excom-municated, and a Clerk was made irregular by it. But after 40 days, no Man might relieve them. Of these there were many in England, and one more famous than therest, at St. John's at Bever may find by reading the Statutes of 26 H. 8. 13. 28 H. 8. 7. 32 H. 8. 15. 1 E. 6. 12. 2 E. 6. 2. and 33. 5 E. 6. 10. SAND-bags, in Fortification, are Bags holding

about a Cubick Foot of Sand or Earth: They are used for raising Parapets in haste, or to repair what is beaten down; they are of use when the Ground is Rocky, and affords no Earth to carry on their Approaches; because they can be easily brought on and off at pleasure: There are a lesser fort of these which hold half what the former do, which are placed upon the upper Talus of the Parapet, to cover those which are behind, and who fire thro the Embrasures, or Intervals that are between them.

SAP, in Fortification, is digging deep under the Earth, in order to pass under the Glacis, and to open a way to come under cover to the Passage of When they are got near the foot of the Moat. the Glacis, the Trench is carried on directly forand to Granulate it, they use no Ale, nor any thing else; this Salt is much whiter and better than the chefbire Salt, and a Winchester Bushelos it weighs and Mantelets upon Wheels: When they are got to the foot of the Glacis, they make Epaulments, or. Traverses on each fide to lodge a good Body of Men. The Sap is made 5 or 6 Fathom from the Saliant Angle of the Glacis, where the Men are only cover'd fideways; wherefore they lay Planks over-head with Hurdles and Earth above them. When they have forced the Enemy to quit the Cover'd Way, the Pioneers make immediately a Lodgment, and cover themselves as well as they can

opposite to the Window board at the botom.

SARPLER, otherwise called a Pocket, is a half Sack of Wooll, a Sack is 80 Tod, a Tod 2 Stone, and a Stone 14 Pounds. This in Scotland is called

Serpliath, and contains 80 Stone.
SATURN, in the Leipsick Acts for September, 1684. there is a new System of the Phænomena of Saturn and his Ring, by Mr. Gallet, and taken from the French Journals of June, 1684.

It doth not appear by any Astronomical Ob-SALT-SILVER, was one Penny, formerly fervations, that Saturn, like the other Planets, which have Satellites, revolves round his own Axis; but the contrary feems to be the Cafe. For in Jupiter and the Earth, which do turn round their Axes, the Equatorial Diameters are longer than Polar ones, or their Axes, but no such thing hat h been found in Saturn.

Each Surface of the Ring of Saturn feems to be plain and fmooth, without any fuch Mountainous Inequalities as the Earths Surface, and the Moons hath; because it is not visible, tho' Illuminated by the Sun, but only when the Eye is e-lausted some few Degrees above its Plane. "Tis Saturn with a Circular Motion; but it it be of a Solid Substance, it is not yet determined, whether it move round the Planet or not. And fince the Figure of Saturns Ring is exactly Circular, it must have no Linea Apsidum, nor any Progression of it: But because the Plane of the Ring hath a large Elevation above the Plane of the Ecliptick, viz. making with it an Angle of 31 Degrees, the Nodes will recede, but yet very flowly, according to the manner of the other Planets.

SATELLITES. Dr. Gregory, in his Exclleent Astronomy, hath demonstrated, that if a Satellite describe an Elliptick Orbit round a Planet, placed in one of the Foci of that Ellipsis; the greater Axis, or the Line of the Apfes will with an Angular Motion twice advance forwards, viz. in the 2 Syzygies, and twice recede backwards, viz. when

in Quadrature to the Sun.

And that this Force of Progression is near twice as great as that of the Recess, and therefore the Line of the Aples in every Revolution of the Satellite, will advance more forward than it recedes backward; and that by the Excess of this Progress. sion, the Apses will move in consequentia, p. 298.

If a Satellite move round a Planet in an Eccentrick Orbit, the Eccentricity will be twice changed in every Revolution, and in each Revolution will be greatest, when the Satellite as in the Syzygies with the Sun, and least when it is in the Quadratures; and will be continually encreasing from the Quadratures to the Syzygies, and decreafing from

the Syzygies to the Quadratures, p. 302.

If a Satellite revolve round a Planet in an Orbit, whose Plane is inclined to the Plane of the Orbit of the Planet round the Sun, then will the Line of the Nodes move in antecedentia, with an unequal Angular Motion; swiftest when the Nodes are in Quadrature to the Sun, after this flower, and at last when the Nodes are in the Syzygies, will be quite at rest. In the intermediate Places between the Quadratures and Syzygies, the Nodes will recede flower; and in every Revolution of the Satellite, will either be Retrograde or Stationary, becarried backward, or move in antecedentia, and in each Revolution will recede fastest, all things confidered, when the Satellite is in the Syzygies,

p. 304. The Inclination also of the Plane of the Orbit of the Satellite, to that of the Planet, will be continually changing, and will be greatest when the Nodes are in the Syzygies with the Sun, and least cateris paribus, when they are in the Quadra-

And all the Inequalities in the Motions of the Satellites will be a little greater when they are in Conjunction with the Sun, than when they are in opposition to him, p. 310.

SAW, is an Instrument very well known in the as well as its use. But they reckon these 1. The Pit-fam, which is several sorts of Saws. used to Saw Timber and Boards, and to cut off Scantlings, Quarters or Battens from any piece of Timber. The Matter to be Sawed is sometimes lain over a Pit, and sometimes on great Trusses above ground. 2. The Whip-Saw isused Trusses above ground. by Joyners, to cut off fuch pieces of Stuff as the Hand-Saw will not eafily notch thro'. 'Tis drawn minated by the Sun, but only when the Eye is elevated fome few Degrees above its Plane. Tis in order to be cut. 3. The Hand-Saw, which is either Fluid therefore like Water, or Polite, like to be used by a single Man, and usually with one like or Glass. If it be a Fluid, it moves round hand. 4. The Frame-Saw, or Bow-Saw, is a Saw with Cheeks made to it, and with a twifted Chord, and Tongue in the middle to draw the upper ends of the Cheeks closer together, that the lower ends may be farther afunder, and so strain the Saw the ftraighter. 5. The Tennon-Saw, which is a thin Saw with a Back to it, to keep it from bending. 6. The Compass-Saw, which is design'd to cut a Round, or any Compass-kerf; wherefore its Edge must be made broad, and the Back thin, and the Blade narrow, that the Back may have a wide Kerf to turn in, and so the eatier follow the Edge.

SCALES Proportional: See Proportional

Scales.

SCALE of Musick, tho' we find mention of several Distances of Musick among the Greeks, yet I rather think them to be Leaps in a fingle part, than Concords in Composition. The Distances talk'd of among the Greeks, are the Tire or Second, the Ailor or or third, the Aideoiger or fourth, the Aideoiger or fourth, the Aideoiger or fourth, cirre or fifth, and Διαπασών or eighth. But if these were defign'd to denote the Concords, they were in the wrong to place the fourth, and more so to place the fecond among them. Or if fuch were admitted, 'tisa wonder that the fixth, which is known to be a Concord, was refused. But if they were used to shew the Distances, by which a Voice may rise or fall, it is no wonder that they left out the fixth and feventh (being Distances not to be used without better Judgment and Design than those Times would admit ot) and made mention of the rest, as being common in their Musick.

The Scale of Musick among the Greeks, consifled but of fifteen Notes, or the Diftances of two Octaves, viz. The first from their ΜεσιλαμβανόμιvG, (which I suppose was the Key of their Musick,) to their Mion, and the second from their Mion or Middle Note to their Nim umg Canalur, or highest Note, by which I suppose they designed only the utmost Extent of a single Natural Voice.

And their Seven Moods, so much talk'd of, were no more than the seven different Methods of altering their Tunes, by Flats and Sharps, placed at the beginning of a Lesson; which therefore they called work own town. Besides the Names of their Notes in the upper Octave, have no Affinity with the Names in the other; whereas in Guido Aretinus his Scale of 20 Notes (tho' our modern Composers in many Parts often exceed the Scale, both above and below) and the Notes in every Octave begin with the same Letter; that we may thereby more readily compute the Concords and Discords.

SCARAGE, Scaragium, otherwise called Escherage, Shewage and Scheawing; and in a Charter of H.2. to Canterbury,'tis written Scewinga, was for-merly a kind of Toll or Custom, exacted by Her Majesties Sheriffs, &c. of Merchant Strangers for Wares

Wares, shewed or offered to Sale within their Precincts. This is now Prohibited by Statute, 19 H. 7. c. 8. But the City of London doth still retain the Cultom, Cowel's Interpreter. The Officer that Collected this Toll, was called the Scabaldue.

SCALA. William I. appointed the Arms, which before him had been usually answered in Victuals, to be converted into Money numbred, and directed the whole in every County to be charged on the Sheriff, who brought it into the Exchequer; adding, that the Sheriff should make the Payment ad Scalam, i. e. as Gervase of Tilbury expounds it, he should pay six Pence over in every Pound to make up the full Weight, and nearly the Intrinfick Value. And this was agreed on, as an easie way to remedy the defective Weight of Money, and to avoid the trouble of weighing all, Money which was brought into the Exchequer.
SCALENOUS Cones. See Cone.
SCEPPE, an old Word, omitted in our Glossa-

ries, fignifying a Bufbel.

SCENOGRAPHICK Projection, or Perspective, is the Transcription of any given Magnitude, into a Plane which interfects the projection. tick Pyramid at a proper distance: For in Projection, there is to be considered, r. The Object, or Foundation, or Ground of the Projection on, from whence the Pyramid, Cone, or Pencil of Rays go. (2.) The Eye of the Spectator, and 3 the Plane Table, or Diaphanum, which interfects the Rays, some where between the Object and the Eye: And the Representation or Appearance of the Object in that Plane, is the Projection or Per-spective of the Object. This Plane is always supfpective of the Object. This Plane is always supposed to be at Right Angles with the Horizon. And from hence it will follow, that (1.) A Point will be projected there in the Diaphanous Plane where the Optick Ray cuts it. (2.) That Right Line will be projected where the Optick Triangle and the Plane do mutually Interfect each other. That a Plane or Superficies will be represented where the Diaphanous Plane cuts the Optick. Pyramid of Rays coming from that Surface. that Representation of it called its Image.

SCHAR-Penny, Scharn-penny, and Iometimes Schorn-penny. It appears from our old Books, that formerly some Customary Tenants were obliged to pen up their Cattle at Night in the Pound or Yard of their Lord, for the benefit of their Dung, or Scearn, as is the Saxon Word. And it they did not do this, they were obliged to pay a small Compensation; which therefore was called by this name of Scharn-penny, that is, Muck-penny, or

Dung-penny.
SCHEAME, or Skeen, in Architecture, is the Workmens Word for the middle part of an Ellip-

SCHIRE-MOTE, was anciently a Solemn Meeting of all the Free Tenants and Knights in any County, to do Fealty to the King, and Elect an Annual Sheriff. See Folk-mote.

SCHIRE-WYTE, was an Annual Tax or Impofition, paid to the Sheriff of any County or Shire,

for holding the Affizes or County Courts.

SCREW,
SCRUE,
See Cochlea.

and this White being taken off with an Iron Bod-

for Shadows: This kind of Work is lasting, but being very rough, is unpleasant to the sight. Twas

used in Rome by Polidoro de Caravagio.

SCRIBING, when the Joyners would fit a piece of Board, Sc. to an irregular Surface, or any other irregular Piece: They open their stiff Iron Compasses to the greatest distance, any where between the 2 Boards, &c. and then carrying one Leg along all the irregular Indentings, &c. of one, the other Leg moving parallel to it, describes that irregular Figure on the other Board; which

being in that manner cut will fit and joyn.

SCUTAGE, all Tenants who held from the
King by Military Service, were either bound to attend Personally in Wars and Expeditions, or for default of fuch Service, to pay a Scut age or Compofition in Money, which was Levied on every Scatum Militare, or Knights Fee, and the Proportional Parts for the King's Use. And the Barons and Knights, which then paid a Scatage to the King, had a Power to Levy the same Tax on those Tenants who held from them in Military Ser-

SCUTAGIO habendo, was a Writ that lay for the King, or other Lord, against the Tenant that held by Knight-Service, to serve by himself, or else to send a sufficient Man in his Place.

SCULPTURE, may be diftinguished into three feveral Arts, each of which hath its Specifick Difference. For (faith Mr. Evelin in his History of Chaleography) besides Sculptura, as it relates to Chalcography, there is both Sculptura and Colatura; both which, according to Quintilian, differ from the first, with respect to the Matter, on or out of which any thing is wrought. For it was applied to cutting or carving in Wood or Ivory; and then was called Tomice, and the Artists Defectores; to working in Plaster, and then called PAradigrammatice, and the Artists Gypsochi; to Cutting or Carving in Stone, and then called Colaptice, and the Workmen Lithoxoi, and laftly in Metals, Glyphice. And it may be described to be an Art, which teaches us to cut or take away all that is superfluous of the subject Matter, reducing it to that Form or Body, which was designed in the

Mind of the Artist.

SCUPPER-Nails, see Scopper-holes.

SCYRE-GEMOTE, was anciently a Court held twice a Year (as the Sherists turn is now) by the Bishop of the Diocess and the Ealderman, i.e. in such Shires as had Ealderman) and by the Bishops and Sheriffs, in such as were committed to the Sheriffs that were immediate to the King; where both the Ecclesiastical and Temporal Laws

were given in Charge to the Country.

SEALER, is an Officer in Chancery, appointed by the Lord Chancellor, or Keeper of the Great Seal, to Seal the Writs and Instruments there

made in his Presence.

SECTOR, besides the Uses of the several Lines Circular and others; which you will find disper-sed under their proper Names. Some Problems may properly come in here under the general Word Sector. As i. To open the Sector to any given An-

SCRATCH-work, in Italian, Sgrafitti, was a the several pairs of Lines thereon drawn to the way of Painting in Fresco, by preparing of a black Ground, on which was placed a white Plaster; Lines on the one side, and the Line of Sines on the case of the line of Here must be noted, that 'tis one thing to open the several pairs of Lines thereon drawn to the Lines on the one side, and the Line of Sines on the and this White being taken off with an Iron Bod-kin, the Black appears thro' the Holes, and serves the Sector are close shut. So also the Line of Superficies, perficies, and the Lines of Solids make an Angle Diameter GF, then Apollonius calls such Sections

of 10°, tho' the Edges are close shut.

The Lines of Lines may be opened to a Right Angle, if the whole lateral Length be applied over between 8 and 6. Because = 8 x = 6 = 100,

ver per ween 8 and 0. Because 8 x 6 = 100, by 47. è 1. Eucild.

The Lineof Sines may be opened to a Right Angle, if the Lateral Sine of 90 be applied over Parallelly between 45°. and 45°. in the Sines, or if the Sine of 45°. be applied over in the between 30°. and 30, in the Line of Sines.

If you would open the Lines of Sines to any particular Oblique Angles, take out the Chord of

particular Oblique Angles, take out the Chord of the Angle required, and apply it over in the Semi-Radius, or at the end of the Line of Chords of 60 Degrees: V. gr. to open the Sines to an Angle of 40 Degrees, take out the Lateral Chord of 40° and to it open the Sector in the Parallel Chord of 60°. or if you apply the same Chord of 40°. over between 50 and 50 in the Line of Lines, it will open them

to the same Angle.

On the contrary, if the Sector be opened to an Angle at a venture, you may find the quantity of that Angle, thus: Take the Parallel Chord of 60°. and measure it in the Lateral Chord, and it shall there give the Angle, i.e. the Angle that those Lines of Chords are opened to: But that will be different from the Angle of the Edges of the Sector. N. B. If you can apply the Centre of a Protrator to the Centre of the Sector, you may easily and readily find the Quantity of any of these Angles

SECTA Curia, is Suit and Service done by Te-

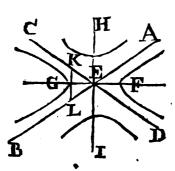
nants at the Court of their Lord.

SECTA Schirarum & Hundredorum, was the Attendance, Suit and Service done by Tenants in the County and Hundred Courts; and Quietos effe de hac Secta, was a Privilege to be exempt from

fuch Customary Service.

SECTIONS Conick, see Conick Sections. SECTIONES Sequentes, is a Term in Conicks

arising thus:



Let there be two Right Lines, as AB, CD, mutually intersecting each other in E; which Point E, is supposed to be the Common Centre of the opposite Hyperbolick Sections, F.G., H.I. and whose common Asymptotes the proposed Lines A B, C D, also are. In this particular Case, the Sections GF, and HI, are called Sectiones Sequen-tis, because they are placed following one another in the Contiguous Angles of two Intersecting

And if the determinate Diameter HG, of one of the Sectiones Sequentes (which is coincident with the supposed Indeterminate Diameter of its Opposed Indeterminate Diameter of its Opposed Indeterminate Diameter of its Opposed Indeterminate Diameter of its Opposed Indeterminate Diameter of its Opposed Indeterminate Diameter of its Opposed Indeterminate Diameter of Its Opposed Inde

Conjugate Sections.

SEGMENTS, on Gunter's Sector there are usually placed two Lines, called Lines of Segments, they are numbed with 5, 6, 7, 8. 9, 10, and lie between the Lines of Sines, and those of Superficies. They represent the Diameter of a Circle so divided into 100 parts, as that a right Line drawn thro' those Parts, and normal to the Diameter, shall cut the Circle into 2 Segments, of which the greater shall have that Proportion to the whole Circle; as the Parts cut have to 100. Their uses are

1. To divide a given Circle into two Segments, which shall have a given Ratio, which is done by opening the Sector, and applying the given Circles Diameter in the Points of 100 in these Lines; for then a Parallel taken from any Points proportional to the greater Segment required, shall give the depth of the greater Segment, accounted on a Diameter bisseding the Segment.

2. To find the Proportion between the Circle

and any given Segments of it.

Open the Sector, as before, and then take the depth of the greater Segments, and apply Parallel to the Diameter, and the Points where it fits in ex-

actly, will shew the Proportion to 100

SEEING. The Sense of Seeing is probably caused thus, the Rays of Light exhibiting all Colours; fall upon the bottom of the Eye, and there cause or excite Vibrations in the Tunica Retina: which Vibrations being communicated, or propagated a-long the Solid Fibres of the Optick Netves into the Brain, do there cause that Sensation, which we call Vision or Seeing. For because dense Bodies conserve their Heat a long while, and the Denfest, the longest time, the Vibrations of their Parts are of a lasting nature, and therefore may be pro-pagated along solid Fibresof Uniform Density toa great distance, for conveying into the Brain, the Impressions made upon all the Organs of the Sense. For that Motion which can continue long in one and the fame part of a Body, can be propagated a long way from one part to another, supposing the Body Homogeneal, so that the Motion may not be reflected, refracted, interrupted, or disordered by any unevenness of the Body. Newton's Opticks, Book 3.

The same Author renders it probable, that the Species of Objects seen with both Eyes, are united in that Place where the Optick Nerves meet and joyn, before they come into the Brain: The Fibres on the right fide of both Nerves uniting there, and after Union, going thence into the Brain in the Nerve, which ison the right fide of the Head; and the Fibres on the left fide of both Nerves uniting in the same place, and after Union going into the Brain in the Nerve, which is on the left side of the Head: And these two latter Nerves meet and unitein the Brain, in such a manner that their Fibres make but one entire Species or Picture: Half of which. viz. that on the right fide of the Senforium, comes from the right side of both Eyes, thro' the fide of both the Optick Nerves, to the Place where these Nerves meet, and from thenceon the right fide of the Head into the Brain: But the other half, viz. that on the left fide of the Senforium, comes in like manner from the left side of both Eyes. For the Optick Nerves of such Aed betwen the Asymptotes in the Point G, of the tick Nerves of such Animals as do oot look the fame. Same way with both Eyes (as of Fishes, and of the Chamælion, do not so meet and unite. If I am

rightly informed.

When a Man in the dark, presses either corner of his Eye with his Finger, and at the same time turns his Eye a contrary way, he will see a Circle of Colours, like those in the Feather of a Peacock's Tail; which variegated Circle of Colours, seems to arise from the same kind of Motions excited in the bottom of the Eye by the Pressure of the Finger, as at other times are excited there by Light for causing Vision. And when a Man by a stroke upon his Eyes sees a Flash of Light, are not the like Motions excited in the Retine by that

SEIGNOURAGE, 9 H. 5. Stat. 2. c. 1. seems to have been a Royalty or Prerogative of the Prince, whereby he challenged allowance of Gold and Silver brought into the Mass for his Exchange for Coin. Out of every Pound Weight of Gold, the King had for his Coin five Shillings, out of which he paid to the Master of the Mint for his Work, fometimes I Shilling, and fometimes 18 Pence. Upon every Pound Weight of Silver the Seignourage, answered to the King, in Edw. 3. Time was eighteen Penny-weight pondere, which about that time amounted to about a Shilling, and out of which he paid sometimes 8, sometimes 9 Pence to the Mint-master. In H. the 5th's Time the King's Seignourage for every Pound Weight of Silver was 15 Pence.

SELL, in Architecture, is the Term both for the lowest piece of Timber in a Timber-building, or for that on which the whole Superstructure is crected, and also for the bottom-pieces in a Window-frame; the former is called a Ground-sell, the

latter a Window-sell.

SEME, Summa, is an Horse-load, a Seme of

Corn is 8 Bushels,

SENESCHAL, was the Word anciently for the Chief Steward or Head Bailiff of a Baron, that kept his Courts, and managed his Demeloe-lands, and hath been the Title of the Lord High Steward, and of the Steward of the King's Houshold, &c.

SEPTUAGESIMA, is always the third Sunday before Quadragesima exclusive: from which, until the Octaves after Easter, Marriage is forbidden by the Canon-Law. It takes its name from its being

above 70 Days before Easter.

SEPTUM Medium, is properly the infide of the left Ventricle of the Heart, because its Fibres are continued with the Fibres of the opposite side of the same Ventricle; it divides the left Ventricle of the Heart from the right.

SEQUELA Cause, is the Process and depending lifue of a Cause or Trial.

SEQUELA Molendini, is owing Suit to a particular Mill, or being bound to grind Corn in that Place only; which formerly was a Duty and Service laid upon many Tenants; wherefore Concidere Sequelam Molendini, was to grant all the Toll and Profits arising from such Customary Rights.

SERGEANT; is a word diversely used in our Law, and applied to fundry Offices and Callings.

A Sergeant at Law, or of the Coif, is the greatest
Degree taken in that Profession, as that of a Dostor is in the Civil Law. As these are the most
Learned and Experienced, there is one Court approprieted to Pland in by themselves, which is the propriated to Plead in by themselves, which is the Common-pleas, where the Common Law of England is most strictly observed: But the' they have

this Court to themselves, they are not prohibited Pleading in other Conrts; where the Judges (who must be first Sergeants) call them Brothers. These Sergeants are call'd by the King's Mandate, or Writ directed to them, and commanding them, under a great Penalty, to take upon them that Degree by a Day Affigned. Out of these one is (more may be) made the King's Sergeant, to Plead for him in all Causes, especially in Treason.

SERGEANT at Arms, is an Officer appointed to attend the Person of the King, An. 7 H. 8. c. 3. to Arrest Traytors, &c. and Persons of Quality Offending, and to attend the Lord High Steward when he fits in Judgment on any Traytor, Gc. By the Stat. 13 Richard 2. c. 6. There cannot be above 30 in the Realm. Two of these by the King's Allowance attend the two Houses of Parliament. The Office of him in the House of Commons is to keep the Door, and to execute such Commands as the House shall direct, especially as to the apprehension of Offenders, &c.

Another of these attends on the Lord Chancellor or Keeper in the Chancery, and one on the Lord High Treasurer, one to attend on the Lord President of Wales, and another on the Lord President of the North. Another fort of Sergeants, are chief Officers executing feveral Functions in the King's Household; of which you may find many in Stat. 33 H. 8. c. 12. There is also an inferiour kind of Sergeants of the Mace, whereof there is a Troop in the City of London, attending the Lord May.

SERJEANTRY, was a Service formerly done for the holding of Lands, and was either Grand Serjeantry, which was fome Honourable Military Service paid only to the King; as to carry his Banner, bear his Sword, Gc. Or Petty-Serjeantry, which was some less Noble Service paid to the King, or any other Lord. Some will have Grand Serjean try, to be where a Man holds Lands of the King by Service, which he ought to perform in Person, and Petty-Serjeantry, to be where he holds his Lands of the King, to yield him Yearly some small thing towards his Wants.

SERVICE-Royal, was the Rights and Prerogatives that within such a Mannor belonged to the king if I and a fine and more growth.

King, if Lord of it; and were generally rec-koned to be these 6. 1. Power of Judicature in Mat-ters of Property. 2. Power of Life and Death in iminal Causes. 3. A Right in Ways and rays. 4. Assessments. 5. Minting of Money, Assizs of Bread, Beer, Weights and Mea-Criminal Caules.

SERVICE, (which is fometimes called Servage) is divided into Personal and Real, and into Military and Base; as also into Intrinsick and Extrinfick. IntrinsickService they reckon due to the Capital Lord of the Mannor. Service is again divided into Frank and Base, the one is termed Liberum Servitium, the other Villenagium, 'Tis also divided into Continual or Annual, and into Cafual or Accidental; the former being the Seisin of Rent, and the latter Seifin of Reliefe.

SERVICE, in a Legal Sense, is a right by which onething is subject to another thing or Per-

And of these some are,

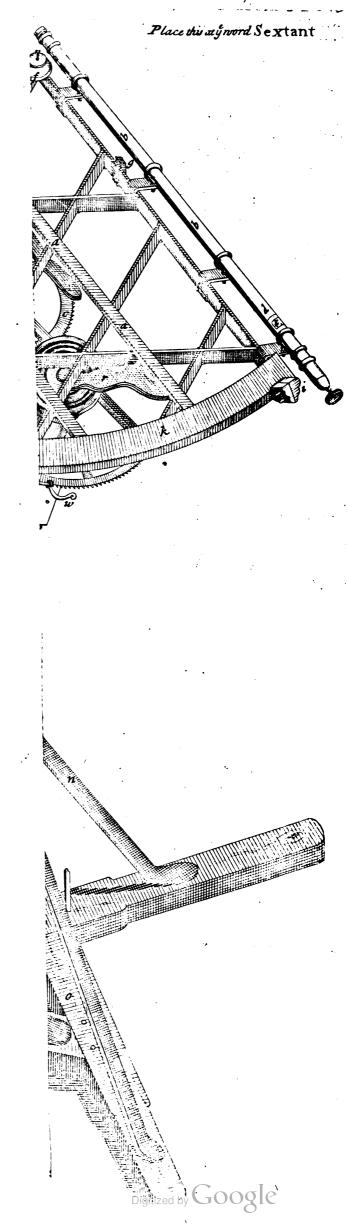
SERVICES Predial or Real, which are Rights that one Estate sometimes owes another: And these Predial Services, they reckon to be tome Rustical or Rural, such as the Right of Riding or Walking, or going with a Carriage thro' another Man's Ground &

dex bly an nich wer Di-Line the eing l by y 10 Sexther eels, tant Iron 1 the pleat (!) ie Ey ac-ay of t the well xtanow Mine 1 tha they led a

n the they hich I Dehelf, first they ad by at of ly ae the 'egention

Chief for
the the Shehis Brit-

Cha of l cle cocl feen cite the Lig stro the Stre S. to 1 Prin and for (the: whi Wo Pen Seig that of w to 1 King Silvi S the I or fo are E dow latte S I Corn SI Chia kept ard, befor the C abov SE left 1 conti the fi of th SE ding SE ticul Place vice dere and] SE Law A Sa Degr ctor Lear prop Com land



Ground; the Right of drawing Water, or bringing it thro' his Ground, &c. And some Services gradually (by the help of a Screw) and sensibly are called Urbana, which are the Rights that are shews its Progress, to the thousandth Part of an preferred to Mens Houses, built contiguous to one Inch.

SERVICES personal, are those Services which are due from a Thing to a Person; and of these they account 3 by name, viz. Usufruct, Use and Habitation; but there are very many and various ones which have no distinct Names.

SERVITIUM Regale, Royal Service, are the Rights and Prerogatives that within such a Mannor belong to the King as Lord of it; and these are generally reckon'd 6. As, 1. Power of Judicature in Matters of Property. 2. Power of Life and Death in Cases of Felony and Murder. 3. A Right in Waifs and Strays. 4. Assessments. 5. Minting of Mony. And 6. Assigned and Beer, Weights and Measures.

All these entire Privileges were annexed to some Mannors, in their Grants from the King, and were sometimes conveyed in the Charters of Donation

to Religious Houses.

SERVITORS of Bills, are such Servants or Messengers of the Marshal of the King's-bench, as were sent abroad with Bills or Writs, to Summon Men to that Court. They are now commonly called Tip-flaves.

SESAMOIDEA Offa, the Use of these Bones, which are placed at the Articulations of the Bones of the Fingers and Toes, is that they may ferve as fo many Pullies about which the Tendons pass, at some distance from the Centre of the Articulation, whereby the Directions of the Motions of these Tendons are kept always at the same distance from the Centre of Motion of the Articulation.

SEWERS, are Passages, Canals, or Gutters to carry Water into the Sea or some River. therefore the Commissioners of the Sewers are such Persons, as by Authority under the Great Seal of England, do see Ditches and Drains in Marshes and Fenny-places, well kept and maintained for the better preserving the Grass upon the Land for feeding of Cattle, Ge. by conveying the Water off the Ground into the Sea or River.

SEXTANT. The Description of a New Sextant, lately made for the Observatory in Trinity-College, Cambridge, by Mr. John Rowley.

a a Iron Bars fet edge and flat-ways, compofing and framing the Body of the Sextant, whose Radius is five Foot.

bb Are two Tellescopes, the one fixt on the right Edge of the Sextant, from which the Divifions on the Limb are numbred, and the other moveable with the Index.

cc Two large Brass Semi-circles on the Backside of the Sextant, which by Nuts and Screws can bring the Instrument into any Position in any

Plane, Horizontal, Vertical, or Reclining.

dd The Place of the Cross-Hairs within the Tellescope, which are made to be moved (from the Out-side) for the better adjusting them to the In-Arument.

e The Revolution-Work, which proves the Index

f The Centre of the Instument, from which a Plumb-Line falling on the Line (i) at the lower End of the Right Edge of the Sextant, takes Di-

stances from the Zenith.

g Is another Centre, from which a Plum Line falling on the Line (h) takes Altitudes from the Horizon.

k Is the Brass Limb of the Instrument, being Diagonally divided into every 5 Minutes, and by proportional Parts on the Index, shews every 10

l Is a Lignum-Vita Axis, upon which the Sex-tant turns; and is made so, as to be plac'd either parallel to the Axis of the Equator, or of the Horizon.

m m Is a Contrivance by the Motion of Wheels, Nuts and Screws, so as to make the whole Sextant. move answerably to the apparent Diurnal Motion of the Heavens.

nn Three strong Iron Feet, fix'd to an Iron

Collar, to hold the aforesaid Axis (1.)

ooo Are Three Pieces of Timber, to which the Iron Feet are screw'd, and which serve to compleat the Pedestal of the Instrument.

p An Arch of Iron, which shifts the Axis (1) to its Parallelism with either the Axis of the E-

quator or Horizon.

The Limb of this Noble Instrument is very accurately divided, Diagonally, and by the way of unequal Divisions, used by Hevelius; so that the Angle may be taken either of those ways, as well as be found by the Revolution-Work.

SEXTAR of Wheat or other Corn (from Sextarius) was that quantity anciently which we now call a Quarter, containing a Bushel. In some Countries'tis called a Seame.

SHAFT, is the hollow Entrance into a Mine which is funk or dug to come at the Ore. Tin Mines, after this is funk about a Fathom, they leave a little long square Place, which is called a Shamble.

SHAMBLE, see Shaft.

SHELF, is what the Miners (especially in the Tin-Mines) call the Fast-Countrey, by which they mean an Imaginary Surface of the Earth, which at the Concussion of the Waters in the general Deluge of Noah, was never moved; and to the Shelf, they think all the Loads or Mineral Veins at first lay even and parallel; tho' after the Flood they were some elevated, some depressed, &c. And by Shelf now they mean that hard Surface or Coat of the Earth which lies under the Mold, usually about a Foot deep; for they suppose, that since the Flood the Earth hath gotten a new Coat of Vegetable Earth, or fuch as is made by the Corruption of Vegetables and Animals.

SHERIVE or Sheriff, Vice-Comes, is the Chief Officer of the King in any Shire or County, formerly the Sheriff was chosen by the People in the County-Court by Vote, as the Knights of the Shire for Parliament now are; but now the Sheriff is nominated by the King. Camden in his Kkkk

Britannia, describes this Office, and the Antiqui-ty and Authority of this Officer. See Co. Rep. lib. 18 The Hallards. 4. And Spelman's Glosfary under the word Vice-Comes. His Oath is extant in Rey. Orig. fol. 331.

SHERIFF-TOOTH, feams anciently to have 19 Mizzen Top-Maft. been a Tenure by the Service of apacy of providing Entertainment for the Sheriff at his County-ding Entertainment for the Sheriff at his County-Turns or Courts. For it appears by Ryley's Placi-ta Parliament. fol. 653. that in Derbysbire the King's Bayliffs did formerly take 6 Pence of every Extra Parliament. Sol. 125 Its Back-Stay. been a Tenure by the Service or Duty of provi- 20 Its Sails furl'd.

SHILLING, Solidus in the Latin is a word of very uncertain Signification, and differs almost in every Nation. But the word Scalling or Shilling in England, never fignified any thing but 5d. with 30 The Cross-Trees. the Saxons, and 12d. ever fince. When it first 31 The Cap. the Saxons, and 12d. ever fince. When it first went for 12d. 'tis hard to find: But there was no 12 Penny Piece of that name Goined in England till 33 Its Stay 1504 and then Stow calls them Grouss: tho' Fa-bian mentions them under the name of Shillings. In 34 H. 8. there were 12 Penny Pieces struck, 36 The Vane. but they were called Testons.

SHINGLING Tongs, are used in the Finery of an Iron-forge, to take out the Loop, in order to bring it under the Hammer into a Bloom.

SHIP. The Description of the several Parts and Rigging of a First Rate Ship, lying at Anchor-

H Her Hull.

A The Cut-water. B The Stem. C The Hawse Holes.
D The Cat-Head. E Waste Cloaths. F The Fore Chain-wale. G The Main Chain-wale. H The Minuen Chain-wale.

I The Chefs Tree. K The Entring Port. L The Head. M The Gallery N The Tafferel. 000 The Three Poop Lanterns. P The Ensign Staff. Q Its Truck. R The Enfign or Antient.

Z The Mizzen Mast and Rigging.

1 The Mixnen Maft. 2 The Mizzon Fard and Sail. 3 The Mizmen Sheet. 4 The Mizzen Shrowds and Laniards. 5 The Mizzen Bow-lines. 6 The Mizzen Brayles. The Goer. 8 The Mizzen Peck Halliards. 9 The Cross Jack-Yard. 10 The Lifts. II The Braces. 12 The Mizzen Puttock Shrowds, 13 The Mizzen Top. 14 The Mizzen Top Armour. 15 The Cap. 16 Crow-feet.

Mizzen Top-Mast and Rigging.

26 Its Bow-lines. 27 Its Sheet. 28 The Clew-lines. 29 The Stay 32 The Stump. 34 Its, Truck 35 The Spindle. 37 The Slings of the Cross Fack-Tard.

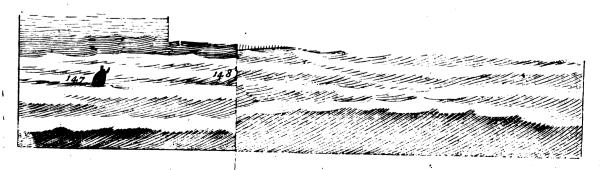
MaThe Main Mast and its Rigging.

38 The Main Mast. 39 Runners and Tackles. 40 Tackle. 41 The Main Shrouds and Laniards. 42 The Main Stay and Sail. 43 The Stay-Sail Halliards. 44 The Main Tard and Sail. 45 The Geers. 46 The Main Sheets. 47 The Main Tacks. 48 48 The Bunt-lines. 49 49 The Main Bow-lines. 50 The Main Braces. 51 51 The Leech-lines. 52 The Main Puttock Shrouds. 53 The Crow-foot. 54 54 The Main Lifts. 55 The Main Top. 56 The Top Armour. 57 The Top Rope. 58 The Main Cap. 59 The Main Tard Tackles.

Main Top-Mast and Rigging.

60 The Main Top-mast. 61 61 Tackles. 62 The Main Top-mast Shrouds. 63 The Back Stays. 03 The Back Stays.
64 The Main Top-sail Halliards.
65 The Main Top-sail Stay and Sail.
66 The Main Top-stay-sail Halliards.
67 The Main Top-sail Yard and Sail.
68 The Main Top-sail Braces.
69 The Main Top-sail Bow-lines. 70 The Main Top-fail Sheets.
71 71 The Main Top-fail Clew-lines.
72 72 The Main Top-fail Lifts.
73 The Rumer.
73 The Rumer. 74 The Bunt-lines. 75 The Cross Tree. 76 The Cap. 77 The Stump.

78 The



78 The Stay. 79 The Iruck. 80 The Pendant.

F The Fore-Mast and Rigging.

81 The Fore-Mast. 82 82 Its Runner and Tackles. 83 The Tackle. 84 The Fore Shrouds and Laniards. 85 The Fore Stay.
86 The Fore-Mast Yard and Sail.
87 The Fore-Sheets.
88 88 The Fore-Packs. 89 89 The Fore-Braces. yo 90 The Fore-Bow-lines. 91 91 The Bunt-lines. 92 92 The Leech-lines. 93 The Fore-Yard Tackle. 94 The Fore-Geers. 95 The Puttock Shrouds. 96 The Crow-foot. 97 The Fore-Top. 98 Its Top Armour. 99 The Top Rope. 100 100 The Lifts. 101 The Cap. 102 The Fore-Top-mast. 103 The Tackles. 104 The Fore-Top-mast Shrouds. 105 The Back-Stays. 106 The Fore Top-fail Halliards. 107 Stay and Sail. 108 The Halliards. 109 The Fore-Top mast Yard and Sail. 109 The Fore-10p maje sare more 110 The Runner.

111 111 The Fore-Top-fail Lifts.

112 112 The Fore-Top-fail Bow-lines.

113 The Fore-Top-fail Bow-lines.

114 114 The Fore-Top-fail Clew-lines.

115 The Fore-Top-fail Bunt-lines.

The Cross Trees. 117 The Cross Trees. 118 The Cap. 119 The Stump. 120 The Stay. 121 The Truck. 122 The Spindle.
123 The Vane.

B Bow-sprit and Rigging.

124 Bow-sprit.
125 The Horse.
126 The Sprit-Tard and Sail.
127 The Sprit-sail Lists.
128 128 The Sprit-sail Sheets.
129 129 Its Clew-lines.
130 130 The Sprit-sail Braces.
131 The Bob-Stay. 132 The Top. 133 The Top Armour. 133 The Top Armour.
134 The Sprit-sail Top-mast.
135 The Sprit-sail Shrowds.
136 The Sprit-sail Halliards.
137 The Crane-line.
138 The Sprit Top-sail Yard and Sail.
139 The Sprit-sail Top-sail Braces.
140 140 Its Lists. 141 141 Its Sheets.

142 The Cross-Trees. 143 The Cap.
144 The Jack-Staff.
145 The Truck.
146 The Jack.

147 The Buoy of the Best Bower Anchor. 148 The Cable of the Best Bower Anchor. 149 The small Bower Buoy.

SHOALD, is the Miners Term in the Tin Mines, for fuch Fragments of Ore, which by Rains, Currents of Water, &c. are torn off from the Load or Veins of Ore. These are washt down from the Mountains, and by finding of them, they guess where to look for a Load of Ore. Sometimes 'tis called Squod, sometimes Squad.

SHORT Sails, in a Man of War, are the same with the Fighting-sails, and are the Fore-sail, Mainsail, and Fore-top-sail: These are all that are used in a Fight, lest the rest should be fired or spoiled: And besides they would be troublesome to handle, and would hinder the fight and useof Arms. When a Ship gives Chase to another, if the Chase hath a mind to fight, they say, the Chase strips her self into her short or Fighting-Sails; that is, puts out her Colours in the Poop, her Flag at the Main-top, and her Streamers or Pendants at her Yard-arms; Furls her Sprit-sail, Peeks her Mizen, and Slings her Main-yard, and when the Chafer sees this, he is to prepare for an Engagement.

SIGNALS, are Signs made at Sea by the Admiral or Commander in Chief of any Squadron of Ships, either in the Day or by Night, either for Sailing or Fighting, or for the better Security of the Merchants Ships that are under the Convoy of His Majesties Men of. War. These Signals are appointed and determined by Order of the Lord High Admiral, and are a follows:

SIGNALS by Day, when Ships are at an Anchor, in weighing Anchor, Sailing, &c. When the Admiral or Commander in Chief would have the Fleet prepare for Sailing, he first looses his Fore-Top-sail, and then the whole Fleet are to do the same.

2. When he would have them Unmoor, he loofes his Main-top-sail, and fires a Gun; which in the Royal Navy is to be answered by every Flagg Ship.

3. When he would have them wergn, he rootes his Fore-top-fail, and fires a Gun, and sometimes hawls home his Sheets; the Gun is to be answered by every Flag Ship, and every Ship to get to Sail as soon as it can. If with the Leeward side, the When he would have them Weigh, he loofes

4 When the Admiral or Commander in Chief would have the Weather-most and Head-most Ships to Tack first, he hoists the Union-flag at the Foretop-mast-head, and fires a Gun, which each Flag

Ship must answer.

But if he would have the Sternmost and Leeward-most Ships to Tack first, he hoists the Union Flag at the Mizen-top-mast-head, and fires a Gun. And when he would have all the whole Fleet Tack, he hoists an Union, both on the Fore and Mizentop-mast-head, and fires a Gun.

5. When in bad Weather, he would have them Wear and bring to the other Tack, he hoists a Pender of the Control of the Cont

Kkkk 2

Head. Every Flag is to answer with the same Sig- nal.

and the Admiral would have them hear up and Sail before the Wind, he hoists his Ensign, and fires a Gun, which the Flags are to answer. And then the Leeward-most Ships are to bear up first, and to give room torthe Weather-most to Wear, and Sail before the Wind with an easie Sail, till the Admiral come a Head.

But if it should happen when the Admiral hath occasion to Wear and Sail before the Wind, that both Jack and Ensign be abroad, he will haw! down the Jack before he fires the Gun to wear, and keep it down till the Fleet is before the firing one Gun.

Wind. When they are Sailing before the Wind, and he would have them bring to with the Starboard Tacks Aboard, he hoists a Red Flag at the Flag-staff, on the Mizen-top-mast-head, and Fires a Gun; but if they are to bring too with the Larboard-tack, he hoists a Blue Flag at the same Place, and Fires a Gun. Every Ship to answer the

his Jack and Ensign, and keep it aboard till the Admiral or Commander in Chief Answer him by hoisting his; on sight of which he is to hawldown

his Enfign.

9. If any discovers Danger, he is to Tack, or bear up from it; and to aw Jack abroad from the Main-top-mast Cross-trees downward upon the Back-stay, and Fire two Guns: But if he should strike or stick fast, then besides the same Signal with his Jack, he is to keep Firing till he sees all the Fleet observe him, and endeavour to avoid the

10. When any fees a Ship or Ships more than the Fleet, he is to put abroad his Enfign, and there keep it, till the Admiral's or Commander's is out, and then to lower it as often as he fees Ships, and to fland in with them, that so the Admiral I. When the Admiral would have the Fleet to may know which way they are, and how many: Unmoor and Ride short, he hangs out 3 Lights one But if he be at such a distance that the Ensign over another in the Main-top-mast-shrouds, over can't well be discovered, he is then to lay his the constant Light in the Main-top, and fires two Head towards the Ship or Ships so descryed, and Guns, which are to be answered by the Flag-Ships; to brail up his low Sails, and continue hoisting and each private Ship hangs out a Light in the and lowering his Top-sails, and making a West with his Top-gallant-sails, till he is perceived by the Admiral.

11. When the Admiral would have the Vice-Admiral, or he that Commands in the second Post of the Fleet, to fend out Ships to Chafe, he hoifts a Light in the Main-top-mast-shrouds, and fires a Flag, Striped White and Red, on the Flag-staff, a Gun, which is to be answered by all the Flags; at the Fore-top-mass-head, and fires a Gun. But and every private Ship must hang out a Light in if he would have the Rear-Admiral do so, he then his Mizen-shroud.

vision that Ship is. When he would have them Stern-most Ships must Tack as fast as they can ; and

dant on the Enfign-staff, and fires a Gun : And Flag-staff at the Fore-top-mast-head, and fires a then the Leeward-most and Stern-most Ships are to Gun: Which Signal is to be made also by that Wear sist, and bring on the other Tack and less a Chase, till the Chasing Ship sees the Signal is to be made also by that gives by, or go on with an easie Sail till be comes a Chase, till the Chasing Ship sees the Signal is to be made also by that gives by, or go on with an easie Sail till be comes a Chase, till the Chasing Ship sees the Signal is to be made also by that

In Case of Springing a Leak, or any other 6. If they are lying by, or Sailing by a Wind, Difaster that disables their Ship from keeping Company, you are to hale up your Courses, and fire two Guns.

14. When any Ship would speak with the Admiral, he must spread an English Ensign from the Head of his Main or Fore-top-mast downwards on the Shrouds, lowering his Main or Fore-top-sail, and firing Guns till the Admiral observe him; And if any Ship perceives this, and judges that the Admiral doth not, that Ship must make the same Signal, and make the best of his way to acquaint the Admiral therewith, who will answer by

15. When the Admiral would have the Fleet to prepare to Anchor, he hoists an Ensign striped Red, Blue and White on the Ensign-staff, and fires a Gun; and every Flag-Ship makes the

sameSignal.

16. If he would have the Fleet Moor, he hoifts his Mizen -top-sail with the Clew-lines haled up,

and fires a Gun.

17. If he would have the Fleet Cut or Slip, he 8. When any Ship discovers Land, he is to hoist looses both his Top-sails, and fires two Guns; and then the Leeward Ships are to cut or flip first, to give room to the Weather-most to come to Sail

So if he would have any particular Ship to cut or flip, and to Chase to Windward, he makes the Signal for speaking with that Ship, hoists a Red Flag in the Mizen-Ihrouds, and fires a Gun: But if the Ship is to Chase to Leeward, he hoists a Blue Flag, as before.

18. If he would have the Fleet Exercise their Small Arms, he hoists a Red Flag on the Enfign-Staff, and fires a Gun; but if the great Guns, then he puts up a Pendant over the Red Flag.

SIGNALS by Night, to be observed at an An-

chor, in Weighing, Anchoring and Sailing.

1. When the Admiral would have the Fleet to the constant Light in the Main-top, and fires two Mizen-ihrouds.

N. B. All Guns fir'd for Signals in the Night must be fir'd on the same side, that they may make

no alteration in the Sound.

2. When he would have them Weigh, he hangs

hoists the same Signal on the Flag-staff at the Mizen-top-mast-head, and fires a Gun.

Lights on the Ensign-staff, one over another, above the constant Light in his Poop, and fires a Gun; which is to be answered by all the Flags: And which is to be answered by all the Flags. king with the Captain, and hoists a Red Flay in the Mizen-shrouds, and fires a Gun, But if to chase to Leeward, a Blue Flag; and takes in his.

The fame Signal is made by the Flag in whose Diagram of the Signal is made, the Deward-most and the fame Shin is When he mould have the same of Shin and Captain a

give over Chase, he hoists a White Flag on his the Stern-most Flag-Ship, after he is about upon the other other Tack, is to lead the Fleet, and him they are to follow, to avoid running thro' one another

in the dark.

4. When he is upon a Wind, and would have the Fleet Wear and bring to on the other Tack, he hoists up one Light at the Mizen-peek, and fires 3 Guns: which is to be answered by the Flag-Ships, and every private Ship must answer with one Light at the Mizen-peek. The Stern-most and Leeward-most Ships are to bear up so soon as the

Signal is made.

5. When he would have them in blowing Weather to lie a try, short, or a Hull, or with the Headfails braced to the Mast, he will shew 4 Lights of equal height, and fire 5 Guns; which are to be answered by the Flag-Ships, and then every private Ship must shew 4 Lights. And after this, if he would have them to make Sail, he then fires 10 Guns; which are to be answered by all the Flags, and then the Head-most and Weather-most Ships are to make Sail first

6. When the Fleet is Sailing large, or before the Wind, and the Admiral would have them bring too, and lie by with their Star-board Tacks. Aboard, he puts out 4 Lights in the Fore-shrouds: and fires 6 Guns; but if with the Lar-board Tacks Aboard, he fires 8 Guns, which are to be answered by the Flag-Ships, and every private Ship must shew 4 Lights. The Wind-most Ships must bring

too first.

7. Whenever the Admiral alters his Course, he fires I Gun (without altering his Lights) which is to be answered by all the Flag-ships.

8. If any Ship hath occasion to lie short, or by, after the Fleet has made Sail, he is to fire I Gun,

and shew 3 Lights in his Mizen-shrouds.

9. When any one first discovers Land or Danger, he is to shew as many Lights as he can, to fire I Gun, and to Tack, or bear away from it. And if any one happen to spring a Leak, or any be disabled from keeping company with the Fleet, he hangs out 2 Lights of equal height, and fires Guns till he is relieved by some Ship of the Fleet.

TO. If any one discovers a Fleet, he is to fire Guns, make false Fires, put one Light out on the Main-top, 3 on the Poop, to Steer after them, and to continue firing Guns, unless the Admiral call him off, by Steering another Course, and fire 2 or 3 Guns, for then he must follow the Admiral.

3 Guns, for then he must follow the Admiral.

11. When the Admiral Anchors he fires 2 Guns, a small space of Time one from the other, which are to be answered by the Flag-ships; and every

private Ship must shew 2 Lights.

12. When the Admiral would have the Fleet to Moor, he puts a Light on each Top-mast-head, and fires a Gun; which is to be answered by the Flag-ships, and every private Ship is to shew one

Light.

13. If he would have them lower their Yards and Top-masts, he hoists one Light upon his Enfign-staff, and fires one Gun; which is to be answered by the Flag-ships, and every private Ship must shew I Light. And when he would have them Hoist their Yards and Top-mast, he puts out 2 Lights, one under the other, in the Mizentop-mast-shrouds, and fires a Gun; which is to be answered by the Flag-ships, and each private Ship must show I Light in the Mizen-shrouds.

14. If any strange Ship he discovered coming into the Fleet, the next Ship is to endeavour to speak with her, and bring her to an Anchor, and not suffer her to pass thro' the Fleet. And it any one discovers a Fleet, and it blow so hard that he cannot come to give the Admiral notice timely, he is to hang out a great number of Lights, and to continue firing Gun after Gun, till the Admiral answers him with one.

15. When the Admiral would have the Fleet to Cut or Slip, he hangs out 4 Lights, one at each Main-yard-arm, and at each Fore-yard-arm, and fires 2 Guns; which are to be answered by the Flag-ships, and every private Ship is to shew one

Light.

SIGNALS used when a Fleet Sails in a Fog.

1. If the Admiral would have them weigh, he fires 10 Guns, which every Flag-ship is to answer.

a. To make them Tack, he fires 4 Guns; which are to be answered by the Flag-ships, and then the Leeward-most Ships, and Stern-most Ships must Tack first. And after they are about, to go with the same Sail they tack'd with, and not to lie by, expeding the Admiral to come a Head: And this is to avoid the Danger of running thro' one another in thick Weather.

3. When the Admital brings to, and lies with his Head-sails to the Mast; it with the Star-board Tack Aboard, he fires 6 Guns; but if with the Lar-board Tack Aboard, 8 Guns, which the Flag-Ships are to answer: And after this, if he makes Sail, he fires 10 Guns, which the Flag-ships must answer; and then the Head-most and Weather-

most Ships are to make Sail first.

4. If it grow thick and foggy Weather, the Admiral will continue Sailing with the fame Sail fet that he had before it grew toggy, and will fire a Gun every hour; which the Flag-ships must answer, and the private Ships must answer by firing of Muskets, beating of Drums, and ringing of Bells.

But if he be forced to make either more or less Sail than he had when the Fog begun, he will fire a Gun every half hour, that the Fleet may discern whether they come up with the Admiral, or fall a Stern of him; and the Flags and private Ships are

to answer, as before.

5. If any one difforers Danger which he can avoid by Tacking and standing from it; he is to make the Signal for tacking in a Fog; but if he should chance to strike and stick fast, he is to fire Gun after Gun, till he thinks the rest have avoided the Danger.

6. When the Admiral would have the Fleet to Anchor, he fires 2 Guns, which the Flags are to answer; and after he hath been half an hour at an Anchor, he will fire 2 Guns more, to be answered by the Flags, as before, that all the Fleet may

know it.

SIGNALS for calling Officers on Board the Admiral.

1. When the Admiral puts abroad a Union-Flag in the Mizen-shrouds, and fires a Gun, all the Captains are to come Aboard him: And if with the same Signal there be also a West made with the Ensign, then the Lieutenant of each Ship is to come on Board.

2. If

2. If an Enfign be put Aboard in the same Place, all the Masters of the Ships of War are to

come on Board the Admiral.

all the Flag-Officers are to come Aboard the Admiral. If the English Flags only, then a Standard in the Mizen-shrouds, and fire a Gun: If the Flags and Land General Officers, then the Admiral puts Aboard a Standard at Mizen-top-mast-head, and a Pendant at Mizen-peek, and fires a Gun.

4. It a Red Flag be hoisted in the Mizen-shrouds, and a Gun fir'd, then the Captains of his own Squadron are to come on Board the Admiral; and if with the same Signal there be also a West with the Ensign, a Lieuten ant of each Ship must go on Board.

5. It he hoists a White Flag as before, then the Vice-Admiral, or he that Commands in the fe-cond Post, and all the Captains of his Squadron are to go on Board the Admiral. If a Blue-Flag, &c. then the Rear-Admiral, and the Captains of his Squadron must come on Board; and if there be a West as before, the Lieutenants.

6. When a Standard is hoisted on the Ensign. staff, and a Gun fired, the Vice and Rear-Admirals must both come on Board the Admiral's Ship.

7. When the Admiral would speak with Captains of hisown Division, he will hoist a Pendant in the Mizen-peek, and fire a Gun; and if with the Lieutenants, a West is made with the Ensign, and the same Signal. For whenever he would speak with Lieutenants of any particular Ship, he makes the Signal for the Captain, and makes a Weft also with the Ensign.

8. When the Admiral would have all the Tenders in the Fleet come under his Stern and speak with him, he hoists a Flag, striped Tellow and White, at the Mizen-peek, and fires a Gun. But if he would speak with any particular Ships Tender, he makes a Signal for speaking with the Captain she tends upon, and a West with his Jack.

y. It all the Pinnaces and Barges are to come on Board, Manned and Armed, the Signal is a Pendant on the Flag-staff, housted on the Fore-topmast-head, and a Gun; and it he would have them Chase any Ship, Vessel, or Boat in View, he

hoists the Pendant, and fires 2 Guns.

10. The Signal for the Long-boats to come on Board him Mann'd and Armed, is the Pendant hoisted on the Flag-stass at the Mizen-top-masthead, and a Gun; and if he would have them Chase any Ship, Vessel, or Boat in open View, without coming on Board him, he hoists the Pendant, as aforefaid, and fires 2 Guns.

When the Admiral would have all the Boats in the Fleet come on Board him, Mann'd and Arm'd, he hoists a Pendant on the Flag-staff, both on the Fore-top-mast, and Mizen-top-mast-head, and fires i Gun; but if he would have them Chase, he hoists his Pendants, as before, and fires 2

11. When the Admiral would speak with the Victualler, or his Agent, he puts an English Enfign in the Mizen-top-most-shrouds; and when with him that hath charge of the Gunner's Stores, he will spread an Ensign at his Main-top-sail yard-arm.

SIGNALS for managing a Sea-fight. When the Admiral would have the Fleet form 3 It a Standard on the Flag-staff be hoisted at a Line of Battle, one Ship a head of another, the Mizen-top-mast-head, and a Gun fired, then he hoists an Union-flag at the Mizen-peek, and fires a Gun, and every Flag-ship does the same.

> But when they are to form a Line of Battle, one a breast of another, he hoists a Pendant with

the Union-flag, &c.

2. When he would have the Admiral of the White, or he that Commands in the Second Post, and his whole Squadron, to Tack, and endeavour to gain the Wind of the Enemy, he spreads a white Flag under the Flag at the Main-top-masthead, and fires a Gun; and when he would have the Vice-Admiral of the Blue do so, he doth the

same with a blue Flag.

If he would have the Vice-Admiral of the Red do so, he spreads a Red Flag from the Capon the Fore-top-mast-head, downward on the Backstay: If the Vice-Admiral of the Blue is to do so, he spreads a blue Flag, &c. and fires a Gun. If he would have the Rear-Admiral of the Red do so, he hoists a Red Flag at the Flag-staff at the Mizen-top-mast-head; it the Rear-Admiral of the White, a white Flag; if the Rear-Admiral of the Blue, a blue Flag, and under it a Pendant of the same Colour, with a Gun.

4. If he be to Leeward of the Fleet, or any part of it, and he would have them to bear down into his Wake or Grain, he hoists a blue Flag at the

Mizen-peek, and fires a Gun.
5. If he would be to Leeward of the Enemy, and his Fleet, or any part of it, be to Leeward of him; in order to bring these Ships into the Line, he bears down with a blue Flag at the Mizen-peek, under the Union-flag (which is the Signal for Battle) and fires a Gun; and then those Ships which are to Leeward of him, must endeavour to get into his Wake or Grain, according to their Station in the Line of Battle.

6. When the Fleet is Sailing before the Wind, and he would have him that Commands in the second Post, and the Ships of the Star-board Quarter to clap by the Wind, and come to the Star-board Tack, he hoists a Red Flag on the Mizen-top-mast-head; but a Blue one, if he would have Ships of the Lar-board Quarter come to the

Lar-board-tack, with a Gun.

7. If the Van are to Tack first, he spreads the Union-flag at the Flag-staff on the Fore-top-mast-head, and fires a Gun, if the Red Flag be not abroad; but if it be, then he lowers the Fore-topsails a little, and the Union-flag is spread from the Cap of the Fore-top-mast downwards; and every Flag-ship doth the same.

8. If the Rear be to Tack first, he hoists the Union-flag on the Flag-staff at the Mizen-topmast-head, and fires a Gun, which all the Flag-

ships are to answer.

9. If all the Flag-ships are to come into his Wake or Grain, he hoists a Red Flag at his Mizen. peck, and fires a Gun, and all the Flag-ships must do the same.

10. If he would have him that Commands in the fecond Post of his Squadron to make more Sail (tho' he himself shorten Sail) he hoists a white Flag on the Enlign-staff: But if he that Commands in the third Post be to do so, he hoists a Blue Flag at the same places, and fires a Gun, and all the Flag-ships must make the same Sig-

11. When ever he hoists a Red Flag on the Flagstaff at the Fore-top-mast-head, and fires a Gun, every Ship in the Fleet must use their utmost endeavour to engage the Enemy, in the Order prescribed them.

12. When he hoists a white Flag at his Mizenpeek, and fires a Gun, then all the small Frigats of his Squadron that are not of the Line of Bat-

tle, are to come under the Stern.

13. If the Fleet be Sailing by a Wind in the Line of Battle, and the Admiral would have them brace their Head-sails to the Mast, he hoists up a yellow Flag on the Flag-staff, at the Mizen-topmast-head, and fires a Gun, which the Flag-ships are to answer, and then the Ships in the Rear must brace first.

14. After this, if he would have them fall their Head-sails and stand on, he hoists a yellow Flag on the Flag-staff at the Fore-top-mast-head, and fires a Gun; which the Flag-ships must answer, and then the Ships in the Van must fall first, and stand on. If when this Signal is made, the Red Flag at the Fore-top-mast-head be abroad, he fpreads the Yellow Flag under the Red.

15. If the Fleets being near one another, the Admiral would have all our Ships to Tack together, the sooner to lie in a posture of Engaging the Enemy, he hoists a Union-flag on the Flag-staves at the Fore and Mizen-top-mast-heads,

Fleet are to do the same.

16. The Fleet being in a Line of Battle, if he would have the Ship that leads the Van, hoist, lower, set, or hawl up any of his Sails, the Admiral spreads a Yellow Flag under that at his Maintop-mast-head, and fires a Gun; which Signal the Flag-shipsare to answer, and then the Admiral will hoist, lower, set, or hawl up the Sail, which he would have the Ship that leads the Van do; which is to be answered by the Flag-ships of the Fleet.

17. When the Enemy runs, and he would have the whole Fleet follow them, he makes all the Sail he can after them himfolf, takes down the Signal for the Line of Battle, and fires 2 Guns out of his Fore-chase, which the Flag-ships answer, and then every Ship is to endeavour to come up

and fires a Gun.

19. If he would have the Red Squadron draw into a Line of Battle, one à breast of another, he puts abroad a Flag, striped Red and White on the Flag-staff, at the Main-top-mast-head, with a Pendant under it, and fires a Gun: If the white or fecond Squadron are to do so, the Flag is striped Red, White and Blue; if the Blue or third Squadron are to do so, the Flag is a Genoueze Ensign and Pendant. But if they are to draw into a Line of Battle, one a Head of another, the same Signals are made without a Pendant.

20. If they are to draw into a Line of Battle, one a Stern of another, with a large Wind, and he would have the Leaders go with the Star-board-Tacks Aboard by the Wind, he hoists a Red and White Flag at the Mizen-peek, and fires a Gun: But if they should go with the Lar-board-tacks or pounded with Charcoal only.

Aboard by the Wind, he hoists a Genoueze Flag at the same Place; which Signals must be like others, answered by the Flag-ships.

SIGNET, is one of the King's Seals, wherewith his private Letters are Sealed, and is always in the Custody of the King's Secretaries; and there are 4 Clerks of the Signet Office always attending

SILVER, of the ways of Smelting and Refining of Silver, I find these Accounts. Mr. Ray, at the end of his Catalogue of English Words about the Silver Mines in Cardigansbire

in Wales.

The Mine first beaten into small Pieces, is brought from the Mine to the Smelting-house, and there melted with black and white Coal, i. e. with Charcoal and Wood flit into small Pieces, and dried in a Kiln for that Purpose: And they use both Wood and Coal, because the Coal alone makes too violent a Fire, and the Wood alone too gentle. After the Fire is made, the Mine is cast on the Coals, and so again, Mine and Coals interchangeably. The Mine, when melted, runs down into the Sump, which is a round Pit of Stone lined with Clay within; thence 'tis laden out and cast into square Bars with smaller ends, fit to

lift and carry them by. These Bars they bring to the Resining Furnace, which is covered with a thick Cap of Stone bound about with Iron, and moveable, that so they may lift it up, and make the Test at the Bottom anew and fires a Gun, and all the Flag-ships in the (as they do at every Refining.) In the Middle of the Cap there is a Hole, in which the Bar of Silver hangs in Iron-slings above the Furnace, that so it may be let down by degrees as it melts off. Besides this Hole, they have another in the side of the Furnace, Parallel to the Horizon, and bottom'd with Iron; at which Hole they thrust in another Bar. The Test is of an Oval figure, and fits at the bottom of the Furnace. The Fire is put in by the side of the Bellows, when the Furnace is come to a true Temper of Heat, the Lead converted into Litharge, is blown off by the Bellows, the Silver fubsiding to the bottom of the Test.

As foon as all the Glut (as they call it) of Litharge is blown off, the Silver in the bottom of the Cuple or Test grows cold, and the same Degrees of Heat will not keep it melted, as before. The with, and Board the Enemy.

18. When he would have the Chase given over, fesupinto Branches (saith Mr. Ray, but I question he hoists a white Flag at the Fore-top-mast-head, his Information as to this Point.) The Test is made of Marrow-Bones, burnt to small Pieces, then powdered and made into a Past with Water. The Test is about a foot thick, laid in Iron: After the Cake of Silver is taken out, that Part of the Test which is discoloured, they mingle with new Ore to be melted; the rest they pound and

powder, and use again for another Test.

The Litharge is brought to a Reducing Furnace, and there with Charcoal only melted into Lead. The Litharge is cast upon the Charcoal in the Bing of the Furnace; and as the Charcoal burns away, and the Litharge melts, more Charcoal is thrown on, and Litherge put upon it, as at first Smelting

Another Furnace they have, which they call an Almond Furnace, in which they melt the Slugs (or Refuse of the Litharge) not stamped

The Slugs or Cynders of the first Smelting, they beat small with great Stamps, lifted up by a Wheel moved by Water, and falling down by their own Weight. First they are stamped with their own Weight. First they are stamped with dry Stamps, then sifted with an Iron-sieve in Water. That which lies at the bottom of the Sieve is returned to the Smelting-furnace, without more ado; that which swims over the Sieve is beaten with wet Stamps.

What hath pass'd thro' the Sieve, and also what after being beaten with the wet Stamps, passes thro' a fine Grate, or Strainer of Iron, goeth to the Buddle; which is a Vessel made like a shallow Tumbrel, and stands a little shelving.

On this the Matter is laid, and Water runs constantly over it, the Matter being moved to and fro with an Iron-rake; by which means the Earth and Dross being carried off by the Water, the Me-

tal remains behind.

That which is thus Buddled, they lue with a thick Hair-sieve, close wrought in a Tub of Water, rolling the Sieve about, and inclining it this way and that with their Hands: The light Part which swims at top of the Sieve, or rather over it, is returned again to the Buddle; and that which subsides goes to the Furnace to be Smelted

They have also an Assay Furnace, wherewith they try the Value of the Metal, of what Proporties the Silver: which they do tion the Lead bears to the Silver; which they do by cutting off a Piece from every Bar, and melting it in a small Cupel: First they weigh the Piece cut off, and then after the Lead is separated, the A Tun of Metal sometimes will yield 10, 15, and if rich, 20 Pound Weight of Silver.

All Lead Ore digg'd in England, hath a Proportion of Silver mixt with it; but some so lit-tle, that it will not quit cost to Refine it.

At the first Smelting they mingle several forts of Ore together, some Richer, some Poorer, else they will not melt so kindly. The Silver made here is exceeding good and fine. These fix Mountains in Cardigansbire, not far from one another, afford Silver Ore; Talabout, Geginnon, Comsomlack, Gedarren, Bromefloid and Cummer. when Mr. Ray was there, they digg'd only at Talabout.

Their Way of Digging and Collecting the Ore, was thus: They link a Perpendicular square Hole, or Shaft, the sides of which they strengthen round from top to bottom with Wood, that the Earth may not fall in. The Tranverse Pieces of Wood, they call Stemples; and on these, catching hold with their Hands and Feet, they descend without using any Rope: They dig the Ore thus, one holds a little Pique, or Punch of Iron, having a long Handle of Wood, which they call a Gad; and another with a great Iron-sledge drives it into the Vein.

The Vein of Metal runs East and West; it rises North, and dips or flopes to the South. There is a white Fluor about the Vein, which they call Spar, and a black one, which they call Blinds: This last covers the Vein of Ore; so that when it appears, they are sure to find Ore.

There are several Silver Mines at Schemuitz in

Hungary, the chiefest of which are Windschaht and Irinity. Of which Dr. Edward Brown gives us

kept open with Under-work at a great Expence. Much of this Minebeing in an Earthy Soil, its Ore is much esteemed. Diverse Veins lie North, and others run to the North-east. The blackish Ore is esteemed the best; much of it hath a mixture of a yellow shining Substance, called Marchaste; which if not in too great quantity; disposes the Ore to Fluidity, and makes it melt and run the better. There is often found growing to the Ore a red Substance, called Cinnaher; this Substance, ground with Oil, makes a Vermillion equal to, if not exceeding that Cinnabar which is made by Sublimation of Mercury and Sulphur.

An hundred Pound Weight of Ore fometimes

yields but half an Ounce, or an Ounce of Silver;

fometimes 2, 3, 4, 5 and 20 Ounces.

There is an Officer in the Works, whom they call the Probeirer or Essager, who proves the Richness of the Ore, thus: Of all forts of Ore he takes the same Quantity, and having first dried, burned, and powdred them, then he gives an equal Proportion of Lead to all, melteth and purifieth them; and then by exact Scales he takes notice of the Proportion between the Ore and the Metal contained in it, and reports it to those concerned in the great Melting-furnaces.

If the Ore be found to hold 2 Ounces and a half, or more of Silver in an 100 Pound Weight, they ordinarily melt it, without any previous Preparation by the help of Iron Stone (which, by the by. is not Iron Ore, but a Stone found thereabouts, of which the Livered-colour is the best.) Kys, (which is a fort of *Pyrites*) and *Slacken*, (a Scum or Lake taken off the Top of the Pan, into which the melted Mineral runs, and is a Substance made out of the former, melted by Fusion) which are

thrown with it into the Melting-furnace.

If the Ore be poorer, holding but 2 Ounces in 100 Pound Weight, or less: Then 'tis first pounded and wash'd, till it become richer, or hath a greater Proportion of Metal, with respect to the Ore, much of the Earthy Parts being washed away. Then 'tis thrown into the Furnace with the former Materials; and the Marchasite, which remains still with it, as finking always to the bottom with the Silver in the Walb-works, helps

to quicken the Fusion of the Ore.

Whatever is melted in the Melting-furnace, is let out thro' an hole at the bottom thereof into the Pan, which is placed in the Earth before it. And thus exposed, it immediately acquires an hard Scum, Dross, Loaf or Cake; which being taken off from the Top, the Metal remaining becomes the purer; to which is added Lead, and after some time the melted Metal is taken out. Then being again melted in the Driving furnace (as they call it) the Lead, or what elfe remains mixt with the Silver is driver off by the Blast of two great Bellows, and runs over in the form of Litharge. That which first comes over is the White, and that which is last, being longer in the Fire, is Red; the former is called Litharge of Silver, the last of Gold; but are both blown off the same Metal.

Most of this Schemnitz Silver Ore holds some Gold, which is separated from the Silver by Granulation and Dissolution in Aqua Fortis.

Hungary, the chiefest of which are Windschaht and Trinity. Of which Dr. Edward Brown gives us this Account in Philosophical Transactions, No. 58. Trinity Mines are 70 Fathom deep, built and fo as that it can't be forced from its Impuri-

ties by the violent way of Melting; tho' Lead, and even Artificial Salts or Fluxes be added: In this Case the Use of Quicksilver hath been found most advantageous. The way of applying it is

They Calcine the Ore, first broken into small pieces, in a Reverberatory Oven; but with a moderate Fire for fear of Fusion, and driving away into the Airpart of the Metal. This Calcination frees the Mineral from fuch Mixtures as would hinder the Power of the Quickfilver upon it, and also renders the Ore more tractable and pliant under the Milstone; where 'tis reduced to a fine Powder, before the Application of the Mercury upon it. For the Ore being Ground, Calcined, Powder'd, and finely fifted, they divide it into feveral heaps, and then by leffer Effays they find how much Silver is contained in each heap; where tis very ordinary to find not above 6 Ounces in 100 Pound Weight, sometimes 12; but if it arises to 18, 'tis esteemed a very rich Vein ! Yet sometimes there are great Masses found of pure Silver, which they call Virgin Metal.

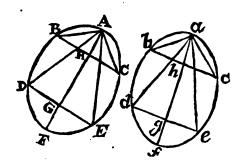
Then proportionable to the quantity of Silver in

each heap, they besprinkle them with Quicksilver, and that not all at once, but at feveral times, flir-ring the Ore up and down. If the Mercury give Signs of its being Tocado (as they call it) i. e. if it appear mortified; not in small and clear Spherical Figures (which is a good Prognostick) but in the form of long Worms, of a wan, pale, dark and Leadish Colour (which indicates that the Ore abounds with Lead, &c.) it is cured by certain Magistrals, which have for their Basis or Master Ingredient, Calcined Copper mingled with Salt.

The heaps of Ore being thus mingled with Quickfilver, are often stirred about, the better to incorporate the Mercury and Silver. They feem to have only Conjectural Signs to know when the Quickfilver hath done its Office in separating the Silver from these Heterogeneal Substances; which occasions by its uncertainty great Losses, e-specially when they Work this way on Gold. But when by the Colour of the Mercury, Coagulated by the Silver in clear Massy Lumps, they conje-dure the Work done, they wash it by means of three Veffels, standing in order, one under another: Dust of the Hoterogeneous Matter that imbody not with the Mercury, is carried away together with the Water into the other Vessels, and from thence is quite thrown out by the continual Current of the Water: While the Silver in clotted Lumps (called Pella's) is by the Weight of the Mercury carried down to the bottom of the Tubs. Then the Mercury, with the Silver is taken out of the Vessels, and diligently squeezed in strong coarse Linen-cloths, and even with Strokes of a Beetle, that the Quickfilver may be separated as much as may be from the Silver. And this Mass is afterwards reduced in Molds of the shape of the Indian Pine-apple, into a Piramidal or Conical Figure, which they call Pineas de la Plata: They are thus fashioned for the easier placing them round the edges of a great Earthen, Vessel of the form of a blind, Alembick: Round about the top of which a Fire is made, and then all the rest of the Mercury forthwith abandons the Silver and falls to the bottom; from whence its recovered and kept for the like use again.

The Silver last of all is melted down with Liga, as 'tis called, which the King of Spain allows, by which he returns to the People in Copper the fifth part, which they allow him of all the Silver. Philog. Trans. No. 41.

SIMILAR Light, according to Sir If. Newton, is such, whose Rays are all equally Refrangible; and this he calls also Simple and Homogeneal.



SIMILAR Sections in Conicks, are fuch whose Diameters make equal Angles with their Ordinates; and also wherethe Triangles ADE, ABC, nates; and also wherethe I riangles ade, abc, and the ate Similar to the Triangles ade, bc. Their Diame-Bases DE to BC; as de, bc. Their Di ters also, as AF, and a f are called Similar.

SIMPLE Light. See Homogeneal,

SINCERITY, in Ethicks, is defined to be that Virtue, Power, or Act of the Mind, by which the Will is determined to follow and perform that which the Intellect determines to be best and most proper to be done in all Cases, and to do it because it is so.

SINE-CURES, are Ecclesiastical Benefices without Cure of Souls. No Church where there is but one Incumbent, can properly be a Sine-cure: And tho' the Church being down, or the Parish being become destitute of Parishioners, the Incumbent may thereby be necessarily acquitted from the actual Performance of Publick Duty, yet he is still So that the Matter in the first and highest, being under an Obligation to do it, whenever a Church worked and stirred about with a Molinet, all the shall be built, and there are a competent number of Inhabitants. And in the mean while, if the Church be Presentative, as most such Churches are, the Incumbent is Instituted in Curam Animarum; and fuch Benefices are rather Depopulations than Sine-cures, and 'twill be proper for the new Incumbent to read the 30 Articles, and the Liturgy in the Church-yard, &c. and to do what other Incumbents usually do. But a Rectory or a Portion of it may properly be a Sine-cure, if there be a Vicar Endowed, and then it doth not come within the Statute of Pluralities of 21 H. 8. c. 13. Which declares that he Parsonage which both a Vicar declares that no Parsonage which hath a Vicar Endowed, shall be comprehended, &c. So that here no Dispensation is necessary to hold this Sinecure with a former Living. Nor need he read the Articles or Divine Service, as required by 13 Eliz. c. 12. which extends only to a Benefice with Cure. A Sine-cure Donative wants no Institution and Induction. But one Presentative must have both; especially if it consist in Glebe and Tithes, and not in a Portion of Money. But the Institution must not run in Curam Animarum, but in L111 RectoRectoriam sive Portionem Rectoria de A. B. &c. By the abovementioned Stat. 21 H. 8. not only Prebends and Rectories, with Vicarages Endowed, but Deanries and Archdeaconries are declared to be Benefices without Cure.

SINES on the Plain Scale, Gunter's Scale, and almost all Scales have a Line, called the Line of Sines. This on the Sector is double, one on each Leg, and hath there many excellent Ules; some of which are these:

1. The Radius of a Circle being known to find the Sine of any Arch or Angle.

Fit in the Radius between on and go in the Lines of Sines, and the Parallel distance between the Numbers of Degrees, answering to any Works or Angles, will give their Sines. Thus the Parallel Angles, will give their Sines. Distance between 60, 30, 45, Ge. will give the Sines of 60°, 30°. 45°. Ge. And vice versa, from the Sine given you may find the Radius, by fitting the Sine into the Sector Parallel-wife, between the Numbers expressing its Degrees. For then the Parallel Distance between 90 and 90, will be the Radius fought.

2. The Radius of a Circle being given, and any Right Line less than it, to know of what Ark it

may be the Sign.

Apply in the Radius between 90 and 90, in the Lines of Sines, and taking the Length of the Line in the Compasses, carry it Parallel to the Radius, till it fall exactly on like Sines on each fide; and the Degrees and Minutes where it fits, shall give you the Sine it represents.

SINUS, in the Dura Mater, is that ftrong and thick Membrane which covers all the Cavity of the Cranium. There are several eminent Sinus's or Chanels, which run 'between its External and Internal Membrane: Of these four principal ones are usually described; as 1. The Sinus Longitudinalis, 2 and 3 Sinus Latereles; and 4 Sines Vertebralis. (Keil, p. 133.)

SI Recognoscant, is a Writthat lies for a Creditor against his Debtor, for Money Numbred, and owned before the Sheriff in the County-court by the Debtor, to be due to the Creditor.

SIXAIN, is an ancient Order of Battle for 6 Battalions, which supposing them all in a Line, is formed thus: The 2d and 5th Battalions advance and make the Van. The 1st and 6th fall into the Rear; leaving the 3d and 4th to Form the main Body. Each Battalion should have a Squadron on its Right, and another on its Left. Any Number of Battalions which are Multiple of 6, may be drawn up by this Order, i.e. 12 Battalions may be put into 2 Sixains, and 18 Battalions into 3, &c.

SIZING, is a curious way of Drefing the Tin Ore, after it comes from the Launder of the Stamping-mill; which is by fifting it thro' an Hair-Sieve, casting back the remainder in the Sieve in-to the Tails, to be Trambled over again. See Buddle and Tin

which are enclosed in two or three Covers of a Pyramidal Figure. Between these Papilla are an infinite number of Holes, which are nothing but the Orifices of the Excretory Vessels of the Miliary Glands underneath.

Secondly, There appears a Web of Nervous Fibres, and other Vessels, differently interwoven: This is always covered with a Mucous Substance, ferving to support and moisten the Papilla Pyrami-And this is the Parenchyma, or that part of the Skin that Parchment is made of.

The third part is an infinite number of Miliary Glands, about whom there is much Fat usually: These Glands separate the Matter by Sweat and Insensible Perspiration. Each Gland receives a Nerve and Artery, and sends out a Vein, and an Excretory Duck; which last passes thro' the other two Parts to the Cuticula, in order to moisten it and the Papilla Pyramidales, lest they should be so dry as to hinder the Sense of Feeling; and also to dif-

charge that Matter out of the Body.

The use of the Skin is to cover and wrap up all the Parts of the Body, to be the Organ of Touching or Feeling, and to be the Emunctory of the whole Body. For thro'the Glandsof the Skin, pass not only such Particles of the Vessels, as decay, by reason of the continual Motion of the Blood, but likewise the greatest part of the Liquors which we drink; which having perform'd part of their Office, in conveying the Aliments into the Blood, are in the next place to dissolve the Saline and Terrestrial Particles to be carried off thro the Glands of the Skin and Kidneys. Sanctorius computes, that about 50 Ounces a Day are thus carried off thro' the Cutaneous Glands: So that if a Man's Body be supposed to weigh 160 Pound in 51 Days he may perspire a Quantity equal to the weight of his whole Body. Keil's Anato-

Above the Cutis or thick Skin of the Body lies the Cuticula or Scarf-skin, and is composed of several Plates of small Scales, which cover one another, more or less, or lie thicker, according as it is thicker in one part of the Boey than in another: Between these Scales the Excretory Duck of the Miliary-Glands of the Cutis, or thick Skin, open. Lewenhoeck reckons, that round about one Cuticular 500 fuch Ducts may lie, and that a Grain of Sand will cover 250 of these Scales: So that one Grain of Sand will cover 125000 Orifices of these little Ducts; and yet into every one of these Miliary Glands an Artery, Vein and Nerve do certainly enter. These Glands secent the Sweat, and what goes off by infensible Perspiration: And they must be very many in number, fince, Sanctorius observes, 15 Ounces of a Fluid Matter passes in 24 hours time. Next under the Scarf-Skin liethe Papilla Pyramidales, which also are prodigiously numerous, being the Extremities of all the Nerves of the Skin, and do more immediate ately serve for the Sense of Feeling, and to cond vey the Impulse received, by means of the Nerves to the Brain. About these the Nerves and all other Vessels make a fine Web, all covered over with a Mucous Substance, to moisten these Papil-SKIN. As foon as the Cuticula or Scarf-skin is feparated from the Cutic or true Skin of a humane. Dulls up to the Surface of the Scarf-skin on the Cutic or true Skin of a humane. Body, there are these three parts appear first, an which there are many Parallel Lines, and these infinite number of Papilla Pyramidales, which are tracked by others, and in each Intersection there the ends of all the Nerves of the Skin, each of is an Hair usually placed. The Scales of the

Scarf-skin defend the Orifices of the Excretory Ducts of the Miliary Glands, and hinder Objects from making too exquisite and painful an Impresfion upon the Nerves, and so to save them from External Injuries. The Skin itself is designed to External Injuries. enwrap the whole Body, and to sustain the Pa-pille Pyramidales in their Places, and the Miliasy Glands from being disordered; also to receive the Impression of external Objects, and to be the Organ of the Sense of Touching and Feeling.

SLAM; a Term used in the Alum-Works:

which fee.

SLEDGE; is a large Smith's Hammer to be used with both Hands: Of this there are two forts, The Uphand Sledge, which is used by under Workmen, when the Work is not of the largest fort: This is used with both the Hands before, and Thus, if A and B be the fides of 2 Cubes to be they seldom raise it higher than their Head. But the other, which is called the About-Sledge, and which is used for battering or drawing out the largest Work, is held by the handle with both Hands, and swung round over their Heads, at their Arms-end, to strike as hard a Blow as they can. will be equal to SI.OOP, is a Vessel of the Shallop-kind. In in Substraction.

our Navy such attend upon the Men of War. They are usually about 60 Tun, and carry about 30

Men

SMACK, Smaka in Latin, is a small Vessel with but one Mast. Sometimes such are employed as Tenders on a Man of War, and they are also

used for Fishing upon the Coasts.

SMOK E-farthings, the Pentecostals, or Custo-mary Oblations offered by the Inhabitants within mary Oblations offered by the Inhabitants within gle, take the Distance between 8 and 8, and any Diocess, when they made their Processions to that shall give you B, suppose the former of the the Mother or Cathedral Church, and came by degrees into an annual standing Rent, called Smokefarthings.

SOFITTO, is the Italian Term in Architecture, for the Eaves of the Corona of the Capital

of a Column.

SOLIDS: there are usually placed on the Sector 2 Lines (one on each Leg) which are called by Gunter very properly, the Lines of Solids. These are graduated, either by finding 2 mean Proportionals between the whole fide, and each 1000 part of the like side, all of them cutting the same 2 Right Lines; and then the former of the 2 Lines so cut, shall contain the Divisions required. Or Apply over then 18 between 27 and 27 in the Line the Lines of Solids may be made out of the Line of Solids, and keeping the Sector at that Angle; this is the readiest way; for the Roots taken out the Lines of Equal Parts, shall give the Cubes in the Lines of Solids, c. gr. To inscribe the Place of 125 in the Line of Solids, affix 12 Cyphers to it, and then extract the Cubick Root, which will be and then extract the Cubick Root, which will be 50000; and that taken out of the Line of Lines, will find the Point of 125 in the Line of Solids, &c.

The Use of the Lines of Solids.

1. To find the Proportion between two or more

Similar Solids.

In the Sphere, in regular Parallels, and other like Bodies, whose Sides adjoining to the equal Angles are proportional; proceed thus: Take one
Root, &c. Wherefore the Line of Solids is diviof the Sides of the greater or greatest Solid, and ded first into 1000 unequal Parts: And thereopen the Sector to it in the Points of 10 and 10, in the Line of Solids: And then taking the like Sides of the lesser Solids severally, and carrying

longing to those Points, will express the Proportions to 1000; that is, the Solids will be to each other as these Numbers are to 1000

2. To Augment or 1 iminish a Solid in a given

Ratio; as suppose in that of 2 to 3.

Open the Sector to the side of the Solid given in the Points 2 of the Number given; and then keeping it at that Angle, the parallel Distance between 3 and 3, the Points of the Number required, shall give the like fide of a Solid fimilar to the former, and in the Ratio required.

3. To Add or Substract one Solid to, or from

Find the Ratio between them (by Prob. 1.) and then Add or Substract those Proportions, and accordingly augment or diminish (by the precedent.) added or substracted; I first find the Proportion of A to B to be, suppose, as 100 to 10, or as 5 to 2 3 then adding 5 to 2, it makes 7: wherefore I augment the side A, in the Ratio of 5 to 7, which will give a new side, as C, on which a Cube being made, will be equal to them both. Proceed vice versa,

4. To find 2 Mean Proportionals between 2 gi-

ven Lines; as suppose between A and D.
First find (by the Line of Lines) the Ratio between the 2 given Lines, which are the Extreams, and let that be in Numbers as 27 to 8; and then open the Line of Solids on the Sector, so that the greater Extream A, may be applied in the Points 27 and 27. Then keeping the Sector at that An-2 Means. Next, apply that Mean B over in the Line of Solids on the Points 27 and 27, and then the parallel Distance between 8 and 8 will give you C, the other Mean fought.

5. To find 2 Mean Proportionals between 2 Num-

bers given: Suppose between 27 and 8.

Reckon 27 and 8 on both fides in the Lines of Solids from the Centre. Then taking 27 from the Centre also in the Line of Lines, put it over in the Line of Solids in the Points 27 and 27. So shall the parallel Distance between 8 and 8 in that Line, reckoned in the Line of Lines from the Centre, give 18, the former of the 2 Means fought.

In the Extraction of the Cube Root, you must point from the Right-hand towards the Left, the first, and then every third Place; and then there will be as many Places in the Root, as there are fuch Points over the Cube Number given. Whereore if the Number be under 1000, the Root can consist but of one Figure. If less than 100000, it can confult but of 2 Places; and if less than fore, if the Number given be greater than 1000, the first Division of the Line, which before signified but one, will now stand for 1000, &c. as in them parallel to the former, till the Feet of the the Line of Numbers. By this means, if the last Compasses stay in like Points; the Numbers be- Point over a Cubick Number, fall on the last Fi-Ddddd

gure to the Left-hand, the Number given shall be reckoned on the Line of Solids, from 1 to 10, and the first Figure of the Root will be either 1 or 2. But if the Point fall on the last Figure but one, the Number given must be accounted in the middle of the Line of Solids, between 10 and 100, and the first Figure of the Root will be always either there is a Solution of this Problem, of finding the 3, or 4. And if the last Point stand over the last Figure but two, then the Number given shall be accounted at the end of the Line of Solids, between 100 and 100.

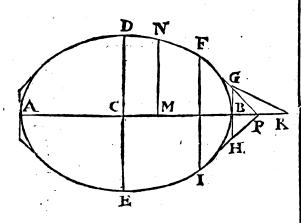
This being premised, the Extraction of the Cube Root will be easy, without opening the Sector: Set one Foot in the Sector, and extend the IA, from I towards X. other to the Point representing the Numbers. That Distance will reach in the Line of Lines

from the Center to the Root.

Thus the nearest Root of 8490000 is about 204 of 8490000 — 439 of 849000000

And the Extent from the Centre of the Line of Lines to any Number for a Root, will reach in the Solids from the Centre to the Cube.

SOLID of least Resistance, Sir Isaac Newton, in his Principia, p. 327. shews, that if



there be a Curve Figure, as DNFB, of fuch a nature, as that from any Point, as N, taken in its Circumference, a Perpendicular be let fall to the Axis, as NM: And if from a given Point, as G, the Right Line GR, be drawn parallel to a Tangent to the Curve in that Point; and also if the Axis being produced till GR cut

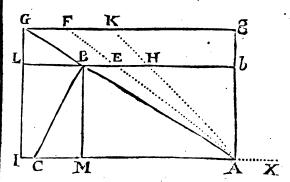
it, it then be, as MN. GR:: GR . 4BRx

Then the Solid, which may be generated by the Revolution of this Curve round its Axis AB, when moved most swiftly in a rare and elastick Medium. shall meet with less Resistance from the Medium, than any Circular Solid whatfoever, described af-ter the same manner, and whose Length and Breadth are the same.

After this, in the Year 1629, M. le Marquis de L'Hospital, produced an easy Method of finding a round Solid, which being placed in a Fluid, whose Parts are at rest, shall, when moved in that Fluid parallel to its Axis, meet with less Resistance from the Medium, than any Solid whatever, whose Length and Breadth are the same, and which shall be moved with the same Velocity.

And this he doth by finding a Curve, which revolving round its Axis, shall generate the Surface of fuch a Solid. See Memoires de l'Academ. Royale des Sciences, 1699. In the latter end of the Year 1700, Mr. John Craig sent to the Publisher of the Philosophical Transact. a Latin Letter, in which Solid of least Resistance. (See Philos. Trans. No. 268) and which is introduced by this Lemma.

To find the Ratio between the Resistance of the Right Angled Triangle AIG, and the Rectangle AIGB, circumscribing it, when each is moved in a Fluid, according to the Direction of the Line



From any Point, as B, draw the right Line BG, perpendicular to the Diagonal GA, Bb parallel to AI, and also BM normal to AI; then take in Bb, bH= CM^{*}

BC and bE=BC, and thro' the Points H, E, let the right Lines HA, EA, be produced till

they cut Gg in k and in F.

Then I fay, that the Resistance of the A AIG, is to the Resistance of the Rectangle AIG, as the Area of the Triangle AIG, is to the Area of AFg, and the Refistance in any part of the Line AG, is to the Resistance in the corresponding part of the Line Ag (suppose in AB and Ah, &c.):: as the Area AHB, to the Area AEB. The Demonstration of this depends on a general Theorem, which I did very easily deduce from the 35 Prop. of Sir Is. Newton's Princip. p.

Cor. 1. Let BG, and hg, be infinitely small Parts of the Lines AG, and Ag, and produce bB to L; then I say, that the Resistance in BG, (which let us call e) is to the Resistance in bg,

(which call E) as GL^2 is to GB^2

For e. E:: KHbg. FEbg; that is, e. E:: bg x b H. bg x b E (by the preceeding Lemma) CM. wherefore e. E :: bH. bE. (that is) e. E :: BC

BC. (by the Construction of that Lemma) wherefore e. E:: CM². BC². But CM². BC²:: GL². GB², (from the similar Triangles BMC, GLB)

wherefore e. E:: GL². GG². Q.E.D.

Cor. 2. The Resistance against the infinitely small part GB, is equal to the Cube of the Line GL, divided by the Square of the Line GB. For if all the infinitely small Parts of the Line Ag, (as bg, Ec.) be supposed equal; then the Resistance in by might be expressed by bg: that is, E=bg, and therefore E=GL. Wherefore, by Cor. 1. e. GL::

GL: GL². GB². wherefore e= Q.E.D.

Cor.

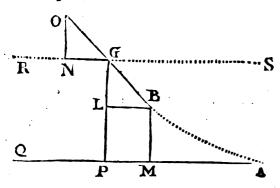
Cor. 2. Let r be Radius, and c the Circumfe rence of any Circle; I say, the Resistance against the Conical Surface, generated by the Rotation of the Lineola G B, round about A I, is equal to the Product of $\frac{c \times BM}{r}$ into $\frac{GL^3}{GB^2}$: for the Re-

fistance against that Conick Surface, is equal to all the Resistances against the Lineola G B; that is, to all the e. That is, 'tis equal to the Circumference of the Circle whose Radius is B M, multiplied by ϵ . That is, the Resistance against that Conick Surface, is equal to $\frac{c \times BM}{r} \times e$. wherefore

by Cor. 2. it is equal to $\frac{c \times BM}{r} \times \frac{GL^4}{BG^2}$ Q. E. D.

Then follows the Problem proposed, which is this:

Problem, To find the Curve, by whose Rotation round an Axis, a round Solid shall be produced, which, supposing to be moved in a Fluid, according to the Direction of the said Axis, shall suffer the least possible Resistance in that Medium.



Suppose O G, G B, two infinitely small Parts in the Curve required, by whose Rotation round the Axis A Q, the Solid of least Resistance is ge-nerated. Let B M, G B be drawn at Right Angles to AQ, and draw BL parallel to AQ, and ON parallel to BM. Tis then plain, that $c \times BM \times GL^3$ is the Resistance against the Surface generated by the Rotation of the Lincola GB, about the Axis AQ; and that $\frac{c \times GP \times ON^3}{r \times OG^2}$

is the Refistance against that generated in like manner by OG, from Cor. 3. of the preceding Lemma. Now both these Resistances taken together, must be the least possible: Wherefore

 $\frac{c \times BM \times GL}{r \times GB^{2}} + \frac{c \times GP \times ON^{2}}{r \times OG^{2}}$ - == a Minimum,

or to the least possible Resistance. And consequently in the Line R S, (which must be drawn parallel to A Q; so that O N = GL) the Point G is to be Investigated, where this will happen. And supposing O and B sixed Points, this will easily be sound by the Meshed of Maximis Sd. Minimus Sd. Minim be found by the Method de Maximis & Minimis. And producing the Calculus, it will come

 $\frac{BM \times BL}{BG^4} = \frac{GP \times NG}{OG^2}.$ at last to stand thus; -

Wherefore tis plain, that $\frac{BM \times BL}{BG^4}$ is an invari-

able Quantity. So that if the Abscissa AM, be called x, and the Ordinate BM = y, then BLwill be = x and GL = y (which in this whole Calculus, I suppose invariable) whereof BG:

 $x \times y y^*$ will be an invaria $xx \times yy$. Wherefore .

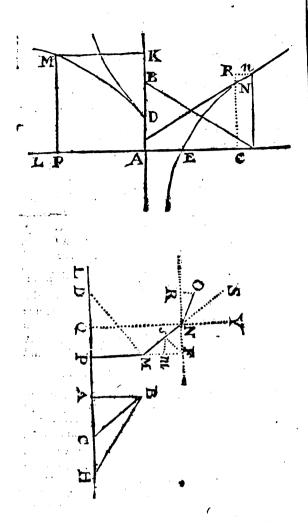
ble Quantity. Let then a be an invariable Line, and then, according to the Laws of Homogeneals, it

will be $\frac{yx}{xx \times yy^2} = \frac{a}{y^4}$ as was discovered by the famous L'Hospital, and James Bernouilli. Q.E.I. SOLID of least Resistance. The wonderful Sir Is. Newton, in his excellent Treatise, de Princip. If. Newton, in his excellent Treatile, ae Princip. Philof. Mathem. l. 2. Sect. 7. gives us, in Prop. 35. and Schol. of Lib. 2. the Property of a Curve, as DM; which being supposed to revolve about its Axis AL, shall generate a Solid, whose Re-fistance, when moved in any Fluid whose Particles are at rest, according to the Direction of the said Axis, from L to A, shall be the least possible: that is, the Solid shall meet with less Resistance from the Fluid, than any other generated by any other Curve described to the same Axis AL, and passing thro' the given Points D M.

The Excellence and Usefulness of this Problem, especially as to the Figure of the Bodies of Ships, did engage several eminent Mathematicians to consider it fully, and (because the great Author had concealed his own) to communicate several Methods of Investigation of this Curve: As the Noble Marquis de L'Hospital, Mr. John Bernouilli, Mr. J. Craig, and M. Fatio, have already done. From whence the Industrious Mr. Hayes, in his Book of Fluxions, p. 147. extracts the fol-

lowing Solution.

Dadada



To investigate the Nature of that Curve which shall generate the Solid of least Resistance.

Imagine the little Lines MN, NO to be two sides of the Infinito-lateral Polygon, which conflitutes the Curve required: Draw MP, NQ Ordinates to the Axis AL, and draw RNF Parallel to the fame Axis AL, and let OR, MF be perpendicular to RNF, and MD perpendicular to the Side MN.

Then'tis evident, that if the Right Lines MN, NF move in the Direction of the Axis from L towards A, that the Force of Resistance of the Fluid in such a Case, is equal to the Action of the Fluid moving in the same Direction from A to-Lines MN, MF, being quiescent, draw FS per-pendicular to MN, and then the Triangles FSN, FMN, PMD are similar; therefore if FN represent the Force of a Particle of the Fluid to move the Line FM, in the Direction of AL, from A towards L, then FS will represent the Force of the same Particle of the Fluid to move the Line MN in the Direction of MD, from M towards D; that is, the Force of the Particle to move M from FA towards L, is to the Force of the same Particle to move MN, from M toward D::FN:
FS::MD:DP. Again, if MD represent the Porce of the same Particle to move MN from M towards D, then DP will represent the Force of the same Particle to move MN in the Direction of DP, from P towards D; therefore the Force of the Particle of the Fluid to move MF, from A

towards L, is to the Force of the same Particle to move MN from A towards L: DM : DP : MN : FM : The Proportion between the Force of the Particle of the Fluid to move MF (or Q v) from A towards L, and the Force of the same Particle to move MN from A towards L may be sound thus: If FN represent the Force of the Particle against QN v in the Direction from A towards L, then FS will represent the Force of the same Particle against MN s in the Direction of MD; and if FS represent the Force of the Particle against MN from M towards D, then mS will represent the Force of the same Particle against MN in the Direction of AL from A towards L: therefore the Force of the Particle of the Fluid to move MF (or QN) from A towards L, is to the Force of the same Particle to move MN from A towards L, as EN is to mS, that is, as FN q is to FS a, or as MD a is to DP a.

to FSq, or as MDq is to DPq.

Whence if the given right Line AB(a) represent the Velocity of the Particles of the Fluid striking against the Right Lines MN, MF, then the Force of the same Fluid upon the Plane described by MF revolving about the Axis AL at the distance MP, and directly opposed to the Motion of the Fluid, will be as the Surface described, and Velocity jointly; that is, as a x MF x MP, whence to find (from A towards Q) the Force of the Fluid on the Surface MN; say, MN²:

FM²: Ax MF x MP.

Whence to MF x MP.

FM²: : a × M F × M P: MN²

to the Force (in the Direction of AL from A towards L) of the Fluid on the Oblique Surface deficibed by the Rotation of MN about the Axis AL; or, which is the fame thing, the Quantity

a × MF³ × MP

expressing the Resistance which

MN²,

the same Surface moving from L towards A,
suffers from the Fluid at rest. In like manner
the Resistance, which the Surface described by
NO revolving about the Axis AL, meets with
from the quiescent Fluid, may be represented by

 $\frac{a \times OR^{t} \times NQ}{\overline{NO}^{2}},$

Then 'tis evident, that if the Right Lines MN, Now if we suppose the Points MO, and the NP move in the Direction of the Axis from L towards A, that the Force of Resistance of the Fluid in such a Case, is equal to the Action of the Fluid moving in the same Direction from A towards L(and with the same Velocity.) On the said Lines MN, MF, being quiescent, draw FS per-

Let the invariable Quantities MF be = m, MP=r, OR=n, NQ=q; and the variable Quantities FN=v, and NR=z; then MN^z = mm + vv, and NOz = $nm \times zz$; therefore the Resistance which the Surface described by the Line MN meets with, viz. $\frac{a \times MF^{*} \times MP}{MN^{2}}$

is $=\frac{a+m^2 \times r}{m m + v v}$, and that which the Surface described by NO (revolving about the Axis AL)

viz. $\frac{a \times \overline{OR}^3 \times \overline{NQ}}{\overline{NO}^2}$ is $= \frac{a \times n^3 \times q}{nn + zz}$, whence And having thus discovered the Property of the Curve MD, it may be Constructed by help of the Logarithmetical Line in this manner: that the Quantity $\frac{a \times m^3 \times r}{mm + vv} + \frac{a \times n^3 \times q}{nn + x}$ ought to be a minimum, and (Art. 198.) confequently the Fluxions thereof must be = 0. Whence $\frac{2 m \cdot r \times vv}{m m + vv} = \frac{-2 n \cdot q \times zz}{n n + zz^2}.$ Now because v z + is = R F an Invariable Quantity, therefore v = -z, and confequently $\frac{m \times r \times v}{m m + v v}$ $\frac{n: \times q \times z}{zn + zz}$. Whence if A B (a) be erected Perpendicular to the Axis A L, and if the right Lines B C, B H, be drawn Parallel to the Infinitely little Sides M N, NO, it will be 4 A B × A C: BC:: BC: MP; and in like manner 4 A B * × AH: BH:::BH: NQ; for because the Triangles M F N, B A C are Similar, therefore A $C = \frac{a u}{m}$ and B $C = \frac{a \times mm + vv|_{2}^{2}}{m}$, whence $4 \text{ A B}^{\bullet} \times \text{A C}\left(\frac{4 a^{\bullet} v}{m}\right) \cdot \overrightarrow{\text{B C}^{\dagger}}\left(\frac{a^{\bullet} \times m m + v v}{m^{\bullet}}\right)$ $: BC\left(\frac{a \times mm + vv\frac{1}{2}}{m}\right): MP(r) \text{ and confe-}$ quently $\frac{r m! v}{m m + v v} = \frac{1}{4} a$. In like manner, because the Triangles OR N, BAH, are Similar, A H = $\frac{az}{n}$ and B H = $\frac{a \times nn + zz\frac{1}{2}}{n}$. Whence by the Property of the Logarithmetical Line. by the Property of the Logarithmetical Line $z: \overline{BH}(\frac{a \times n + z + z}{n}): BH^{s}(\frac{a \times n + z + z}{n}): NQ = q.$ Whence CN, therefore AP(x) is $\frac{az}{4a} = RN$, whence $\frac{az}{4a} = RN$. $\frac{qn \cdot z}{nn + zz} = \frac{z}{4}a; \text{ and consequently, } \frac{m \cdot x \cdot x \cdot v}{mm + vv} + \frac{z}{4}a \text{ Invariable Quantity } \frac{sa}{48}, \text{ and consequently,}$ n + zzthat we first found. Whence 'tis manifest; that the Nature of the

Curve MD (which being revolved about its Axis A L, generates the Solid of least Resistance) is fuch, that drawing A K Perpendicular to the Axis A L, and taking A B = a, and drawing B C parallel to any Tangent of the Curve, v. g. in the Point M, then it will always be 4 A B 2 x A C: BC': BC: MP the Ordinate paffing thro the Point M, which is the Property of the Curve that generates the Solid of least Resistance, discover'd by Sir Isaac Newton.

In the Perpendicular A K assume A B = a, and in the Axis A L produc'd, take A E = $\sqrt{\frac{1}{2}}aa$.

and through the Point E describe the Logarithmetical Line EN, and let AK be the Assymptote, and ‡ a the Sub-tangent; then take AC at pleafure, which suppose = z, and draw C N parallel to A K, until it meet the Logarithmetical Curve in N; then if A K be taken = $\frac{aa}{4z} + \frac{z}{4} + \frac{z^3}{4aa}$ and $AP = \frac{xz}{4a} + \frac{3z^4}{16a^3} - \frac{5a}{48} + CN$ (viz. + CN when AC AE and —CN when AC AE) and compleat the Parallelogram PK, I fay, the Angle M, or the Point wherein K M interfects

P M will be in the Curve requir'd.

For A C being = x, if A P = x, and P M = y, then by the Property of the Curve A K or $PM = y is = \frac{a^4 + 2aazz + z^4}{4aaz}, \text{ and confe-}$

quently, $y = \frac{1}{2}z + \frac{3zzz}{4aa}, -\frac{aaz}{4zz}$ and because B C is parallel to the Tangent in M, therefore the Triangle ABC is Similar to the little

Triangle at M, and consequently $a:z:y:\frac{zy}{a}$ $\dot{x} = \frac{z\dot{z}}{2a} - \frac{3z^2\dot{z}}{4a^4} - \frac{az}{4z}$, and the flowing Quan-

Which is the very same Equation when CN vanishes, then A P or x will vanish also, therefore C M is the Curve requir'd.
SOLSTICE: how to find the exact Times of

Solstices, see under Tropick in Vol. 1.

SOUND, Mr. Carre, of the R. Academy of Sciences at Paris, hath published this Year a Book Sur la Theorie General du Son, &c. In which he shews that Sound, when considered with relation to Body, confifts only in the Motion of the Air; but in such a Motion as is very different from the Wind. The first Motion from whence Sound comes, is produced (he thinks) by little Vibrations, or Shakings repeated, which the Parts of the Sonorous Body occasions in the Air; whereas Wind consists in a Local Motion of the Air, without Vibrations; and this he proves by several Experiments. The Motion of the Air in Winds, will act strongly on Flame, but will not affect the Ear with Sound, but on the Interpolition of some Body which may occasion some Vibrations: Whereas the Agitation of the Air in Sounds affects not Flame; for a lighted Candle put near a

Bell which hath been struck, will not have its

Flame agitated by the Sound.

He concludes also, that Sound is not produced by a total and fensible Vibration of the sonorous Body; but by insensible Vibrations of the little Parts, always helped, and sometimes occasionable by total Vibrations. Thus, when a Chord hangs loose, it will move forward and backward quick enough (when struck) without making any Sound; because thro' want of being straitly extended, each little Part can't make its Vibrations by itself, and

communicate them to the Air.

In sonorous Bodies, in the same, or of different Matter, the difference of Sound, as to Grave or 3. Whether Sounds move in the fame Time, the Acute, flows from the greater or lesser spring of same. Spaces, in all States of the Atmosphere, each l'arr, and from the more or less quickness and Heights of the Barometer? with which these Parts do bend and unbend. Two Strings or Wires, one of Gold and the other of Steel, of the same Length, Thickness, and Tension, yet will give a different Sound, viz. the Gold one more Grave, the Steel-wire one more Acute; because the Parts of the Gold are more soft and flexible, and have less Spring than those of the Iron, and therefore will have less speedy, and weaker Vibrations. But yet Sound, be it flat or sharp, is still strong or weak; and 'tis not the Strength or rates or retards the Motion of Sound?

Weakness of Sound, that renders it flat or sharp:

8. Whether Sounds have the same strong Seundarises from great Vibrations in the Air, Velocity in Summer and in Winter. and from a great Quantity of it, moved in the same time; and the weak Sound is occasioned by the just contrary. So that the Strength or Weakness of Sound, is in proportion to the Quantity of Air struck, and the Strength of the Vibrations: But Grave and Acute Sounds follow the Proportion of fwift at all the Elevations of the Gun? greater or leffer Number of the Vibrations of the Air in the same time.

The Reverend Mr. William Derham, a very industrious and useful Member of the Royal Society. in Philosophical Transactions, Nº 313. hath obliged the World with some very curious and careful Observations and Experiments about the Motion of Sound; being furnished with very good Position? Instruments, and many Advantages to make them,

which others have not been.

He observes, first, that there hath been a considerable difference in the Accounts given by good Authors, about the Velocity of the Motion of Sound. Sir If: Newton, in Princip. Lib. 2. Prop. 50. allows but 968 Feet for the l'rogress of Sound in a Second of Time.

The Hon. Mr. Fr. Roberts, Phil. Trans. No 207. 1300 Feet.

Mr. Boyle, in his Fffay on Languid and Unheeded Motion, 1200 Feet.

Dr. Walker, in Phil. Trans. No 247. 1338 Feet. Mersennus in Balistie. Prop. 39. 1474 Feet.

Flamstead and Halley, 1142 Feet.
The Florentine Academy, 1148 Feet.
The French Observ. Hist. Acad. Regie, 1172 Feet.

The Reason of this Diversity he judges to arise, (1.) From these Gentlemens using not good Pendulum Clocks ordinarily, but a String and Plummet only, of fuch a length as to swing Seconds. But this latter way can't be so exact as that by a Movement; because the Observer's Eye must first observe the Flash of the Gun, &c. fired; and then the Swing of the Pendulum, which takes up Time, and occasions much Confusion. (2.) From there not being distance enough between the Sound and the Place of Observation.

Winds, of which more below. And he judges, that the little difference there is between the three last Numbers of 1142, 1148, and 1172, arifes from there being good Pendulum Clocks made use of in these Observations, and the Distances being considerable.

After this, he proposes to answer the following

Questions:

1. How far a Sound moves in a Second of Time, and consequently in any Time assigned?
2. Whether the Report of a Gun, discharged with its Mouth towards, comes somer, than when its Muzzle is from the Observer?

4. Whether they move faster by Day, or by

Night?

- 5. Whether they move swifter with, or slower against the Wind? And how the Wind affects them ?
- 6. Whether Sounds move faster in calm or ftill, then in windy and turbulent Weather?

7. Whether a strong transverse Wind accele-

8. Whether Sounds have the fame Degree of Velocity in Summer and in Winter.

9. Whether they have the same in snowy and clear Weather?

10. Whether a great Sound and a small one have the fame Velocity?

11. Whether the Sound of a Gun move equally

12. Whether different Strengths of Gun-powder change the Motion of the Sound of the Re-

13. Whether the Velocity be the same in all Heights of the Atmosphere above the Earth?

14. Whether the Report be in the same Time, if the Piece be discharged in an Acclive or Declive

15. Whether all kinds of Sounds, as of Guns, Bells, Beetles, &c. have the same Velocity?

16. Whether Sounds be swiftest in the begin-

ning of their Motion, and slowest in the end?

17. Or whether they be not rather equable, moving equal Spaces in equal Times?

18. Whether Sound move equally fwift in all

Regions? in North, South, &c. Climates?

19. Whether Sound move in a right Line the nearest way, or whether along the Earth's Surface?

To solve these Problems, Mr. Dernam was at the trouble of getting, and had the advantage of hearing and seeing from the Tower of his Parish-Church at *Upminster* in Esc, many Muskets fired at the distance of 1,2,3, and so far as to 8 Miles; beyond which he could not hear in that woody Place, the Report of a Musket. But the the Firing of these small Arms did him much Serivce in his Design, he was much better served by the Ordnance, or great Guns, on Black-Heath; for he could from his Church aforesaid, always by Night with his naked Eye, and by Day with a Telescope, see the Flashes of the Sakers (a fort of Cannon) there fired, to exercise her Majesty's young Engineers, and hear their Report very plainly. On these he made many repeated Observations; and at last, by favour of the Board of Ordnance, And, (3.) From there being no regard had to the he got leave to have two Sakers (see that word in

Vol. 1.) to be placed one by another on the Heath, blowing directly against the Sound.

rort of each Gun, he always found to be about cannot be the same Particles of the Air or Atmo-120, or 122 half Seconds of Time. He mentions sphere, which carry both; at least they can't be both these Numbers, because the Sound of the Re-moved after the same manner. He concludes, as

Sound's Progress, when the Saker was fired to-

Question.

the feveral Muskets made any alteration in the Motion of the Sound; which is an Answer to his 11th that different Quantities or Strengths of Powder, of the Noise. Nor did he find that there was any Variety in the Time of the Motion of the Sound, der, Clouds, &c. either by Night or Day; whether it were clear or either by Night or Day; whether it were clear or In Philosophical Transactions, No. 156, you cloudy; whether it rained or snowed, whether have an Account of the Doctrine of Sounds, by the Barometer were high or low, and whether it were Summer or Winter; which folves his No. 247, of the Swiftness of Sounds, and their 3, 4, 6, 8, 9 Queries. He found also, in answer Reflections by Echoes. 3, 4, 6, 8, 9 Queries. He found also, in answer to his 15th Question, that all kinds of Sounds, as of Bells, Beetles, Muskets, &c. from the same Distance came to his Ear in the same Time.

moves just an English Mile in 94, or 9, 25 half dy, in order that they may exert their Spring or

that Sound moves the nearest way, and that it ly, that as exhausting the common Air out of a doth not creep along the Earth's curved Surface: that the Velocity of the Sound is the same in Accli- or conveying more Air into a Vessel, made on purvites and Declivites; tho' he hath not had oppor-pose for such Condensations of Air, did very sentunity of making Experiments enough to deter-sibly augment the Sound of the included Bell. mine it exactly.

From the Communications which his Friends in Italy have afforded him, he thinks the Difference of Regions or Climates, makes no difference in of Gold of the old Standard was to be coined

18th Question.

He found that very thick cloudy and fnowy 10 Shillings. In 4 Ed. 6. Soveraigns were coined Weather, did always leffen and dull the Noise made at 24 Shillings a-piece, and in 6 E. 6. at 30 Shilby the Discharge of Guns, &c. whereas in frosty lings; and also in 2 Eliz.

and clear Weather, they were much more audi
SOWNE, is a Term of Art used in the Excheand clear Weather, they were much more audi-ble, clear, and distinct, than at any other times.

By many repeated and accurately made Experiments, he discovered, that contrary Winds do in the Original French, hath Des Estreats oriens Soualways retard the Motion of Sounds, and that in venu. And such Estreats and Casualties as are not to proportion to their Strength; which is what the be remembred, run not in Demand, i.e. are not Florentine Virtuosi, and many others have formerly leviable. So now in the Exchequer they say, such been entirely mistaken in; afferting, that Contra- Estreats as the Sheriff by his Industry cannot get,

By Observations and Experiments, made with but with their Muzzles quite contrary ways; and proper Instruments, about the Velocity of the Moon the 15th of Feb. 1703 to be discharged continution of Wind, he concludes, that in the greatest ally every half Hour, from 6 in the Evening, till and most rapid Storms that ever blew, the Wind 12 at Night: There was a small Gale of Wind moves not above 60 Miles an Hour, and perhaps owing directly against the Sound.

not above 50; whereas Sounds may go above 700
The Interval between the Flash and the Re-Miles in the same time: and consequently they port always came double; the first within 120 abovesaid, that the Velocity of Sound is such, half Seconds; the second (which he takes to be that it ordinarily moves 5280 Feet, or an English an Echo from the Wind-Mill, or adjacent Houses Mile, in 9 that Seconds: And that it moves 571 on Black-Heath) within 122.

He observed no difference in the Time of the Time. But that the Winds may be a first the winds may be a firs He observed no difference in the Time of the Time. But that the Winds may so affect it, by conspiring with its Motion, as to carry it 600 Feet wards him, or from him, which answers his second in half a Second; or, by being contrary to it, to nestion.

retard it so, that it may not move more than 500

Nor did he find that any different Elevation of Feet in a half Second of Time.

SOU

He concludes with shewing the Uses that may be made of this Knowledge of the Velocity of the Problem. And to folve the 12th Query, he found Motion of Sound, in measuring the Distances of Ships at Sea from one another, or of a Ship from made no alteration in the Velocity of the Sound's Shore; of Forts and Batteries one from another. Motion; the it manifestly did so in the Strength or of any Places at Land within the hearing of the Report of a Gun; of the Distances of Thun-

In Philosophical Transactions, No. 156,

In the History of the Royal French Academy for A.D. 1700, they fay it hath been experienced, that a Sound moves 180 of their Toises in a Se-And the same he found, as to intense or strong, cond, or 283 middle French Leagues in an Hour. and languid or weak Sounds; which answers his

1. Therefore they conclude, that the Air must be
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1. All Conjectures and Physical Reasons persuade us, that this Motion or
1. Stroke on the Air, must be impressed by very brisk
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1. Therefore they conclude, the Air must be an are the Air must be an are the Air must be an are the Air must be an are the Air must be an are the Air must be an are the Air must be an are the Air must be an are the Air m Seconds; two Miles in 18 1, three Miles in 274, elastick Force (3.) In Philosophical Transactions, &c. and so on uniformly.

As to his last, or 19th Question, he is confirmed, ments of Mr. Hawksbee's, whereby it appears plaindoth not creep along the Earth's curved Surface: Receiver, doth very much lessen the Noise made. And he believes (in answer to the 14th Query) by the Bell there hung and struck, so crouding

SOVERAIGN, was a Piece of Gold Coin, Current at 22 Shillings and Sixpence, in 1 H.8. when, by Indenture of the Mint, a Pound Weight the Motion of Sounds; which is an Answer to his into 24 Soveraigns. In 34 H. 8. Soveraigns were coined at 20 Shillings, and half Soveraigns at 10 Shillings. In 4 Ed. 6. Soveraigns were coined

quer, and seems a Corruption from the French Souvenu, i. e. remembred: For the Stat. 4 H. 5. c. 7. riety of Winds occasion no Retardation of the are Estreats that Sowne not; and Estreats that Motion of Sound.

SPHER**E**,

SPHERE: 1. The Surface of a Sphere is equal to the Periphery of a great Circle, multiplied by

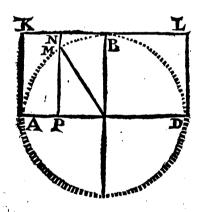
its Diameter; Hayes, p. 73.
2. The Area of any Segment of a Sphere cut off by a Plain, or by two Plains which are parallel, is to the whole Spherical Surface, as the intercepted Portion of the Diameter is to the whole Diameter. Wherefore putting r = Radius, c = Periph. and x = the intercepted Diameter; the Area of any Segment may be found by this Propor- bus

The Part of the Sphere's Surface contained between the Semi-circular Arks of any two (Great) Intersecting Circles, is to the whole Surface, as Circles is to 4 right Angles.

3. When the Diameter of any Sphere is equal to the Radius of any Circle, then the Area of that Circle will be equal to the Surface of the corre-

fponding Sphere.

4. The Convex Area of a Cylinder Circumfcribing a Sphere of the same Diameter with its own Altitude (which in this Notation will be 2 rc) is Quadruple of the Area of the Base; and confequently = to the Area of the Surface of the Sphere, and the Surface of an Hemisphere is to twice the Area of one of its great Cir-those that enter the Spleen. cles.



5. Suppose the Square A L, together with the Semi-circle A B D, to revolve round A D as an Axis; then will the Line K L generate a Cylindrick Surface = to the Hemispherical one generated by the Semi-circle (by 3.) Wherefore if any Point, as M, be affigned, and thro' it P N be drawn Normalto AD; I say, the Surface or Ring described by KN, will be equal to the Segment described by the Ark A M. For the Ring described likewise a few Lymphatick Vessels which arise from by KN, will be to the whole Cylindrick Surface the Spleen, and discharge themselves into the described by K L, as K N, K L. And the Segment made by the Revolution of the Ark A M, is to the whole Spherick Surface, as A P, A D, that is, as K N, K L. Wherefore, &c.

About the Dimensions of the Sphere and Cylinder; see Dr. Wallis in Philosophical Transact.

No. 260. p. 547.

SPIGURNEL, was anciently (Spigurnellus) he that had the Office of the Espigurnantia, or Sealing of the King's Writs. This Word Spelman and ver comes immediately from the Spleen and Du Fresne recite, without interpreting it. But it Omentum, they think that one furnishes the fecms to be taken from the Saxon, Sparrau, which fignifies to Sout up, Seal or Secure. Kennet's Gloss. in Paroch. Antiquit.

SPIRITUALITIES of a Bishop, are such Profits as arise to him from the Benefit of his Jurisdiction in his Diocess, and not as a Baron of the Parliament; fuch as those of his Visitations, Institutions, Ordinations, &c.
SPIRAL Line. See on this Subject further,

Stephano de Angelis de Infinitis Spiralibus inver-

&c. Petavii.

sis, &c. Petavii.

Il. Bullialdi Demonstrationes Novæ de Spirali-

SPLEEN. The Vessel which in Beasts they call the Milt, is fituated in the left Hypochondrium. under the Diaphragm, between the Ribs and the Stomach, above the left Kidney; it is tied to the Peritoneum, to the Diaphragm, and to the Omen-tum. 'Tis of a blueish or leaden Colour, of an the Angle of Inclination of the Planes of those oblong Figure, thick at the edges, and not thin as the Liver: It hath two Membranes, the External comes from the Peritoneum; the Internal Membrane is finer and thicker than the External: for if you blow into the Splenick Artery, the Air will pass thro' the one, but not the other. Its Fibres are not regularly woven, as those of other Membranes feem to be, but they come from in-numerable Points, as *Radii* from fo many Cen-tres; and the Fibres of one Point are regularly woven with the Fibres of the Points furrounding It receives Veins, Nerves and Arteries from

The Substance of the Spleen is not only kept together by its two Membranes, but also by innumerable Fibres which come from the Points of the Internal Membrane, and are inferted in the Points of the opposite side of the same Membrane; and Expansion of the Extremity of these Fibres seem

to compose the Internal Membrane.

The Spleen is composed of an infinite Number of Membranes, which form little Cells and Cavities of different Figures and Bignesses, which communicate with one another, and are always full of Blood.

At the Extremities of the Blood Vessels in the Spleen of Sheep, we find several white soft Specks,

which *Malpighius* calls *Glands*.

The Spleen hath Arteries from the Caliaca, whose Capillary Branches make frequent Inosculations upon the Membranes of the Cells. Veins, whose Extremities communicate with the Cavities of the Cells, as they come out of the Spleen, unite and make the Ramus Splenicus of the Porta, which carries the Blood from the Spleen to the Liver. These, with its Nerves, which are confiderable, from the Plexus Splenicus, are equally distributed thro' the whole Substance of the Spleen, being all included in a common Capfula. There are Lumbary Glands.

The true Use of the Spleen is yet uncertain; the Antients thought it to be the Receptacle for the melancholick Humour: some since considering that in the Spleen there are a great Number of Membranes and Fibres, and also many Nerves. have thought that the Blood is attenuated, and becomes more spirituous in the Spleen: And confidering that the most of the Blood in the Li-Oleaginous, the other the Spirituous part of the

Bile.

SPOTS,

SPOTS in the Sun: Besides what may be concluded about these Solar Spots, being no Planets revolving round the Sun's Body, as some have thought; Dr. Hooke, in his Opera Post. draws these further Conclusions: (1.) That these Bodies are either opake, and so hinder the Sun's Light from passing thro' them; or else are incombustible and dark Bodies, which will afford no Light at all for a certain time, and do, as it were, quench and deaden that part of the Sun where they rise. (2.) There appear in some Parts of the Sun's Face, also Nebula or Clouds; in some others Facule or Blazes, which give a clearer Light than the other Parts of his Body. The Spots are subject to increase and decrease, having sometimes covered a part of the Sun bigger than all Europe, and sometimes bigger than the whole Surface of the Earth. (3.) The Motion of these Spots is always from East to West, according to the Order of a Line of Sines, beginning from the Center, of which the Semi-diameter of the Sun is Radius. And this Motion appears to be in a straight Line in the beginning of June and December; when the Earth is in that part of the Plain of the Ecliptick, which cuts the Plain of the Equinoctial of the Sun's turbinated At other times the Line of their Motion is incurvated and bent into an Ellipsis; which is greatest when the Earth happens to be in those Parts of the Ecliptick, which are the extreme Limits of it, compared to the Plain of the Sun's Equinoctial: And this also is twice a Year, viz. Man is in Stabili Statione, at his Standing in the Fointhe middle between the Nodes, both Plains passers with a Cross-bow, or Long-bow, ready to shoot fing thro' the Centre of the Sun, that is, about the at a Deer; or else when he is standing close up by beginning of March and September. Whence he a Tree, &c. with Grey-hounds in a Leasth ready deduces, by undeniable Demonstration, that the Sun is of a Globular Figure, and that it moves on its own Axis from East to West: As also, that the Axis of his turbinated Motion remains fixed, and is always directed towards the same Point in the Heavens, as the Earth's Axis is found to do; as also the Axis of Jupiter and Saturn is, as far as can yet be discovered by the Spots, Satellites, and Ring of these Planets. (4.) He observes also, that there is a kind of Torrid Zone, or certain Space or Breadth on each fide the Sun's Equator towards the Poles, in which these Macule, Nobule and Facule, do Whereas, without these Limits, or appear most. in the temperate Zones (as with regard to our Earth they may be called) they appear but seldom, and never towards the Polar parts.

SQUADRON of Ships, is a Division, or part of a Fleet, commanded by a Vice or Rear Admiral, or some other Commander or Commadore, as they call it; but the Number of Ships in it is uncertain.

SQUADRON, is a Body of Horse, whose Number is not fixed; but usually is from 100 to 200 Men, according to the General's pleasure, Caracts of fine Gold, and 2 Caracts of Copper; the strength of the Army, and as occasion serves and the French and Spanish Gold are nearly of the Usually a Squadron consists of 3 Troops, each of same Standard. See Caract. 50 Men, and it never exceeds 200 Men; because a greater Number than that can't be advantageously posted, nor have room to act in narrow Ground, Woods, Marshes, Defiles, &c. The Eldest Troop

File.

To form, any Number of Men into a Square Battle, as suppose 500, extract the nearest Square Root of 500, which is in Integers 22; and that will give the Number of Men for Rank and File. There will be a Remainder of 16 Men, who may

be disposed of as the Commander thinks best.

SQUARE Battalion of Ground, is when the Ground of the Flanks is of the same extent as the Ground of the Front and Rear. To make a square Battalion of Ground; as suppose the Number were 60, multiply 60 by 3, the Number of Feet which every Man takes up in Front, the Product will be 180; divide that by 7, which is the Number of Feet each Man takes up in depth, or which is the dissance of the Ranks, the Quotient without a Fraction will be 25, whose square Root is 5; which will give the Number of Men in File. And if you divide the first given Number 60 by this Root 5, you will quote 12, which is the Number of Men in each Rank.

SQUARE Hollow, or bollow Square, in the Art

Military, is a Body of Foot drawn up with an empty space in the middle, for the Colours, Drums and Baggage, facing and covered by the Pikes every way to keep off Horse.

STABLE-STAND, is the Term for one of the four Evidences or Presumptions whereby a Man is convicted, to intend the stealing the King's Deer in the Forests. The other three are Dog-draw, Backbear, and Bloody-hand. This Stable-stand is, when a

STAKE, is the Name of a small Anvilused by Smiths; fometimes it stands on a broad Iron-foot, on the Work-Bench, to be moved up and down occasionally; and sometimes it hath a strong Iron Spike at the bottom, by which 'tis fixed to some place on the Work-Bench. Its use is to set small and cold Work Strait, by hammering it on the Stake, or to cut or punch upon with the cold Chissel, or cold Punch.

STALLAGE, was a customary Rent paid in Fairs or Markets, for the Liberty of a Stall or

Standing, by the Stallangers or the Creamers, i.e. those Traders who exposed their Goods to Sale on the faid Stalls. In Scotland they call it Stallenge; the Romans called it Siliquaticum from Siliqua, which was their first and least Weight, a kind of

Caratt of 4 Grains.
STAMPING-MILL, called also a Knocking-Mill, is a Mill used in the Tin-works to bruise the Ore small. See the Description of it under

STANDARD for Gold-Coin in England, is 12

For Silver-Coin, 11 Ounces and 2 Penny Weight of fine Silver, and 18 Penny Weight of Copper, being melted together is the true Standard, and fuch Silver is called Sterling. When either Gold takes the Right of the Squadron, and the Second the Left, and the youngest the Center. A Squadron is always drawn up 3 deep, or in 3 Ranks, with the length of a Horse between each Rank. The Standard is always in the Center of the first Rank. SQUARE Battel, or Battalion of Men, is one that hath an equal Number of Men in Rank and File.

Incomplete Standard, they call it better; if coarser, worse: and they reckon the excess or defect by Caracts, and Grains of a Caract in Gold, and by Penny-weights in Silver. And it is thus discovered: They take a small Quantity and assume that hath an equal Number of Men in Rank and melt it in a Crucible with a strong Fire, so long File. Eeeec

till the Copper, or other Allay mixed with it, be Silver, such as we now call Standard. But the burnt away. When cold, they weigh it again act word Sterling, as being a Piece of Money, geneweight, they call it fine Gold; if it hath lost all y if not always, fignifies a Penny. And as for a Weight, they call it fine Gold; if it hath lost 124 good while together there was no other Coin but part of its Weight, they call it Gold of 24 Captages, or one Caract better than Standard; if it thors, the same as Neumans, all good Standard Silvers and the called Same as Neumans. have loft $\frac{2}{24}$ parts, then 'tis 22 Caracts fine, or Standard; if it hath loft $\frac{2}{24}$ parts, 'tis called 21 Caracts fine, or I Caract worse than Standard, &c. And so they assay Silver, only they compute its bottom to the top in any Wainscot, are by the loss by Penny-weights, &c.
STANNARIES; are the Mines and Works

where (Stannum) Tin is dug and smelted; as in Cornwall, and other Places. There are several

Act of Parliament, to carry their Wool, Cloth, is made, was called Reas Credendi, or Stipulandi. Lead and Tin, &c. and such like Staple or Stand-This was the old Sense, but now with us the Word ing Commodities of this Land, in order to their Stipulation is commonly used for the Act of the Perbeing sold by the Great. These Places you will son obliged; and some say that the Word Stipufind in feveral Statutes, appointed and altered by later is common both to Debter and Creditor. the Kings of England, from the fecond Year of Edw. 3. to the fifth of Edw. 6. and what Officers rac, Professor of Medicine at Montpellier, hath by these Staples had belonging to them, you may an easy Experiment shewn, that the Force of the see in Anno 27 E. 3. Stat. 3. c. 21. The Staple Stomach alone (in Vomiting) without taking into fee in Anno 27 E. 3. Stat. 3. C. 21. The Staple Commodities of this Land, are Wool, Leather, Woolfells, Lead, Tin, Butter, Cheese and Cloth; as appears by 14 Rich. 2. c. 1. tho' fome will allow only the first five.

STAR. All Deeds, Obligations, Contracts, Releases, &c. of the Jews, were antiently called Stars, from the Hebrew Sherar, a Deed or Contract. These were sometimes written in Hebrew and La-

tin, but usually in Hebrew alone.

STAR-CHAMBER; was a Chamber at Westminster, formerly so called, from its Roof being
painted with Stars. Henry the Seventh and Eighth, painted with Stars. Henry the Seventh and Eighth, STRIÆ, are the Lists or Rays which run be-ordered by several Statutes, that the Chancellor, tween the Flutes, Channels or Striges, in Fluted affished by others there named, (vid. 3 H. 7. c. 1. Pillars. These as and 21 H. 8. c. 2.) should have Power to punish the Ionick Order. Routs, Riots, Forgeries, Embraceries, Perjuries, and provided for by the Common-Law; and for which Workmen Flutings and Grooves. They more pronues to this day

STATIONARY; how to an Eye placed at the Earth, a Planet appears to stand still or be Stationary, see under the word Direct in this Vol. 2.

TELLIONATE, in the Civil Law, is all kind of Cozenage, and Knavish Practice in Bargaining; and all forts of Frauds that have no peculiar Names in the Law. And 'tis so called from Stellio, a Lizard with great variety of Spots, and very prejudicial to Mankind.

STERLING Money; this Word seems to come, as Mr. Somner hath derived it, from the Saxon Word Steore, that is, a Rule or Standard; and therefore that Brace, which is framed into the King-Piece it fignifies that Coin or Money, which for Metal and the principal Rafters.

and Value, was to be a common Standard of all STUDDING-SAILS, in a Ship, are Bolts of Current Money. And this is the more probable, because such Money, at the coming in of the Norfub Anno 1082. Porrigam quindecem Sterilensiare fometimes also used to the Clew of the Main-um, Dr. Kennet's Glossary. Esterling in Stow is used fail, Fore-sail and Sprit-sail, when the Ship goes for a Penny-weight, signifying a Penny of fine either before the Wind, or Quartering.

ver came to be called Sterling Silver, and good Money, Sterling Money, as it is to this day.

STILES; the upright Pieces which go from the

Workmen called Stiles.
STILOBATUM, is, in Architecture, the Body

of the Pedestal of any Column.

STIPULATION, in the Civil Law, is a Con-Laws about, and Liberties granted to the Stanna-tract made by Words, and not in Writing, by asking Courts in feveral Acts of Parliament; as in the ing a Question, and receiving presently a proper time of Edw. 1. and afterwards, as abridg'd by Answer: And in this Contract the Obligation is Edw. 3. and in 17 Car. 1. c. 15.

only upon one fide, i. e. on the fide of the PromiSTAPLE, fignifies this or that Town, City of fer, who was called Reus Debendi, or Promittendi;
Place where the Merchants of England were, by as the Stipulator, or Creditor, to whom the Promife This was the old Sense, but now with us the Word

Stomach alone (in Vomiting) without taking into confideration the Muscles of the Diaphragm and Abdomen (whose force together is more than that of 248000 Pound weight) is equal to that of 12000

Pound weight.

STRAIKS, in Gunnery, are Plates of Iron of the length and breadth of one of the fix Felloes, which serve for the Round of the Wheel of a Guncarriage, and fixed on the Circumference of the Wheel with strong Nails, which are called the Straik-nails; these Straiks cover the Joints of the Felloes, and defend the Wheel.

Pillars. These are 20 in the Dorick, and 24 in

STRIGES, in Architecture, are the hollow such other Misdemeanors, as were not sufficiently Channels in the Shaft of a Column, called by our the inferior Judges are not so proper to give Corperly belong to the Ionick Order, tho' they are rection. But this Court, by 17 Car. 1. c. 10. was found sometimes in the Dorick, and often in the entirely dissolved and determined, and so conti-Corinthian and Composite. They are generally at right Angles with the Plane of the Base, but are fometimes found winding about the Pillar. Sometimes the Striges are filled up with a fwelling a third part from the Base, lying in the hollow like a Stick shot of a round form: These Mr. Evelynthinks we should call Staved or Cabled Columns.

STUCCO: Painting in Stucco was revived from the Antients by Giovanni d'Udine, a Scholar of Raphael's; he found the true Matter which the Antients made use of, which was a Composition of

Lime and Marble powder'd very fine.
STRUT, is a Term used by some Builders for

Canvas, or any Cloth that will hold Wind, extended in a fair Gale of Wind along the fide of mans, was called Sterilensis. As Orderic. Vital. the Main-sail, and boomed out with a Boom; they

STYLO-

vel Stylo-Hyoides alter, is a Muscle of the Os Hyoidos, which arises fleshy and tendinous from the Styloid Process, near the Origin of the Styloid Process, STYLO-Chondrobyoideus, near the Origin of the Stylo Pharyngaus, and runs under the Cerato-Glosses. It is inserted into the Cartilaginous Appendix of the Os Hyoides; and its Use is to affilt the Stylo-Hyoideus, in putting the Os Hyoides upwards and laterally. Dr. Douglass.

STYLO-Hyoidæus, is a Muscle of the Os Hyordes, arising by a round Tendon from near the middle of the Processus Styliformis, and is inserted in the Axis. middle of the Processus Styllsormes, and the Axis, the tendinous into the Basis of the Os Hyoides, near Point M, and PM an Ordinate to the Axis, the firs Cornu; to which also it often adheres fleshy. TP is the Sub-tangent, because it determines the Its Use is to put the Bone of the Tongue on one Point T, where the Tangent cuts the Axis produfide, and a little upwards, when both act in Con-ced beyond the Vertex of the Curve V. And the

SUBNORMAL; is a Line, determining in any Curve, the Intersection of the Perpendicular of Contact M) in the Axis V D, is called the Subto the Tangent in the Point of Contact, with the normal. And this Subnormal, in the common or Apollonium Parabola, is a determinate invariable urbane, Urbicarie vicine; were such Regions or Quantity; for its always equal to half the Para-Cities of the Roman Empire, as lay within an meter of the Axis.

Equation, some other Quantity which is really pation. equal to it, but express'd after another manner; 6UCTION; there are many Effects vulgarly and this is done, in order to find, at least, such a attributed to Suction, which, in reality, have very

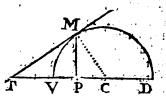
SUB-TANGENT, in any Curve, is the Line which is contiguous to it, follows it by a kind which determines the Intersection of the Tangent of Astraction, as if the Air and Water busy toin the Axis. And in any Equation if the value of gether: And others funcy that the Air moves in the Sub-tangent come out Positive, tis a fign that to the Mouth of the Sucker, and the Water moves the Point of Interfection of the Tangent and Axis, up after the Air, to prevent a Nathum, which falls on that fide of the Ordinate where the Verthey fay, Nature abbors. Whereas the rue Cause tex of the Curve hes; as in the Parabola and of this Phanomenon, is only that the Air and At-Paraboloids. But if it come out Negative, the mosphere presses with its whole weight, swiformly Point of Intersection will fall on the contrary fide on the Surface of the Ligher in the Vessel, and conof the Ordinate, in respect to the Vertex or be-ginning of the Abscissa; as in the Hyperbola, and Hyperboliform Figures.

And universally, in all Paraboliform and Hyperboliform Figures, the Sub-tangent is equal to Pipe to the same height as without, and indeed the Exponent of the Power of the Ordinate muki-little higher, because the Pressure of the Air with-

plied into the Abscissa. Thus, in the common Parabola, whose Prothe fides of the Pipe. Now when any one apperty is px = yy, the Sub-tangent is in length plies his Mouth to the upper end of the Pipe and equal to x the Abscriffa multiplied by z, the Extra fucks, his Lips so strongly enclose the Pipe, that ponent of the Power of yy, the Square of the no Air can get between them and it; and by the Ordinate; that is, its equal to twice the Ab voluntary Motion of the Spirits in the Muscles, scissa and by the former Rule for Paraboliform the Cavity of his Thorax, or Breast, is opened

the

SUB-TANGENT, in any Curve, is a Line which determines the Interfection of the Tangon



Thus, if T M be a Tangent in the Line PC, which determines the Intersection of the Perpendicular MG(to the Tangent in the Point

SUBURBICARLE Regiones, called also Subhundred Miles of Rome, and were under the Jurif-SUBROGATION, in the Civil Law, is put-diction of the Prefect of that City: Wherefore ting another Person into the Place and Right of they are sometimes called Regiones Solice, behim, that, in any Cafe, is the proper Greditor, cause in these the Governour of Rome was wont This is also called Cession. This sile to exercise his solemn Jurisdiction. This also was the antient Extent of the Power and Change SUBSTITUTION, is, in Algebra or Fluxions, was the antient Extent of the Power and Charge the putting in the room of any Quantity in an of the Bishops of Rome, before the Rapal Usur-

SUCTION; there are many Effects vulgarly proper Expression in the Equation, as shall solve different Causes. As when any one fucks Water, the Problem, or Question proposed. And in the or any other Liquor up thro's Pipe, 'tis common-Knack of doing this readily, consists the chiefest ly thought, that by that Asson the Person draws.

Business of the Operations in Pourse is the Asson to the Asson that the Water, the Asson to the Course is the Asson to the Water. fequently prevents any one part of the Water to rife higher than the other there: And if a Pipe be put in of any tolerable large Bore, and be open at both ends, the Water will rise within the in the Pipe is a little taken off by bearing against Figures, it must be taken above the Ordinate in and enlarged; by which means the Air included the Axis produced. Thus also in one of the cubical Paraboloids, where $p \times x = y \cdot y \cdot y$, the self in, and consequently cannot press so strongly length of the Sub-tangent will be 1 of the Abagainst the upper end of the Pipe, as it did before stills.

Thus, in the Figure annexed, you will see that the Cavity of the Thorax was so enlarged, and when the Weight of the whole Atmosphere kept the its Spring bent. And that Weight or Pressure being now taken off by the Lips of the Man char sucks, the Æquilibrium is destroyed, the Air gravitates on the Surface of the Water, but cannot do so on the upper Orisice of the Pipe, because the Juncture of the Lips takes it off; and the Spring of the Air included in the Thorax, being weakened Eccec 2

by the Dilatation of its Cavity, it cannot press wards its Centre. so hard against the upper Orifice of the Pipe, as its Opacity, he concludes, from the disappearing of the Water will do against the lower, and consea common Pump: The Sucker being tight, takes the Flame of a Candle, or the Radiation or hazy off entirely the Pressure of the Atmosphere on the Light about the Nucleus of a Comet, thro' which, Surface of the Water within the Barrel of the as well as thro' its Beard, the small fixed Stars Pump; and consequently the Atmosphere by its may be seen. weight must force the Water up to make the He thinks Aquilibrium. See Hydrostaticks:

SUFFRAGAN; is a titular Bishop appointed to aid and affift the Bishop of the Diocess, and by 36 H. 8. c. 14. every Bishop is empowered to elect two honest and discreet Spiritual Pastors, which shall be called Bishops Suffragans.

SULPHUR: Sir If. Newton, on very good grounds, concludes, that the common Sulphur is composed of volatile and fixed Parts, strictly adhering to one another by mutual Attraction, so it began to give Light, none can contradict it by that they will both sublime together; for by disany Observations we have on Record: For, supposolving Plowers of Sulphur in Oil of Turpentine, sing we had Observations Astronomical of 4000 and then distilling the Dissolution, 'tis found, that Sulphur confists of a thick, volatile and inflammable which are found there in nearly an equal Quan-

fame with the Oleum Sulphuris per Campanam.
SUMMATORY Calculus, according to some, from the Fluxion; and so it is the same with the Calculus Integralis. See Hayes's Fluxions.

SUMMONER, or Summonitor, an Apparitor, who is to cite in Offenders, to appear at a certain Time and Place, to answer to the Charge exhibited against them.

SUMMUM Bonum, or the chiefest Good of human Nature, is that, which, by its enjoyment, The Schools renders truly and compleatly happy. The Schools distinguish this chief Good of Man, into that which is fimply and adequately fo, and beyond which there can be no other; and into a leffer and fubordinate one, which is in some measure attainable in this imperfect State; and this last they call Fælicitas Viatorum, and the former Fælicitas Comprehenforum.

SUN: Dr. Hooke, in Opera Post. p. 89. from all his, and others Observations, thinks it reasonable to conclude, That the Superficies of the Sun is covered with an Air, or Atmosphere, or some other Fluid Body: And that this Atmosphere, tho' possibly 80 times thicker and higher than that stems) much after the manner as Iron, when heaabout our Earth; yet in comparison of the vast ted to such a degree as to be just going into Fusion
Diameter of the Solar Body, becomes wholly inby the vibrating Motion of its Parts, emits with this Atmosphere, and not the very Body of the portion of their Diameters. Sun that shines. And from hence he saith, that Sir Is. Newton hath made it probable, that the all the Phanomena of the Macula and Facula of great Comet in the Year 1680, in its Peribelion, Sun that shines. And from hence he saith, that the Sun will be folved; and that they are only went so near the Sun, as that it acquired a Heat Clouds or Smoaks in this Atmosphere.

The Sun it felf, within this Atmosphere, he concludes to be a Solid and Opacous Body, (p. 91.) from these Reasons. (1.) The Constancy of its Ro-ter, like the Planets, but heated to a very intense tation. (2.) The Fixedness of its Axis. (3.) degree, they may be many Millions of Years The Power of its Gravitation or Attraction to-

These prove its Solidity; and the Water will do against the lower, and conse-quently the Water must be forced up into the Pipe. 'Tis much the same thing in the Suction of Body were transparent as the Atmosphere is, or

He thinks the superficial Parts of the Sun, to confist of Bodies fimilar to our Nitre and Sulphur, and that these are set on fire; and consequently, that the Physical Cause of its Light, is the actual burning or fire of its superficial Parts. Nor can there be any Objection of Moment brought against this Hypothesis, from the danger of the Sun's Fire being burnt quite out in so many thousand Years as it hath been in being; for, (saith be) supposing it to have grown some Minutes less since it began to give Light, none can contradict it by any Observations we have on Record: For, suppo-Years standing, as we have none above 2000 of that kind; and allowing that the Sun's Diameter had been then observed to be as many Minutes as Oil, or of a fat Bitumen, an acid Salt, and a very had been then observed to be as many Minutes as fixed Earth, with a little Metal. The three first of it is now; yet could it not be thence concluded, that the Sun did not lose a Mile in Diameter every tity; but there is only a very small Proportion of the Year, and consequently be now 4000 Miles less last. The acid Salt being dissolved in Water, is the in Diameter than it was then. For fince his Diameter than it was then. meter is near 87 times greater than that of the SUMMATORY Calculus, according to fome, is the same with the Calculus Differentialis of then the Sun's must be 696000 Miles. Now Leibniz: but more properly Summatory Arithmetick, is the nore properly Summatory Arithmetick, is but a 174th part of that Diameter, and metick, is the Art of sinding the slowing Quantity, the sun's must be 696000 Miles. Now consequently would have diminished it but is of a Minute; which is a much less Quantity than the Antients pretended to observe to.

But, supposing they could have observed even to Seconds, yet that could not have contradicted it; because 'tis possible the Sun may have ap-proached as much nearer us as that Diminution amounts to; and for which, he faith, he could shew a Reason.

Sir Is. Newton also, in his Opticks, gives good Reasons, to suppose the Sun and fixed Stars to be great Earths, vehemently hot; whose Heat is con-served by the Greatness of their Bodies, and the mutual Action and Re-action between them and the Light which they emit; and whose Parts are kept from fuming away, not only by their Fixity, but also by the vast Weight and Density of the Atmospheres incumbent on them, and every way strongly compressing them, and condensing the Vapours and Exhalations which arise from them. The Light seems to be emitted from the Sun and fixed Stars (which probably are Suns to other Sy-stems) much after the manner as Iron, when heavisible to us, tho' assisted by the best Telescopes: Force and Violence, copious Streams of Liquid He supposes it also to look as bright as the Body of Fire all around: Great Bodies must preserve the Sun it felf, and that it is really the Shell of their Heat longest; and that, perhaps, in the Pro-

> which would not entirely go off in 50000 Years. Whence we may guess, that if the Sun and fixed Stars be only Collections of dense and solid Matwithout losing any considerable part of their Heat.

According to Caffini, the Sun's distance from the Earth is 172,800,000 Miles English.

The Phanomena of the Sun's apparent Motion round the Earth, on which the Theory of this vast Body is established, are by Astronomers observed to be thefe:

1. That the Centre of the Sun's Body moves anmually in the same Plane of the Ecliptick, and never deviates from the Line so called. Which apparent Motion of the Sun doth in re-

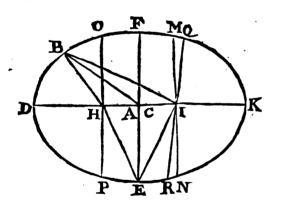
ality belong to the Earth; which being at first put into such a Motion, and with such a Direction by the Great Creator, will always continue to move after the same manner; fince here none of those

in its proper Place.
2. But the apparent Motion of the Sun in the Ecliptick is very unequal; for a little after the Vernal, and a little before the Autumnal Equinox, be is in the Mean between the Extremes of his Motion; but his Motion is most swift a little after the Winter Solstice, as 'tis always most slow a in the Equinoxial Points, the Sun appears to stay

little after the Summer one every Year.

All which arises from the Earth's revolving not in a Circle, but an Ellipsis, in one of whose Foci or Umbelici the Sun is placed. And with this Law also, that the Areas described by Lines drawn from the Earth to the Sun, shall always be equal, in equal and proportional times.

In the Figure annexed, let the Sun be in the Point I, and let the Curve FDEK be an Ellipsis, or the annual Orbit of the Earth's Centre revolving round the Sun, and represented by B.



Let the Point H be the other Focus, and C the Centre of the Ellipsis; KD its great Axis, or the Linea Apsidum; and D the Aphelion; and K the Perihelion of the Earth. FE is the lesser Axis, IC, or CH is the *Eccentricity*, or the distance between the Centre and the Foci. Let MN, or OP, right Line AB bisect the Angle HBI: Now can be obtained to any tolerable Certainty fince by Lines drawn from its Centre to the Sun, the Earth describes always Areas proportional to the Times of its Motion in the Orbit, it will de-feribe equal Areas in equal Times. But feeing the Line BI grows longer towards and at the A-phelion, and *Shorter* at and about the Perihelion, the Earth must move slower in the former, and swifter in the latter Case. And indeed the Velocity of the Earth's Course in her Orbit, will alquantity: but all that we can accurately conclude ways be in a reciprocal Ratio of her distance from it, is, that it is not so; and consequently the Sun; so that if the distance between D and I that the Distance of the Sun is vastly great.

be double to that between K and I, she will move twice as fast in the Perihelion as in the Aphe-

3. And from this Figure 'twill be apparent, that the Sun's Diameter will appear greater when the Earth is in her Perihelion, which is a little after the Winter Solstice, and less when she is in her Aphelion, which is a little after the Summer Sol-flice, as is found by Observation. And this difference in his apparent Diameter, shews also that the Earth moves, not in a Circle, but an Ellipfis round the Sun.

4. Those Places in the Ecliptick, in which these greatest Differences of the apparent Motions disturbing Forces have any Place, which render and Diameters of the Sun happen, in process of the Motion of the Moon so irregular. Of which time are changeable, and do move forward (or in consequentia) equally. For the the Aphelia and Nodes of the Planets are really at rest and immoveable; yet because of the annual Cession of the Equinoxes in antecedentia, they appear to be moved forward just the same Quantity.

about 8 Days longer in the Northern than in the

Southern half of that Circle.

For the Elliptick Orbit of the Earth will be cut unequally by a Line passing thro' the 2 Equinoctial Points: The Perihelion not being far from the Winter Solstitial Point, the Equinoctial Points will not be coincident with the longer Axis, but almost with the Latus Rectum; for in the Figure above the Line of the Equinoxes, QR is not much different from NM the Latus Rectum.

But this Inequality of the Sun's apparent Motion, is not now the same as it was in Ptolemy's Time, and is continually changing, and in pro-cess of Time the Equinoctial Points will come to be in K and D; and then there will be no difference in the time of the Sun's stay in either Segment of the Ecliptick: But after this it will encrease again, and then again decrease as now, if the Earth's annual Motion be continued.

6. And yet the Spaces or Times of the Earth's entire Revolution in her Orbir, are all equal one to another, and are what we call Years, containing each 365 Days, 5 Hours, and 49 Minutes

nearly.
7. The Angle of the Inclination of the Planes of the Ecliptick and Equator, or the Sun's greatest Declination hath been always invariably the fame,

8. The Sun's Diurnal Parallax is almost insenfible, and his Menstrual Parallax is scarce 15 Mi-

nutes of a Degree.

And this is of the greatest use in Astronomy throughly to understand; nay, of such an absolute necessity, that, without its Knowledge, neither be the Latus Rectum of the Ellipsis, and let the the Distances nor Magnitudes of the Sun or Planets,

There have been three Ways made use of by Astronomers, to find the Sun's Horizontal Pa-

1. That of the famous Hipparchus, which proceeds on the Theorem which our Mr. Horrox hath accurately described and explained, and which is exactly and geometrically certain, and would do if the Parallax of the Sun were any confiderable

Mr.

Mr. Whiston's Prelect. Astron. p. 61. where there had seen her from the Centre of the Barch. And

ler, Vendeline, and more especially by Ricciolus. This supposes that you have the exact Moment of the Time of the Half-Moon, or the Dichotomization, or Bisection of her Disk, by the Light and Shadow; and fome other things, as difficult to obtain as what you feek for: And therefore I shall tain as what you feek for: And therefore I shall Acts of October, 1685, with some sew Explica-fay no more of it, than only to refer you to tions and Corollaries. Let the Circle AFBC re-Mr. Whiston's Book, p. 66. where you have a good present the Earth's Equator, HKM the Diurnal account of this Method; because I must give you Ark of Mars, when he moves in the Equator; an account of

And this depends on a Method of determining

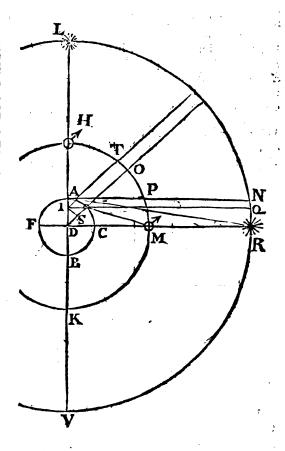
first the Parallax of Venus or Mars.

The annual Parallax of the fixed Stars, being by late Observation established, the Coperni can System is so too, and the Proportions of the Distances of all the Planets from the Sun are given. And since 'tis clear in that System, that not only Mars and Venus, but even Mercury, do sometimes come nearer to the Earth than the Sun ever doth, and consequently must have all of them a greater Parallax than the Sun at fuch times; from hence it is manifest, that if we can get the Parallax of Mars, when in opposition to the Sun, or that of Venus and Mercury, when in conjunction with him; the Sun's Parallax will be discovered. Indeed, as to Mercury, he is usually so hid in the Sun, and his Motion is yet so indetermined, that nothing certain can be established about his Paral-And the Conjunctions of Venus and the Sun are fo rare (and that time only is proper for it) that its Parallax is as yet not accurately enough determined.

There remains then Mars only, who being sometimes distant from the Earth, but half as far as the Sun; and being at fuch times, when he is in opposition to the Sun, very conspicuous and fit for Observation, is much the most sit Planet for our present Purpose. Cassini seems to have been the first that thought of, and practised this Way; but our Mr. Townley's Invention of the Micrometer hath been very serviceable to him in it, as well as of the greatest use in other Astronomical Observations. Before we describe the Method of Cassini for finding the Sun's Parallax, I must remind you, that the Parallax of Mars, for Instance, is only the difference between the apparent Place of that Planet, with respect to the Earth's which the Planet is supposed to describe in 24. Centre, and to a Point on its Surface, when the Hours round the Earth, without any regard now Planet is exactly in the Observer's Horizon; that to any other Motion. Then if you suppose this

is a short account of this Method.

2. The second way of sinding the Sun's Horiany other Planet or fixed Star. But the Method
zontal Parallax, is that which 'tis said Aristarchus
of Cassmi for sinding the Parallax of Murs (v.gr.)
hath this great Advantage in it, That it may be performed by the Observation of but one Alsenomer furnished with a good Telescope and Micrometer; fince the Part of the other may be supplied by means of the fixed Stars: Of which now take Blanchimus's Account, in the Leipsick LVR, as the Equinoctial in the Heavens, 3. A third way of finding this Horizontal Paralextended infinitely in the Region of the fix-lax of the Sun; which tho it be not fo direct, is ed Stars. Let Mars be in A, in the Plane of yet more accurate and exact than either of the Equator; then his Diurnal Revolution will be truly represented by the Motion of the Line DH, round D as a Centre, in the Plane of the Equinoctial, so as to form the Circle HMK,



Planet is exactly in the Observer's Horizon; that to any other Motion. Then if you suppose this is, you must suppose two Observers, one with his Circle to be divided into 24 equal Parts, thro' Eye at the Earth's Centre, and the other Eye at each of which a Plane shall pass at right Angles the Earth's Horizon, at the other Extremity of a to the Equator, and also thro' the Centre D; Semidiameter of the Earth, whose Position is these Planes will be the Planes of the Hour Circles. normal to that Line which connects the Earth's cles, and will also be Meridians, with respect to Centre, and that of Mars, the latter being accu-Places on the Earth. Let the right Line LHAV rately in the Horizon of that Observer, who is be one of these Planes, or the Meridian of the supposed at the Surface. And thus, for instance, Place A in the Earth's Equator, where an Obserthe Moon's Parallax may be obtained by the Obversees the Planet Mars, and the fixed Star L in servations of two Astronomers at the same Minute one and the same right Line. Now if the Star of Time, if she be Vertical to one of them, and and the Planet had only the same Diurnal Motion, Horizontal to the others because the Moon's Place they would be both topether again, at the same Horizontal to the other; because the Moon's Place they would be both together again at the same to the Vertical Observer will be the same as if he Place, or in the same right Line, at the end of 24 Hours .

Hours; and if the Diurnal Motion be supposed equable, in fix Hours the Planet and Star would be in the right Line FDMR, at right Angles with the Meridian LHD, or in the Astronomical Hour-Circle of 6. Wherefore an Eye placed at the Earth's Centre, would always see the Planet and the Star in one and the same right Line, or in conjunction together, whether in the Meridian, or any other Hour-Circle. But it can't be so to an Eye at the Earth's Surface, as suppose at A; for tho' under his proper Meridian, both the fixed Star and the Planet will appear to him in the same right Line AHL, yet in any other Meridian, as suppose that of DR, (which, in respect of the Place at A, may be confidered as the Hour-Circle of 6) Mars will appear to him in the Plane A M, but the fixed Star in the Plane AR. To him therefore Mars will either appear Retrograde, or to move in Antecedentia, or the Star to move in Consequentia, altho' in reality both are supposed to have the same Diurnal Motion. And tho' he knows that they are both at the 6 Astronomical Hour-Circle, yet Mars will appear to be past it, before the 6 Hours are expired: Because the sensible 6th Hour, with regard to the Place A, is not the Plane FDR, but APN. And the difference of Time intervening between Mars coming to the sensible Hour-Circle of 6, and the rational or real one, which may be called the Planet's Horary Parallax, is measured by the Ark of the Equator PM, which Mars by his Motion describes. And the Quantity of this Ark is equal to that of the Angle PAM, or its Alternate AMD; that is, equal to the Angle of the Earth's Semi-Diameter, when seen in Mars, and this is that Parallax of Mars which we have been Wherefore if the Ark PM be just one Degree, Mars will appear to have passed the Plane would be expired in his passing by the Meri-

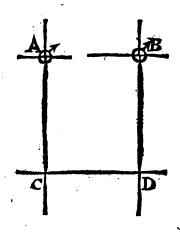
The further Mars moves from the Earth, the leffer will be the Angle of its apparent Semidiameter in Mars, and consequently the lesser will be the above-mention'd difference of Time between the Transit of the Planet by the fensible gles, will answer to the Circles of right Ascension. and rational Hour-Circle of 6.

And if his Elongation from the Earth could come to be so great as that of the fixed Stars, the Angle ARD, or its Equal NAR would then come to be so very small, as to be scarce sensi-ble; so that when the Star is in the Plane DR, it would appear in that of A N.

And by this means a fixed Star, or rather a good Pendulum Clock, made to move with the Star's Hour, will supply the Want of another Observer, in the Place represented by C; for all that an A-Aronomer there could do, is only to affure us, that he had feen Mars in the same Plane of his Meridian, or of our 6th Hour Circle, when he appears to us in another Position. But this our Clock can inform us of, by shewing us that Time after Mars hath transited our Meridian. For fince 'tis plain that the Star L, in 6 Hours after it hath passed our Meridian, will be in the Plane of the Hour Circle DR, we shall know the Star is actually in that Plane, by our Clock's shewing us, that the the transverse Hair AC; and the exact Diffe-

be imagined to pass thro' our Eye, and the Star parallel to the Earth's Axis; that Plane must be that of the sensible Hour-Circle of 6, and in which the Star must necessarily be. But Mars will ap pear to differ from this, by so many Minutes of his Parallel, as are the Number of his Parallax. Counting therefore by the Pendulum, the Seconds of Time, which intervene between the Transit of Mars, and of the fixed Star, and allowing four such Seconds for every Minute of a Degree, you will have the Quantity of the Angle MAN, or AMD, which is the Parallax of the Plane fought.

But how this difference of Time is observed, I must next shew you. In the common Focus of the Object and Eye-glasses of the Telescope you observe with, there must be placed at least 4 sine Threads,



or Hairs, intersecting one another at right Angles; and the Telescope furnished with its Micrometer, 4 Minutes of an Hour before the 6 Hours must be so moved up and down, till that fixed Star which is then nearest the Planet Mars shall appear to pass along one of the Hairs, as the Image of the Planet moves in the Telescope, as it must do, parallel to the Equator; for then the Hairs will, in that Position, be also parallel to the Equator; and the other Hairs which cross them at right An-As in the Figure annexed, where the two parallel Threads AB and CD, have 2 others, AC and BD, placed at right Angles to them, just as the Equator and all its Parallels do interfect the Meridians, or Circles of right Ascension always at right Angles; the Observer then must wait a while with his Telescope and Micrometer adjusted, till the Planet and fixed Star, being both carried together by the same apparent diurnal Mo-tion, come to one and the same Meridian: and then the exact Time of the Appearance must be noted. After 6 Astronomical Hours, the fixed Star will be come into the Plane of the 6th Hour Circle, but Mars will be got thither a little before the Star. About the Hour of 6 therefore the Telescope must be used again, and the Hairs retaining their former Position, must be brought into the Plane of the Hour Circle of 6, and there fixed. Then the exact Moment of Time must be noted when Mars appears by his diurnal Motion to move along by Time is clapfed. And because, with regard to the rence in Time also between the Planet and the fixed Stars (whose diffance is so immense) the Planet Star's coming thither afterwards, must be nicely of the fensible Hour Circle of 6 is coincident with that of the real one; if, when 6 Hours are past Parallax of Mars: which being turned into from the Star's transiting our Meridian, a Plane Parts of a Degree, as above shewed, is the Horis HoriHorizontal Parallax of the Planet requi-

By this Method, our Flamstead, and Cassini at Paris, found the Parallax of Mars to be about 25 Seconds, and certainly not more, but probably a little less.

Having thus gain'd the Parallax of Mars, let us next endeavour to obtain by it the thing at first proposed, that is, the Sun's Horizontal Parallax; which will be easily had from that of the Planet Mars. For fince at this time of Observation of the Martial Parallax, i. e. when Mars is in opposition to the Sun, the Sun must be more than twice as far distant from the Earth as the Planet Mars is, the Sun's Parallax can't be quite half so much as that of Mars, and therefore may be accounted not to be above 10 or 12 Seconds at And this agrees with the Observations of Vendeline, and those made by Cassini about the Parallax of Venus also.

Supposing then the Sun's Horizontal Parallax to be about 10 Seconds, his Distance from the Earth will be thus found: As the right Sine of 10 Seconds is to Radius, fo is the Earth's Semi-diameter in English Statute Miles, to the Sun's Distance in the same Miles; and this Way the Sun's Distance is found to be about \$1,000,000 of our Miles.

The Sun's true Diameter may also by this means

be had; for as Radius is to the Sine of the Sun's apparent Diameter, viz. 31 Minutes and a half, fo is the Sun's Distance above found to his real or true Diameter, or about 800,000 Miles Englisk.

Indeed the true Magnitude of the Sun's Body cannot be determined from hence, because that depends also on his Density, which cannot be found this way.

From this usual way of finding the Sun's Horizontal Parallax, the Astronomers draw these and fuch like Consequences:

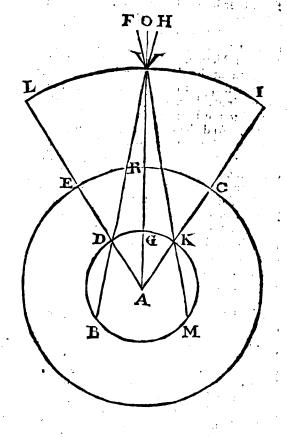
1. That it is easier to determine the annual Parallax of the fixed Stars, than the Sun's diurnal one. For fince the annual Parallax of the fixed Stars is at least quadruple of the Sun's diurnal one, as the Parallax of Mars, by whose Knowledge the folar one was found, is almost double of it; it must be better subject to Astronomical Observation, and be capable of a Determination twice as accurate.

2. In Astronomical Calculations by the Tables, this Parallax of the Sun may generally and fafely be neglected. For since it doth not arise to above

3. The Earth's Distance from the Sun being given, the Distances of the other Planets, both from the Sun and the Earth, are also given; and in the following Table you have their Distances from the Sun, their Dismeters, and the Times of their Periodical Revolution.

Mercury	'	. (32,000,0
Venus The Eart	.h	is distant from the	59,000,0
Mars		Sun, of English Miles	81,000,0
Jupiter)		424,000,0
Saturn		<u> </u>	777,000,0

The Diame English Mi	eter in les of	Venus Venus Earth Mars Jupiter Saturn Sun		4240 7906 7935 4444 81155 67870
The Time of the Periodick Revolution of	Earth	$\left\langle \cdot \right\rangle$	Days. 87 224 365 685 4332	Hours, 23 17 6 23 12 17



SUPERIOR Planets, are Mars, Jupiter, and Saturn: They are so called, because they move in Orbits round the Sun, which are larger than that of our Earth, and so are above us with rea nxtn part of a Minute of Time, it will be gard to the Sun, and never can come between fcarcely confiderable; our present Astronomithe Earth and him. The Theory of the Motions cal Tables not being capable of bringing us to a greater Accuracy and Exactness.

1. That, besides their apparent Motion from East to West, which the diurnal Rotation of the Earth occasions, they appear usually to move also slowly from West to East, and to make entire Revolutions this way; as in reality they do in their Orbits round the Sun: But Mars moves faster than Jupiter, and Jupiter than Saturn, in proportion to their several Distances from the Sun.

2. But sometimes they will also to an Eye at oco our Earth, appear to move the contrary way from East to West, which was a great difficulty in the oco old Astronomy, but may easily be solved by the ooo confideration of the following Diagram; in which let A be the Sun, MGB the Orbit of the Earth, in which it moves annually from M by G, towards

B from West to East; let the Circle QRS be the immense distance, and with respect to which, the Retrogradation and Stations, &c. of the Planet are accounted. For tho' to an Eye placed in the Sun at A, the Planets would appear to move always uniformly and equally forward in their Orbs, as in reality they do; yet to an Eye placed on the a given Ratio, as suppose in the Ratio of 2 Surface of our Earth, the Phænomena will be very different, and the Planets will appear some. Take the Side of the Surface, and to it open times to be Retrograde and Stationary in their Motions, as well as at other times Direct. For, suppose the Earth at M, and Jupiter in C, while Jupiter moves from C to R, and describes the Ark C R, a part of its Orbit round the Sun in A: The Earth, because its Angular Motion is much more fwift, will describe the Ark MG; so also while fupiter describes the Ark R E; the Earth will move from G to B. Now while the Earth is defcribing the Ark M K, Jupiter will appear to be moving a little forward; but whilst the Earth moves thro' the Ark K G, Jupiter, tho' in reality still progressive or direct, will appear to be Retrograde, and to move backward from F to O. Nor can it be otherwise, while the Earth moves from G to D, and while Jupiter describes the Ark R E. But when the Earth comes towards B, then the Planet will appear a little direct again, and his apmove from G to B. Now while the Earth is de-Planet will appear a little direct again, and his apparent Progressive Motion will for a while continually encrease. And when the Earth is near K or \mathcal{D} , the Planet will appear to be Stationary in F or H. So that 'tis obvious to fee that the apparent Motion of the Planets will be very irregular and unequal, sometimes swifter, and sometimes flower, according to their Position, with respect to the Earth.

3. The Progressive Motion of every Superior Planet will be swiftest in his Conjunction with the Sun, as his Retrograde Motion will be swiftest in his Opposition. For the apparent direct Motion of the Planet in his Conjunction, arises from ces. the Sum of the Motions of the Earth and Planet then moving directly contrary one to another; and the Retrograde Motion in the Opposition arises from the greatest Excess of all the Terrestrial Motions above the Planetary, both from there being then the least Distance between the Earth and the Planet, and from the Governing the Church, without any Authority Parallelism of their Motions at that time, as is clear from the Consideration of the Figure

They are made by finding mean responsibilities to tween the two Homologous Sides, and the hundred the two Homologous Sides, and the hundred the part of such a Side, or by a Table of ses, by 25 H. 8. c. 19. the sometimes a Resquare Roots; which Roots may be taken out of view is granted. Before this Statute, the Apartle Divisions of the Lines of Lines, and they will peal from the Archbishop's Court lay to the People of t give the proper Distances from the Centre, where ple only the 10 (or 100) unequal Divisions must be pla-

The Uses of the Line of Superficies.

1. To find the Proportion between two or more Similar Superficies.

Take one of the Sides of the greater Surface, Orbit of any Superior Planet moving the same and put it over from 10 to 100, at the end of the way as the Earth. Let the Circle TV X represent the Sphere of the fixed Stars supposed at an ing Sides of the Similar Surfaces severally, and ing Sides of the Similar Surfaces severally, and carrying the Points of the Compasses so that they fall on the same Number on each Leg, they will there shew the Proportion which they bear to

2. To augment a Surface, or to diminish it in

Take the Side of the Surface, and to it open the Sector in the Points 2 and 2, in the Line of Surfaces; and, letting the Sector lie, the Distance between 5 and 5, will give you the Side of a Similar Figure, whose Area shall exceed that of the given one in the Proportion required. And proceed vice versa, for diminisbing

3. To Add together, or to Substract one from a-

nother, Similar Surfaces.

Find first the Ratio between the Surfaces by Prop. 1. and then Add or Substract the Numbers, expressing those Proportions by Prob. 2. and then augment or diminish by the precedent Pro-

4. To find the Ratio between Unlike or Non-Similar Surfaces.

First find Squares equal to those Surfaces, and then those being Similar Figures, you may easily find the Ratio they bear by Prob. 1.

SUPREMACY of the Queen within her Dominions, is declared by the 37th Article of the Church of England, by Can. 1. and 2. by Stat. 25 H. 8. c. 19, 20, 21. and by Stat. 1 Eliz. 1. to be Power of Sovereignty and Rule over all Persons born within her Majesty's Dominions and Realms, of what Estate soever they be, when the Ecclesistical or Civil (or Temporal) so ther Ecclefiaftical or Civil (or Temporal) fo as no Foreign, nor other Power, shall, or ought to bear any Superiority over them. This Su-premacy chiefly consists in the following Instan-

1. That the Archbishops of either Province cannot fummon their Bilhops and Clergy to Convocation, nor enact any Canons, without the Queen's express Consent, by 25 H. 8. c. 19. Whereas before that Act the Convocation was often called, and Laws were made by it for from the Crown.

2. In that there lies now an Appeal from the Archbishop to the Queen in Chancery; and on SUPERFICIES; they are frequently placed fuch an Appeal, a Commission under the Great Seal upon a Sector, 2 Lines (one on each Leg) which is to be directed to certain Persons, whereof com-Mr. Gunter calls very properly Lines of Superficies.

They are made by finding mean Proportionals be-which is called the Court of Delegates; and which is called the Court of Delegates; and which is called the Court of Delegates.

> 3. The Queen can grant Commissions for vi-fiting such Places as are exempt from the Jurisdiction of the Bishops and Archbishops, and Appeal lies from thence to the Queen in Chan-Whereas before 25 H. 8. the Pope could only visit them, and receive Appeals from those

Courts.

Fffff

4 Pet-

more than Laymen. And,

5. Now the Bishops and Clergy neither Swear, nor pay any Obedience to the Pope, but must take the Oaths of Allegiance and Supremacy to

the Queen, &c.

SURFACE Line, or Line of Superficies, is a Line placed by Mr. Gunter on each Leg of his

their Term for a Quantity of Water which breaks in upon them in their Work; when they meet with it, they drive an Adit on a level till it is dry. See

Lead.

SYMPATHY, is an Agreement of Affections between two or more Persons; some have thought that there is also a Sympathy between some Natural Bodies, or their Particles. But this ought rather to be called a Congruity. See that Word.

SYNDICK, in the Civil Law, is sometimes the Title of a single Person, deputed to act for any Corporation or Community.

SYNODALS, or Synodies, were a pecuniary Rent (commonly two Shillings) paid to the Bi-

4. Persons in Holy Orders are not, as formerly, shop at the Time of the annual Synod, by exempt from the Queen's Temporal Laws, any very Parochial Priest. For the Bishops used For the Bishops used to hold their Diocesan Synods, and to visit all ar once; from whence these Synodals are accounted amongst the Bishop's Procurations at this Time.

SYNODALES Testes, the Urban and Rural Deans were at first so called, from informing against, and attesting the Disorders of the Clergy Sector; 'tis divided into 100 unequal Parts, and and People in the Episcopal Synod. But when numbred with 1, 2,3, 4, &c. to 10. See Superfithey funk in their Authority, the Synodical Witcies.

SWALLET, in the Lead-Mines in Mendip, is of a Priest and two or three Laymen for every Parish. And, at last, two for every Diocess were annually cholen, till, at last, this Office came to be devolved upon the Church-wardens. Some think our Questmen, who are affistant to the Church-wardens, were called Sidef-men, from hence quasi Synod-men.

SYNODALE Instrumentum, was the Solemn Oath that these Synodical Witnesses took, as now our Church-wardens are Sworn to make their just

Presentments.

SYZIGIES; how to calculate the exact Time of the True and Mean Syzigies of the Sun and Moon, in order to the determination of Eclipses, vid. Whiston, p. 145.

lor Scholars of the Poundation of Queen's and certain, and sometimes at the arbitrary Plea-in Oxon. They were so called from a short sure of the Lord; and it was also sometimes com-Gown, called Taberd, or Tabert, in those Days, reaching no lower than their Middle-leg; which

Number of Men into a proper form of Bat-Shot, which they could not do it it were letle: The Greeks were very skilful in this part of the Art Military; having Publick Professors
of it, who were called Tactici, who were to
gem to a Cone, when 'sis coincident with
teach and instruct their Youth in this Matter. two Lines, one of which is drawn on the SurAlian hath a particular Book on this Subject; face of the Cone, and thro' its Vertex, and
and there is a great deal of it in Arrian, in his
the other a Tangent to the Circle of the Base. History of Alex. M. and in Mauritius and Leo meeting the former Line in the Point of Con-

Imperator.
TAILLE Douce, a Term in Painting, fignifying, as Mr. Evelyn in Chalcography tells us, the Art of and half Tangents are made, you'll find under Sculpture or Chalcography it self. In French it fignifies fiveetly or tenderly cut; and this, whether the Parts of Right Circles in Spherical Projection, done with the Burin (or Graver) or with Aquafortis, which we call Etching. He faith, the Use of the Line of artificial Tangents, in concert
Italians call it Intaglia or Stamp, without any
Epithet or Adjunct; and also Bolino, which he
Plain Trigonometry, &c. But there are some takes to be the more antient and unwarrantable, other Uses of the Lines of Tangents and half Tanas implying the use of the Point and Needle, and gents in Dialling, &c. Sometimes on the edge of of Etching with Aquasortis; which is sometimes Gunter's Sector you have a Tangent Line, in whose

ABERDERS, or Tabiters, for so, by Corrup-Tenants by their Lords. And this latter Tallage tion, it is now pronounced, are the Batche-of the Cultomary Tenants was sometimes fixed pounded for.

TALUS Superior, in Fortification, is the Slope these Batchelor Scholars were then obliged to on the top of the Parapet; for the top of the Parapet; for the top of the Parapet is made sloping, that the Sol-TACTICKS, is the Art of disposing any defend the Covert-way with small

vel.

TANGENT; a Plane is said to be a Tan-

TANGENT Line, how the Line of Tangents vou'll find under Scales; and their Uses in Projecting and Measuring fo happily performed, as scarce to be discerned end a Pin or Gnomon, equal to Radius, is nor-from the finest Stroaks of the Bolio, or Graver it felf.

Altitude may be had, by holding the Sector TALLAGE, was formerly a certain Rate or erect, and the Pin parallel to the Horizon; Proportion, according to which Barons and for then the Shadow of the Gnomon, when Knights were tax'd by the King, and inferior turned to the Sun, will, in the Divisions of

the Tangent shew the Degree of the Sun's Glass,

height.
This Tangent-Line is used also to draw the Dialling

On the Cross-staff there are also Lines of Tangents drawn; one usually of 36 deg. 3 min. and a- Lens than the Focus of the least refrangible Rays, nother of 49 deg. 6 min. which, because their mid- by a Distance which is to the 27 ½ part of the dle Points are at 20 and 30, are, by Mr. Gunter, called the Tangents of 20 and 30. These Tancalled the Tangents of 20 and 30. These Tan-Rays from the Lens, as the Distance between that gents are used in taking of Angles, the Altitude Focus and the lucid Point from whence the Rays

fourth Geometrical Lection, p. 40. gives a gene-ral Method of determining the Tangents to all Cycloids, and all other Curves described, or gene-that of the least refrangible, by above the 14th rated after the manner of a Cycloid. In Lect. 9, 10. part of the whole Distance: And if they flow from he shews how to determine Tangents to all a lucid Point so very remote from the Glass, that, manner of Spiral Curves, and to many Curves before their Incidence, they may be accounted of other kinds. In Philosophical Transactions, parallel; the Focus of the most refrangible Rays, of other kinds. In Philosophical Transactions, parallel; the Focus of the most refrangible Rays, N° 284. you have a Method of Tangents shall be nearer to the Lens, than the Focus of the least refrangible, by a 27th or 28th part of the least refrangible, by a 27th or 28th part of by Mr. H. Ditton, taken from the Theory of Maxithe least refrangible, by a 27th or 28th part of ma and Minima, which is very simple and unitheir whole Distance from it. And the Dia-

them on the Coasts of Spain.

TASSELS, in a Building, are those Pieces of Boards that lie under the Ends of the Mantle-

and Measures.

of the Tooth doth not grow in Adult Persons, but only the Perioftium; which is a Substance very different from the Bone every way. 'Tis compo-frangibility of the Rays, is as 1 to 8151; and fed, be faith, of an infinite Number of small consequently is so little, as deserves not to be Threads, which are sastened to the Bone by their Roots, much like the Horns and Nails of Animals; these little Threads grow as the Nails.

laid bare, the Tooth usually perishes.

of Light; and not, as hath been vulgarly suppo-magnify with equal Distinctness, the Apertures sed, by the Spherical Figures of Glasses: and con- of the Object-Glasses, and the Charges, or magfequently, they will not be perfected by Glasses infying Powers, ought to be as the Cubes of the of the Figures of the Conick Section, i. e. by Parabolick, Hyperbolick Glasses, &c. For having shewed the Ratio between the less and the Rays arising from the different Refrangigreater Refractions of the different Rays to be very nearly as 27 to 28, be faith, those that are skilled in Opticks, will easily understand, that the least circular Space, into which the Object Glasses of Telescopes can collect all forts of parallel Rays, is about the $27\frac{1}{2}$ part of half the Aperture of the Whole Aperture; and that the Focus of the most refrangi
of the Glass; or the 55th part of the whole Aperture; and that the Focus of the most refrangi
of $2\frac{2}{2}$ Inches, magnifies about 120 times with perture; and that the Focus of the most refrangi-ble Rays, is nearer to the Object Glass than the Focus of the less refrangible ones, by about 27 \(\frac{1}{2}\) part of the Distance between the Object 15 times.

and the Focus of the mean refrangible

This Tangent-Line is used also to draw the Hour-Lines on the Planes of Dials; and is com- lucid Point in the Axis of any Convex Lens, be monly known and shewn in almost all Books of made by the Refraction of the Lens to converge to Points not too remote from the Lens, the Focus of the most infrangible Rays shall be nearer to the Lens than the Focus of the least refrangible Rays. Distance of the Focus of the mean refrangible of the Sun or Stars, &c. as you will find under flow, is to the Distance between the lucid Point and the Lens very nearly.

Or. Wallis gives an Abstract of his two After this, he shews, by Experiments, made

Dr. Wallis gives an Abstract of his two After this, he shews, by Experiments, made Methods of drawing Tangents to Curves, in with very great accuracy, that the Rays of Light, Philosophical Transactions, N. 81. which are taken which differ in Refrangibility, do not all converge from his Conick Sections, and other Parts of his to the same Focus; but if they flow from a lucid Mathematical Works. And Dr. Barrow, in his Point as far from the Lens on the one fide, as their meter of the Circle in the middle Space between TARTANE; is a small Vessel, much used in these two Foci, which they illuminate when the Mediterranean, with but one Mast, and the they fall there on any Plane, perpendicular to three-cornered Sail, like a Galley; they fish with the Axis (which Circle is the least into which they can all be gathered) is about the 55th part of the Diameter of the Aperture of the Glass. So that its a wonder that Telescopes do represent Objects so distinctly. But were all the TAXERS; are two Officers chosen in Cam-Rays of Light equally refrangible, the Error bridge, to look after the true Gage of all Weights arising only from the Sphericity of the Pigures of Glasses, would be many hundred times less. And TEETH: Mr. de la Hire observes, that the Bone express by Calculation, p. 70. he proves, that the Tooth doth not grow in Adult Persons, to only the Periostium; which is a Substance very Glasses, to that arising from the different Re-

There is another Argument, (faith our excel-When a lent Author, p. 73.) which proves, that the ditpart of the Periostium is broke, and the Bone is serent Refrangibility of the Rays, is the true laid bare, the Tooth usually perishes.

Cause of the Imperfection of Telescopes. For TELESCOPES: (1.) Sir Isaac Newton, in the Errors of the Rays arising from the spherical his admirable Treatise of Opticks, p. 59. demonstrates, That the Perfection of Telescopes is impeded by the different Refrangibility of the Rays thence to make Telescopes, of various Lengths,

concludes that there can scarce be any other means of improving Telescopes by Refractions alone, befides that of increasing their Lengths; for which end the late Contrivance of Hugenius seems well accommodated. (See Philosophical Transactions, Nº. 161.) Glasses are readily manageable, and the Object-Glass being upon a strong upright Pole, becomes more steady.

Sir If. Newton, in his Opticks, p. 76, acquaints us how he polished his reflecting Metal, which he used in his restecting Telescope; and which, because it appears to be a much better way than in any common Use, I here give the Rea-

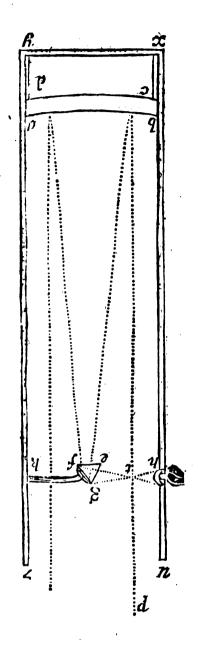
I had two round Copper-plates, each of fix Inches in Diameter, the one Convex, and the o- on the Fore-fide ab, and as much convex on the ther Concave, and ground very true one to ano- Back-fide cd, so that it be every where of an ether; on the Concave I ground the Object Metal qual thickness; for it must not be thicker on one or Concave, which was to be polished, till it fide than the other, lest it make Objects appears had taken the Figure of the Convex, and was coloured and indistinct: it must also be very ready for a Polish; then I pitch'dit over thinly, by well wrought and quickfilver'd over on the Backdropping melted Pitch upon it, and warming it, to fide: Place this Glass in the Tube v. y. z., which keep the Pitch soft, whilst I ground it with the must be made very black within. Let efg repre-Concave Copper, wetted to make it spread evenly sent a Prism of Glass or Chrystal, placed near the all over the Convex. Thus, by working it well, I other end of the Tube, in the middle of it, by made it as thin as a Groat, and after the Convex means of an Handle of Brass or Iron fgk, to was cold. I ground it again, to give it as true a Fi-whose end, made flat, it is cemented. Let this gure as I could. Then I took Putty, which I had Prism be Right-Angled at e, and the other two made very fine, by washing it from all its gross Angles exactly equal, and consequently each 45 Particles, and laying a little of this on the Pitch, Degrees. Let the Sides ef and ge be exactly Particles, and laying a little of this on the Pitch, Degrees. Let the Sides ef and ge be exactly with the Concave Copper, I ground it upon the plane and Squares, and by consequence the third Pitch, till it had done making a noise; and then on Side fg, a rectangled Parallelogram, whose the Pitch I ground the Object Metal with a brisk Length is to its Breadth in a subduplicate Pro-Motion, for about two or three Minutes, leaning portion of 2 to 1. hard upon it. Then I put fresh Putty upon the Pitch, and ground it again, till it had done making a, noise, and afterwards ground the Object-Meta upon it, as before; and this Work I repeated, till the Metal was polished, grinding the last time with all my Strength for a good while together, and frequently breathing upon the Pitch, to keep it moist, without laying on any more fresh Putty.

But because Metal is more difficult to polish than Glass, and is afterwards very apt to be spoiled by tarnishing, and besides reslects not so much Light as Glass, Quickfilver'd over, does; I pro-pound, instead of Metal, to use a Glass, ground Concave on the fore-fide, and as much Convex on the back-fide, and on the back-fide well Quickfilver'd over; the Glass also must be exactly all over of the same thickness, otherwise the Object will look coloured and indi-Hinet.

With such a Glass I tried, about five or fix Years ago, to make a Reflecting-Telescope of four Feet in length, to magnify about 150 times: And I satisfy'd myself, that there wants nothing but a good Artist to bring this Design to Perfection: For the Glass being only after the common manner of grinding Glasses for Telescopes, tho' it seem'd as good as Object-Glasses used to be, yet when it was Quickfilver'd, the Reslection discover'd innumerable Inequalities all over the Glass: And by reafon of these Inequalities, Objects appear'd indi-stinct in this Instrument. For the Errors of Refletted Rays, caused by any Inequality of the Glass, are about fix times greater than the Errors of Re-

By reason of this different Refrangibility, he fracted Rays, caused by the like Inequalities. But I however found by this Tryal, that the Reflexion on the concave fide of the Glass, which I fear'd would disturb the Vision, did really no sensible prejudice to it; and consequently, that nothing is wanting to perfect these Telescopes but good For in his Aerial Telescope, the Workmen, who can grind and polish Glasses trureadily manageable, and the Object-ly spherical. I once mended a common fourteen Foot Object-Glass confiderably, by grinding it with Pitch or Putty, and learning very easily on it in the grinding it, left the Putty should scratch it: befides, leaning too hard on the Glass in grinding it, is apt to bend it; and then the Figure cannot be truly spherical.

Sir Isaac Newton's Method of shortning Te-escopes, vid. his Opticks, p. 29. Let abde represent a Glass spherically concave on the Fore-fide ab, and as much convex on the



Let this Prism be so placed in the Tube, that the Axis of the Concave Speculum may pass thro' the middle of the square side of perpendicularly, and consequently thro' the middle of the side fg, at an Angle of 45 deg. And let the fide ef be turned towards the Speculum, and the Distance of this Prism from the Speculum be such, that the Rays of the Light pq, rs, &c. which are incident upon the Speculum in Lines parallel to the Axis all Money payable to the Queen, by Warrant from thereof, may enter the Prism at the side ef, and the Auditor of the Receipt, and make weekly be respected by the side fg, and thence go out of it and yearly Books of all Receipts and Payable 1.6.1. thro' the side g e to the Point t, which must be the ments, which they deliver to the Lord Treacommon Focus of the Speculum a b d c, and of a Plane Convex Eye-glass b, thro' which those Rays must pass to the Eye. And let the Rays at their coming out of the Glass pass thro' a small round Hole, or Aperture, made in a little Plate, Lead, Brass, or Silver, wherewith the Glass is to be covered; which Hole must be no bigger than is necessary for Light enough to pass thro': for so it raised before the Curtain, in the middle of the will render the Object distinct; the Plate in which Fos: It is of three sorts; the first is composed of a it is made, intercepting all the erroneous Part of Curtain, two Flanks and two Faces: The Ram-

the Light which comes from the Verges of the Speculum ab.

Such an Instrument well made, if it be 6 Foot long (reckoning the Length from the Speculum to the Prism, and thence to the Focus t,) will bear an Aperture of 6 Inches at the Speculum, and magnify between 2 and 300 times. But the Hole b, here limits the Aperture with more advantage, than if the Aperture were placed at the Speculum

If this Instrument be made longer or shorter, the Aperture must be in proportion, as the Cube of the square Root of the length, and the magnifying as the Aperture. But it's convenient, that the Speculum be, at least, an Inch or two broader than the Aperture; and that the Glass of the Speculum be thick, that it bend not in the working. The Prism e fg, must be no bigger than is necessary, and its backside fg must not be Quicksilver'd over; for without Quicksilver it will restect all the Light incident on it from the Speculum.

In this Instrument the Object will be Inverted, but may be erected by making the sides ef, and eg of the Prism efg, not plain but spherically Convex, that the Rays may cross as well before they come at it, as afterwards between it and the Eye-Glass.

If it be defired that the Instrument bear a larger Aperture, that may be also done, by composing the Speculum of two Glasses, with Water between them.

The reason why four Glasses in a Tele-scope represent the Object erect, Mr. Molyneux shews plainly in Philosophical Transactions, Nº 183.

Mr. Auzont saith, in Philosophical Transactions, No 4. That the Apertures of Telescopes ought to be in a Sub-duplicate Ratio of their Lengths; but this must be taken, so as to allow for the Quantity of Light which comes into the Tube; for the more Light comes in, the greater the Apperture must be, saith Dr. Hook. ibid. And Dr. Hook also doth there shew a way to make a Plane Convex-Glassof a small Sphere collect the Rays at a great Distance; but I don't find that he ever made any considerable Use of it afterwards.

Mr. De la Hire saith, in the Memoirs de l'Academie Royal des Sciences, for May 1699. That to prevent the Dew falling on the Object-Glass of Telescope in a no turnal Observation, 'tis a a Telescope in a no Turnal Observation, very good way to make a Tube of coarse brown

Paper.
TELLER; is an Officer in the Exchequer (of which there are four) who receive all Moneys due to the Queen, and gives the Clerk of the Pell a Bill to discharge him therewith. They pay also

TEMPORALTIES of Bishops; are such Revenues, Lands, Tenements, or Lay-Fees, which Kings, or other Persons of high Rank in the Kingdom. have been laid or annexed to Bishops Sees by our

TENAILE of the Foss or Ditch; is a low Work 1 art part of the Curtain, including the Parapet and Meteor, are thus accounted for, and solved by Talus, is but five Fathom thick, but the Rampart Dr. Hooke, Opera Posth. p. 169. of the Flanks and Faces is seven. The Second, which Vauban faith he found to be of very good Defence, is composed only of two Faces made on the Lines of Defence, whose Rampart and Faces which fort of Particles, there are also others raised The Third fort differs from the Seare parallel. cond, only that its Rampart is parallel to the ture of Sulphurcous, Unctuous, or other combusti-Ourtain of the Place. All three forts are good ble Bodies; as we see Spirit of Wine, Spirit of Defences for the Ditch, and lie so low, that they cannot be hurt by the Besiegers Cannon, till they bushible Bodies, will by Heat be raressed into are Masters of the Covert-way, and have planted the form of Air or Smoak, and be raised up into the their Cannon there.

TERRER, or Terrier, is a Book or Roll wherein the several Lands, either of a private Person, or are also other forts of these sulphureous Steams, of a Town, College, Church, &c. are descri-which arise from subterraneous and mineral Bobed; and this should contain the Number of dies; which, only by their coming to mix with the Acres, the Site, Boundaries, Tenants Names, Nitre of the Air, tho' they have no fensible Heat

descendable to all the Sons, and therefore called more especially if any part of them be kindled, Govel-kind, were deviseable by Will, and there-then the whole Train which is mingled with the Gavel-kind, were deviseable by Will, and there-fore called by this Name, Terræ Testamen-

TESSELATA Pavimenta; were the Pavements in the Tents of the Roman Generals, a rich as I could prove by a multitude of relations from

the Form of Dice.

with us in H. 8th's time for 12 d. but in Edw. 6th's out of the Earth (and to this the subterraneal they sunk down to 9 d. and then to 6 d. (which Heat also is continually concurring) a great Quan-still retains the Name of a Testor.) In Anno Dom. tity of sulphureous Vapours, which are of such a 1559, they fell to 4 d. ob. and Stow faith, there nature, as that meeting with the Nitre of the Air, was a second fort of Testons, which in that Year were Cried down to 2 d. q. and that there was a third fort, which were made unpassable at any rate. vid. Chron. Preciof. p. 41. TETRACTYS Pythagorick, was a Point, Line,

Surface and Body.

TETRAGONISTICK Calculus, is the same with the summatory or differential Calculus of

Leibnitz; which see.
THANE, anciently in the Saxons time, was a military Servant; the King's Thane was a Saxon Lord or Nobleman: but after the Conquest the Word came to be used sometimes to denote all Persons of Superior Degree.

THORUS. See Tore.

THRAVE of Corn, in most parts of England, confists of four Shocks; and each Shock contains fix Sheaves; but in some Places they reckon but fire, such Explosion may well follow with such twelve Sheaves to a Thrave.

value of a Groat, or the third part of a Shilling; being seemingly a Corruption from Tremissis, which was a German Coin, of the value of Four-pence. Some will have it to be a Three Shilling Piece, us, will do no mischief, or not considerable; like a but it seems a Mistake.

THUNDER and Lightning. The Phanomena of this very common, but oftentimes dreadful the Explosion be near to us, or amongst us, it

The Atmosphere about the Earth abounds with nitrous Particles of a spirituous Nature, which are every where carried along with it; besides up into the Air, which may be somewhat of the Na-Turpentine, Camphire, and almost all other com-Air. All which, if they have a fufficient Degree TENON, in Architecture, is the square end of of Heat, will catch Fire, or be turned into Flame by the nitrous Parts of the Air; as thousands of Experiments might be brought to prove. in them, will fo ferment and act one upon another, TERRA Testamentales; Lands that were held as to produce an actual Flame: which is a tree from Feodal Services, in Allodio, in Soccage, thing that hath been often found in Mines, and contiguous Air, will immediately take fire, like a Train of Gun-powder, and run from one end of those Vapours to the other, be they ever so long; Mosaick Work, made of curious small square Coal-Mines, and several other Mines. The Ac-Marbles, Bricks, or Tiles, called Teffellæ, from cention of which Vapours is so sudden, and with fuch violence and swiftness runs from one end TESTONS, or; as we commonly call them, Teto the other, as often to kill the Miners, blow up flors, from their having an Head (Testa) upon their Props, Turns, Stays, Houses, &c. and them, were in 34 H. 8. coined either here, or in produceth as prodigious Effects, as if a vast France; and Spelman saith, their value in France Quantity of Gun-powder had been fired in the was 18 d. and he doth not know but that they might. Mine. Now Lightning in the Air seems to be go for as much here. He saith it was Brass, and much of the same Nature; for the Air scontinual-cover'd over with Silver, (which perhaps gave rise by furnished with spirituous nitrous Parts; and the to the Iniquity of Plating Money.) They went Summer Heat, whenever extraordinary, raises up with us in H. 8th's time for 12 d, but in Flore, 6th's out of the Earth (and to this the subterraneal they work upon each other, and thereby begins a further Degree of Heat, which gradually encreases, till at last it arrive at a certain pitch; and then they fall upon and work on one another, producing an actual Fire and Flame, which with won-derful swiftness fires the whole Train, and so produces the Flash and Noise.

Dr. Wallis in Philof. Trans. N° 231. p. 655. faith, That Thunder and Lightning are so very like the Effects of fired Gun-powder, that we may reasonably judge they proceed from the like Causes. Now the principal Ingredients in Gunpowder, are Nitre and Sulphur, (the admission of Charcoal being chiefly to keep the Parts separate, for the better kindling of it.) So that if we suppose in the Air a convenient mixture of Nitrous and Sulphurous Vapours, and those by accident to take welve Sheaves to a Thrave.

Noise and Light, as in the firing of Gun-powder;

THRIMSA, was an old piece of Money of the and being once kindled, it will run from Place to Place, as the Vapour leads it, like as in a Train of Gun-powder, with the like Effects.

This Explosion, if high in the Air, and far from parcel of Gun-powder fired in the open Air, where nothing is near enough to be hurt by it.

may

may kill Men or Cattle, tear Trees, fire Gun-pow- Land, Seas, Lakes, &c. of little or no breadth; der, break Houses, or the like; as Gun-powder because they are so narrow, that the Moon can't would do in all like Circumstances. This Near- act stronger on one Part than on another: and so ness, or Farness, may be estimated by the Distance there being no difference of Attraction, there is no of Time between feeing the Flash of Lightning, reason why one part should swell or rise more than and hearing the Clap of the Thunder; for tho'in another; for, the Attraction being equal, the Watheir Generation they be Simultaneous, yet ter cannot shift or move from one Place to another. Light moving faster than Sound, they come to us ther. successively. I have observed, that commonly the Noise is about seven or eight Seconds after the lumn from the Astragal to the Capital. Flash; but sometimes 'tis much sooner, in a Second or two, or less than that, just after the Mundlek from the Tin-Ore. See its Description Flash; and then the Explosion must needs be under Tin. very near us, and even amongst us. And in such TIN: In Philosophical Transactions, N° 69. and Cases I have more than once presaged the Ex- No 138. you have the following Account of the pectation of Mischief, and it hath proved accordingly.

**Recording Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Common Control of Cont

Now that there is in Lightning a fulphureous

of a little Water, will not only produce a great Effervescence, but will of itself break forth into an actual Fire. I say a little Water, because too much will hinder the Operation, or quench the Fire: And this I take to be the Cause of the Bath-Sulphur cause a great Effervescence, but no Flame. So that there wants only some Chalybeate, or Vitriolick Vapour (or somewhat equivalent) to prodistance in the bottom of a neighbouring Valley. duce the whole Effect, (there being no want of They take notice also of the Frets, or Openings Aqueous Matter in the Clouds.) And there is no doubt, but that amongst the various Effluvia from the Earth, there may be copious Supplies of Matter for fuch Mixtures.

The same Account may also be given of Ætna, and other burning Mountains, where the Mixture of Iron and Sulphur may give a Flame; which is often attended with prodigious Explosions and Earthquakes, from great Quantities of Nitre, as

in Springing a Mine.

the Uvula, arising fleshy from the edge of the upper part of the Cartilago Thyreoides, between the Thyreo-pharing aus, and the Membrana Faucium; from thence it ascends straight upwards, being much dilated as it approaches the Uvula, on the apper fide of which it is spread very broad. In Swallowing, when this Pair of Muscles act, the Foramina Narium are in a great measure shut, to hinder the passing of any thing thro' into the Nose, that is taken in at the Mouth. Douglas Micgr. Comp. Specim.
TICHONIAN Hypoth. See Tychonian.

TIDES: The Tides of the great Ocean being caused (as you may see in Vol. I.) by the Action or Attraction of the Moon upon it (chiefly) and because that part of the Ocean, which is directly under the Moon, will be more attracted by it trust not to any found in the River, it being unthan the rest; there the Ocean must swell or certain from whence the Water may have brought them, and the Water will run from other Parts thither.

TIGE, in Architecture, is the Shaft of a Co-

The Miners imagine, that, before the Deluge, Vapour, is manifest from the sulphureous Smell the uppermost Surface of the Mineral Veins, or that attends it, and the sultry Heat in the Air, Loads, lay parallel to the upper Surface of the which is commonly a Fore-runner of Lightning Earth; but that, in the Flood, they were moved, foon after. And that there is a nitrous Vapour loosed, and torn off; and that by the descending in it, we may reasonably judge, because we do of the Waters into the Valleys, both the Earth or not know of any Body so liable to a sudden and Grewt, and those Mineral Stones or Fragments so violent Explosion.

Grewt, and those Mineral Stones or Fragments so torn off from the Loads, (and which they call Shoad) As to the kindling of these Materials, in order to were, together with, and by the Force of the such an Explosion, I am told that a Mixture of Waters, carried beneath their proper Place, and Sulphur, and Filings of Steel, with the Admistion from some Hills, even to the bottoms of the neighbouring Valleys, and from thence by Land-Floods down into the Rivers.

On these Suppositions, they proceed thus in Trayning or pursuing of a Load: Where they suspections Mine to be, they diligently search that Waters, and other hot Springs, where Steel and Hill and Country (as they call the Place where the Mine lies) that they may the better know the Green and the Stones, when they meet them at a which are made in the Banks of Rivers, newly made by great Land-Floods, which usually are then very clean, to see whether there be any Metalline Stones in the Sides, or Bottoms; together with the Cast of the Country, as they call it, i. e. any Earth of a different Colour from the rest of the Bank. And this is a great help to them, to discover which Hill, or which fide of it to search. The Mineral Stones are discovered, either by their Weight, or their Porofity; for most Tin-Stones THYREO-STAPHILINUS, is a Muscle of are Porous, not unlike great Bones, almost e Uvula, arising sleshy from the edge of the upvery firm Stones; and Dr. Chr. Merret faith, that they are usually found betwixt two Walls of Rocks, which are commonly of an Iron Colour, of little or no Affinity with the Tin. Vid. Phil. Trans.

> Another Way they have to discover whether the Stones contain any Ore, is, what they call Vauning, which is, to powder the Stone, Clay, &c. or whatever is suspected to contain any Metal, and then placing it on a Vauning Shovel, then will the Gravel remain in the hinder part, and the Metal at the Point of the Shovel; whereby the Nature, Kind, and Quantity of the Ore is very nearly guess'd at.

them. But then they go to the fides of the Hills most suspected, where there is a convenience of But from hence only it will not follow, that bringing a little 8tteam of Water (the bigger the there should be Tides produced in Rivers and in better) and then they cut a Leat or Gurt, as they

call it, that is, a Trench about two Foot over, and no other Load or Vein, neither doth it fend forth as deep as the Shelf; and by this means turn the Water, running two or three Days, that by washing away the Earth from the Stones, it may discover the Shoad. If they find any, they conclude there is a Load in the upper part of the Hill, or at least a Squat. Then at the foot, or bottom of the Hill, they fink what they call an Pffay-batch, i.e. a Hole about fix Foot long, and four broad, and always as deep as the Shelf; and if they find no Shoad there, when they come to the Shelf, there is none to be expected: Tho' fometimes the Shoad is washed clean away, when you come within two or three Foot of the Load, which then lies so much further up in the Hill. But if they find Shoad, they are almost at a Certainty; and this is held as an infallible Rule, that the nigher the Shoad lies to the Shelf, the nigher the Load is at hand, and vice versa.

If they find no Shoad in the first Hatch, they ascend usually about twelve Fathom, and then fink another, as before; and if no Shoad appear here then they go as far on each hand side-ways, and fink there, as before. And so they ascend pro-portionably with three or more Hatches (if the Space of Ground require it) as it were in Breast, till they come to the top of the Hill. And if they find no Shoad in any of these Hatches, farewel to

But if they find any Shoad in any Hatch, then they keep their ascending Hatches from thence in a right Line; and as they draw nearer the Load, they leffen the first Proportion of twelve Fathom to fix, or yet less, as Conjecture directs them. If they find Shoad lying near the Shelf in one Hatch, and none in the next ascending, they conclude they have over-shot the Load, and then they sink nigher that Hatch, in which they last found the Shoad. Sometimes they find two different Shoads in the same Hatch, at different Depths, and then they have a Certainty of another Load above the former; and it may be in Training up to the second, Pounds, well steeled at the Points, and four-they meet with the Shoad of a third. Some Tin-square; these will last three or four Days, or a ners affirm, that the seven Loads may lie parallel one to another in the same Hill, but yet only one ders. 5. Wheelbarrows to carry the Deads and Master-Load; the other six, three on each side, being the leffer Concomitants; and so may five

lie, three are common.

Every Load hath a peculiar coloured Earth or Grewt about it, which is found also with the Shoad in a greater quantity, the nearer the Shoad lies to the Load; and so lessens by degrees to near a

A Valley may lie so, at the Feet of three several Hills, that they may find three feveral Deads, i.e. common loose Earth, in which the Shoad lay, and which is not only contiguous to the Load: This they call the Run or Cast of the Country, or of each Hill; and the Knowledge of this is very necessary, in order to surer Training of them one after another, as they lie in order, according to the foregoing Rules of Essay-Hatches; for the uppermost will direct you which Hill to begin first.

It may be, after they have trained up the Hill, they find nothing but a Bonny or Squat, which likewise have their Shoad. Their Form is about two or three Fathom long, and half as broad, few larger, and most less: These communicate with the same Breadth in all Places.

any of its own, but is entire of itself, and perhaps will go down into the Shelf, five or fix Fathom deep, and there terminate.

The Manner of their Digging the Ore, is thus:

When they have found the Load, and last Essayhatch, 'tis then called a Tin-shaft; or Tin-batch, which is funk down about a Fathom, and then is left a little long square Place, called a Shamble; and so they continue finking from Cast to Cast, (that is, as high as a Man can conveniently throw. or cast up the Ore with a Shovel) till they either find the Load to grow small, or degenerate into some fort of Weed, which are divers; as Mundick, or Maxy, corrupted from Marchasite; and this is white, yellow, and green. Daze, which is a kind of glittering Stone, enduring the Fire, of different Colours; as white, black, and yellow: Iremould, black and rusty; Caul, which is red, differing both from Mundick and Daze, or Spar, (enduring the Fire) which Marchasite will not ; Glister, which is Blood-red and Black.

Then they begin to make a Drift three Foot wide, and seven Foot high; and if the Load be not broad enough of itself, as some are scarce half a Foot, then they usually break down the Deads, or that part of the Shelf which contains no Metal, but encloseth the Load, as a Wall between two Rocks, and then they begin to rip the

Load itself.

The Instruments they use, are, 1. A Beele, or Cornish Tubber, i.e. double Points of eight or ten Pounds, sharp'ned at both ends, steeled and holed in the middle. This, in a hard Country, will last about half a Year, but must be new pointed eve-

ry fourteen Days.

2. A Sledge, flat-headed, from ten to rwenty Pound, will last about seven Years, new ordered once a Quarter. 2. Gadds, or Wedges, of two Week; and then must be new sharpened. 4. Lad-Ore out of the Drifts or Adits, to the Shambles. There are two Shovel-men, and three Beele-men, which are as many as one Drift can contain, without hindering one another. The Beele-men rip out hindering one another. the Deads and Ore, the Shovel-men carry it off, and land it, by casting it up with Shovels from one Shamble to another; unless where there is a quarter of a Mile's distance; but further than Winder with two Kechles or Buckets, one of which that, the peculiar Grewt is never found with the comes up as the other goes down.

Shoad.

It is usually observed, that the Tin Loads run

East and West, and then they constantly dip towards the North, and sometimes as much as three Foot in eight perpendicular. But in the higher Mountains of Dartmoor, there are some considerable Loads that run North and South, and

these dip to the East.

Four or five Loads may a while run parallel to one another in the same Hill, as hath been known in Hingston in Cornwall, and then turn in and meet altogether in one Hatch, and after separate

igain, and run parallel, as before.

The Breadth of Master-Loads is generally from three to seven Feet, seldom larger, unless where feveral Loads unite, and make a Knot, or fend forth Springs and Veins: But they do'nt retain

The

The Load is usually in a hard rocky Country, made up of Metal, Spars, and other Weeds, as it were all along in a continued Rock; but it hath easily meet with the Tongues so placed in the Lifmany Veins and Joints.

Fret deep from the Load, at others not at many Ore, thereby breaking it into small Sand, which

are forced to draw it up with Winders and Kee-bles, or force it up with Pumps. Some, but very few Pumps may be dry. They observe, that when The Stamping-Mill is thus contrived to go two few Pumps may be dry. Damps are sometimes enlarged by working of the Mundick with the Ore.

derprop their Drifts with Stemples and Wall-plates, placed much like a Carpenter's Square, on the one fide, and over-head.

skilful Person first fastens the end of a long Line is divided into three parts, the Fore-head, the at a known Place, and then exactly observes the Middle, and the Tail. That Ore which lies in Point at which the Needle of his Dial or Compass the Fore-head, or within one Foot and a half of the rests; and at the next Flexure, or Winding, he makes a Mark on the Line, and again notes the apart; the Middle and Tail is another Heap, which the Needle stands at this second which is accounted the worst. This latter Heap Station; and so he proceeds from turning to turning is thrown up by the *Trambling Buddle*, that is, a ing, still marking the Points and his Line, till he long square Tye of Boards, or Slate, about somes to the intended Place. Then he repeats above ground what he had done below, and his standard Man what he had done below, and his standard Man what he had done below, and his standard Man who was the Standard Shovel in his Hand,

The Manner of Dressing the Tin, is thus:

When the Ore is landed, and the greater Stone broken at the top of the Mine by the Shovel-men, 'tis three Bottom-boards, with two Side-ones, set slope-wise) in which the Ore slides down into the Coffer; but that it may not tumble down all at once, there is placed a *Hatch* nigh the lower end of the Pass, (that it is a Thwart-board to keep up the Ore.) Beneath that, comes in the Cock-water in a Trough ced between two strong broad Lones, having two not different from the first. Braces, or Thwart-pieces on each fide, to keep them steady as a Frame, with Stamper-heads, many Timbers or Guiders between them, are lift- Tin, i.e. fuch as is compleatly ready for the Blowed up, in order, by double the number of Tap-ing-house. pels (fastened to as many Arms, passing diametri-

cally to a great Beam, turned by an Over-skot Water-wheel on two Boulsters) which exactly, but any Veins and Joints.

In most Places they meet with Water at some suffering the Listers to fall with great force on the Fathoms; it runs continually thro' the Heart of is washed out by the Cock-water, thro' a Brass the Load.

When it begins to trouble us, we begin at the Bars of Iron at one end of the Coffer, into the Foot of the Hill, a Drift scarce half so big as that Launder, i.e. a Trench cut out in the Floor, eight of the Load, and work it on a Level, till we come Foot long, and ten over, and stopped at the other up to the Load. But where they have not this end with a Turf: so that the Water runs away, Convenience, or if they pass that Level, then they and the Ore finks to the bottom; which, when

The Stamping-Mill is thus contrived to go two they have Water, they never want Air sufficient Hours, or more, after they give over attending it. for Respiration, and for their Candles to burn in; There is a Tiller, or long Pole, sastened without at yet sometimes in a soft clayey Country, the Air one end to the Slew or Ponder, i.e. that loose and is so condensed, as to become in a manner a Damp, last part of the Trough, that conveys the Stream and to require an Air-Shaft for a Vent: which to the Overshot Wheel. Then, at the other end, there is tied a short Rope, with a transverse Stick at the end of it, curiously, but Trap-ways, hitched If the Country be not strong enough, they un- at both ends, under two little Pins, fastened in the Lones for that Purpose: There is another Pin set in one of the Listers, at such an exact height, as that if there be no Ore in the Coffer, to keep To know which way the Load inclines, to bring that Lifter high enough, the purposed Pin, in dean Adit, or to sink an Air-skaft in the desired Place, the Use of the Dial is needful; which they call over the Mill-wheel; so that when the Coffer is Plumming and Dialling, and is thus performed. A still Desson first sales and of a long I included into three parts, the Fore head the apart; the Middle and Tail is another Heap, which is accounted the worst. This latter Heap Dial and Line leads him, till he come exactly o-to cast up the Ore, about an Inch thick, on a long for the Place where he ended the Mine. for a long for Board, just before him, and as high as his Middle, which is called the Buddle-bead; and with the Edge of his Shovel, he dexterously cuts and divides it long-ways, in respect of himselt, about half an Inch asunder; in which little Cuts, the Water coming gently from the edge of an upper brought on Horses to the Stamping-mill, whence the plain Board, carries away the Filth, and lighter Ore is landed at the head of the Pass, (i.e. two or part of the prepared Ore first, and then the Tim immediately after, all falling down into the Bud-dle; where, with his bare Foot, he smooths it transversely, to make the Surface the plainer, that the Water, and other Heterogeneous Matter, may,

ithout lett, pass away the quicker.
When this Buddle grows full, they take it up a cut in a long Pole, which, with the Ore, falls down into the Coffer, (i.e. a long Square of the Middle and Tails, which are trambled over again: firmest Timber, three Foot-long, and one Foot and But the Fore-head of this, with the Fore-head of half over) wherein are the three usual Listers, plathe Launder, are trambled in a second Buddle, but In like manner, the Fore-head of this being likewise separated from the two other Parts, is carried to a third, or the drawweighing about thirty or forty Pound each of Iron, ing Buddle,; whose difference from the rest is only which serve to break the Ore in the said Coffer. this, thath no Tye, but only a plain sloping. These Listers, being about eight Foot long, and Board, whereon its once washed with the Trambals a Foot square, of Heart of Oak, and having as bling-shovel, and so it new names the Ore Black many Timbers or Guiders herewere them are life.

There

Ggggg

There is also another more curious way, called Sizing; that is, instead of a Drawing Buddle, they use a Hair-sieve, thro' which they sift the Ore, casting back the remainder into the Tails, and

new trambling it.

Fore-head in the second Buddle, and dilve it, (i.e. sutting it into a Canvas-fieve, in a large Tub of Water, and shaking it lustily) so that the Filth Tin behind, which is put into Hogsheads, covered and locked, till the next Blowing.

The Tails of both Budhles, after two or three Tramblings, are cast out into the first Strake or Tye (which is a Pit made purposely to receive them) and what over-small Tinesse may wash a-

way in Trambling.

There are commonly three or four of them fucceffively, which contain two forts of Tin, the one which is too finall, the other too great. The latterisnew ground in a Craze-mill (which is just like three Foot and a half broad, and fix long, and called Pryan Tin which turns upon two Iron-Pins, fastened in both ness of the other. ends, and the whole placed between two Posts; so Shovel and Water.

which makes it brittle and hard, they are necessitated to burn away the Weed in a Tin Kiln. This Kiln is four-square, and at the top hath a large Smoke. Moor-stone about six Foot long, and sour broad; The in the middle of which is a square Hole of about Fin-Ore, and sometimes on heaps; they are hard, half a Foot in Diameter: About a Foot beneath enough to cut Glass; and some of them are of a this Stone, is placed another, which is not so long transparent red, and have the Ludge of a deep by half a Foot; because it must not reach the in-Ruby. They seem to be only a fine hard Spar, nermost, or back part of the Wall, which is the The best Tin Ore is that which is in Sparks, open Place, thro' which the Flame ascends from a and next to this, that which hath bright Spar in it. leffer Place below that, where a very strong Fire of The Furnace where they melt, and from whence Furze is constantly made. The Fore-part is like a they cast their Tin, they call a Blowing-house, See common Oven; but near the back, on one fide, there also Mr. Ray's Collection of English Words.
is another little square Hole. When the Kiln is TIP-STAVES, are the Warden of the Fleet's throughly heated, the black Tin that is to be burnt, Officers, attending the Queen's Courts with a paintis laid on the Top stone, and as much of it is cast ed Staff, for taking into Custody such Persons an down by the square Hole, on the second, or Bot-from-stone, as will cover it all over, about three or Prisoners as go at large by Licence. By this Name four Inches thick. Then the Hole at the top is also are the Judges Officers called, who carry a immediately covered with green Turfs, that the Rod, or Staff, tipped with Silver, and take charge Flame may reverberate the stronger; and a of such Prisoners, as are either committed, of Rake-man, with an Iron Coal-Rake, constantly turned over at the Judges Chambers. fpreads and moves the Tin, that all Parts of the Mundick may get uppermost of the Tin, and so 12 Car. cap. 23. containing 28 Pound, or 2 Stone be burned away; which we certainly know by Weight. this, that then the Flame will become yellow (as ufual) and the Stench lessen'd: for whilst the Mun-dick behind burns, the Flame is exceeding blue. Suage stood: "Tis a Word much used in Fines. Then with the Rake he thrusts it down at the o-pen Place into the open Fire, and receives a new Ivory. The Artist in this Work was called Depen Place into the open Fire, and receives a new Supply of Tin from above. Now when the Place Peter.

Supply of Tin from above. Now when the Place Peter.

TOMPION, is the Stopple of a great Gun of Tin, Coals, and Afles, with the Rake he draws it Mortar, being made of Wood, and put into the Coals, and Afles, with the Rake he draws it Mortar, being made of Wood, and put into the Coals at the little Guara Hele of Mortar, being made of Wood, and put into the forth with the Coals at the little square Hole, on Mouth, to keep out Rain; also in loading of a the one fide, near the back; where the Ore, fiery Mortar, there is a Tompion of Wood, which is fithough and red, lies in the open Air to cool; which it ted exactly to the Bore of the Piece at the Mouth

will scarce be in three Days, because of the Coals, that lie hid in it; but when they cannot stay so. long, they quench it with Water, and it is like Mortar. And whether it cool of itself, or be quenched, they must new tramble it, or wash it, After the second trambling it, they take that before tis put into the Furnace; which is no otherthan an Alman-Furnace.

Moor-Tin, or such as is digged up in the Moors;, runs or melts best with Moor-coal charked; but other Tin which lies in the Country, runs best with an equal Proportion of Charcoal and Pear (or. Moor-coals) for the first Running: but when they, re-melt their Slugs, then they use Charcoal. When all is melted down, and re-melted, there. fometimes remains a different Slug in the bottoms of the Float, which they call Mount-egg; and this is mostly an Iron Body, tho of a Tin Cornel of the Poler lour; as was tried, by applying one of the Poles. of a Load-stone to it, which it quickly attracted, tho not so strongly as Iron.

The' Tin, for the most part, be made from the. a Grist-mill, with two Stones, an upper and an under) and after that, trambled in order. The fortimes mixed with a gravelly Earth, sometimes miter, by reason of its exceeding Smallness, is white, but usually red; from whence its easily dressed on a Rock, or Frame of Boards, about separated by bare Washing. This gravelly Tin is, called Pryan Tin, and has scarce half the Good-

The Mundick Ore is usually discovered by its that it hangs in an Æquilibrium, and may, like Glittering, yet sad-coloured Brownness, where a Cradle, be moved easily either way with the with it will soon discolour their Fingers. This is, faid to nourish the Tin; and yet they say, where much Mundick is found, there is little or no Tins. Blowing of Tin.

Certain it is, that if there be any Mundick left in.

melting the Tin, it makes it thick and curdy:

that is, not so ductile as otherwise. The Mun; dick seems to be a kind of Sulphur; for Fire only. separates it from the Tin, and evaporates it into

The Cornish Diamonds lie intermixed with the

TOD of Wool, is a Weight mentioned in

TOFT, Toftum in the Law fignifies a Mes-

of the Chamber, and this is drove in hard after the Why some Problems are ne ither Plain, Solid, nor Powder, and the Bomb is placed upon it.

and then they are made to enter into one another, could be found, it would follow, that by the help fo that the Sap of the Graft may join to that of thereof, any Angle, Ratio, or Logarithm, might be the Root as much as can be. Lap the jointed divided in the given Proportion of one right Line part about with a little Hemp, or Flax Hurds, and to another; and this by one universal Construction. And consequently, the Problem of the Section of ten or twelve Inches deep, so as the Joint may be an Angle, or the Invention of any number of mean about four Inches at least covered under the Earth, Proportionals, would be of a certain Degree. that it may not be bared at any time, but kept Whereas the different Numbers of Parts of an Anmoist by the Earth. The Root you graft on, gle, or of mean Proportionals, do necessarily remay be a piece of the Root of an Apple or Pearquire different Degrees of Algebraical Equations. tree, about for Inches in length; it should not be And therefore the Problem, understood in general

Spring following I plucked up forty of these Seed-fides are determinate; therefore 'tis necessary lings, grown to the thickness of a fair Graft; I that such Lines should also be received into Geografted them in this manner of Tongue Grasting, metry, as are alone sufficient for the Construction and planted them again: they all grew, and four of these Problems.

of them bare Fruit to perfection that Year; so that in a Year and a half, from an Apple-kernel ly by a continual Motion (as is apparent in the Cyland Pruit.

Some of these Trees will now cloid,&c.) they ought not to be accounted Mechanibigger than most of those Trees among which Plumbs, Cherries, Apricocks, Peaches, and all forts of Fruit-Trees, may be thus raifed.

TORNADO, is the Name given by the Seamen for a violent Storm of Wind, and sometimes followed by Rain; it usually swifts or turns about to almost all Points of the Compass, whence

I suppose its Name.

TORT, is a French Word, signifying Wrong or Injury, and is often used in our Law; as, de son Tort, is in his own Wrong.

TRAINING a Load, in the Miner's Language,

is fearching for, and pursuing a Vein of Ore.

TRAMBLING, is the Term used in dressing of Tin-Ore, for washing it very clean in Water, which is done with a Shovel, that they call a Trambling-shovel, and in a Frame of Boards, which they call a Buddle; see Buddle and Tin.
TRANSFORMATION of Curves.

The Abbot Galloys of France, having in the Year 1693, maintained, that Mr. James Gregory, and our excellent Dr. Barrow, had borrowed their affume General or Indefinite Equations, for the Lines general Propositions about the Transformation of Curves from Mr. Roberval; Dr. David Gregory, and Ordinate, the Equation I use for a Line sought, Astronomy Professor, doth in Philosophical is, a+bx+cy+exy+fxx+gyy, &c. =0. Transactions, N° 214. p.233. fully refute that Affertion, by shewing that Mr. James Gregory's Book was published at Padua, 1663; and Dr. Barrow's Lectiones Geometr. 1674. And therefore enquire the Tangent, and that which results for the Lines and Proposition of Sought. Ex. gr. putting x and y for the Lines fought. Ex. gr. putting x and y for the Abscissa. By the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for the Abscissa is a superior of the Abscissa is a superior of the Abscissa is a superior of the Abscissa is a superior of the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate, the Equation I use for a Line sought, and Ordinate is a superior of I use for a Line sought, and Ordinate is a superior of I use for a Line sought, and Ordinate is a tis more than probable, that Mr. Roberval had comparing with the given Property of Tangents, I feen those Books, fince he did not die till Oct. find the Value of the assumed Letters, a,b,c, &c. 1675; and yet we find not that he makes any such And thus I define the Equation of the Line Complaint.

TRANSCENDENTAL Quantities, Mr. Leibnitz, in the Act. Erud. Lipsie, for June 1686, hath a Differtation, in which he proposes to shew the innumerable Lines may be found that will satisfy Origin and Rise of such kind of Quantities, viz. the Problem.

Sur-folid, nor of any certain Degree, but do tran-TONGUE Grafting, is a way of Grafting in Roots, thus: The Root is cut floping about an how it may be demonstrated without a Calculus, that an Algebraical Quadratrix for the Circle or Hyfmooth; then each is cleft an Inch in length also, perbola is impossible. For if such a Quadratrix less than the Graft, but it may be bigger; but 'tis of any Number of Parts of an Angle, or mean best when they are both of the same size. vid. Proportionals, is of an indefinite Degree, and Phil. Trans. Numb. 95.

Phil. Trans. Numb. 25.

About twenty-nine Years ago, faith Mr. Lewis, who communicated the Method above, I ly be proposed in Geometry (nay, and ought to flowed a Bed of Apple-kernels in March, the be reckoned amongst the most principal) and befill the law forty of these Seedfides are determinate; therefore 'tis necessary

bear two Quarters of Apples upon a Tree, and are cal, but Geometrical Curves; especially too, fince they are of much greater use than all the Lines of they stand, which cost twelve Pence a Tree, when the common Geometry (except the right Line these were Kernels. I conceive, saith he, that and Circle) and have also some very important and Properties, which are altogether capable of Geometrical Demonstration.

Des Cartes therefore was no less out in excluding these from Geometry, than the Ancients were, who neglected the Loca Solida & Linearia, as not Geo-

Now, because the Method of discovering indefinite Quadratures, or their Impossibilities, is with me but a particular Case (and indeed an entire one) of a much sublimer Problem, which I call the Inverse Method of Tangents, in which the greatest part of the whole Transcendental Geometry is contained; and which, if it could be always Algebraically folved, all that is wished for would be done; fince also I find nothing satisfactory, as yet, extant about it: I will now shew you how this may be done, as well as the Indefinite Quadrature itself.

Whereas then Algebrists used before to assume some general Letters, or Numbers for the Quantities sought, I (in these Transcendental Problems) fought.

In which Equation, sometimes there are some things which remain arbitrary, and in that Case

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And

And this was the Reafon that a great many, obferving the Refult, believed the Problem not to be sufficiently determined, nor indeed possible. The fame things are also done by Series; but with respect to the Abridgment of the Calculus, I have several helps; of which, more in some other

Now, lassly, if the Comparison above-mentioned doth not proceed, I pronounce the Line fought, not to be an Algebraical, but a Transcen-

dental one.

This supposed, the next Work is to find the Species of the Transcendency; for some Transcendentals depend on the general Division or Section of a Ratio, or upon the Logarithms; others upon the Arks of a Circle; and others on more indefi-nite and compounded Enquiries.

Here therefore, besides the Symbols x and y, assume a third, as v, which denotes the Transcendental Quantity; and then of these three, I form a general Equation for the Line sought, from which I find the Tangent, (according to my Method, which proceeds even in Transcendental Quantities;) then what I find, I compare with the given Properties of the Tangents, and so discover not only the Values of a,b,c, &c. but also the particular Nature of the Transcendental Quantity

And tho' it may sometimes happen, that the se veral Transcendents are so to be made use of, and those of different Natures too from one another; also, the' there be Transcendents of Transcendents, and a Progression of these in infinitum, yet we may be satisfied with the most easy and useful one, and, for the most part, may have recourse to some peculiar Artifices for shortning the Calculus, and reducing the Problem to as simple

Terms as may be.

(in which the Property of the Tangent is always ted. given) 'tis manifest, not only how it may be And thus is the Analytical Calculus extended discovered, whether the indefinite Quadrature be to those Lines which have hitherto been exclualgebraically impossible, but also how (when this ded, for no other Cause, but that they were Impossibility is discovered) a Transcendental Quathought incapable of it.

Also Dr. Wallis's Interpolations, and i have been shewn. So that it feems, I may with ble other things are derived from hence.

As to What remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains that I may also be a what remains the contract of the contract o out vanity affert, that Geometry is by this Method carried infinitely beyond the Bounds, to which Vieta and Des Cartes brought it: Since, by this means, a certain and general Analysis is established, which extends to all these Problems, which are of no certain Degree, and consequently are not comprehended within Algebraical Equations.

Again, in order to manage Transcendental Problems (wherever the Business of Tangents or Quadratures occurs) by a Calculus, there is hardly any that can be imagined shorter, more advantageous or universal, than my Differential Calculus, or Analysis of Indivisibles and Infinites (a very small Specimen of which, is contained in my Method of Tangents, formerly published.) From this Calculus may be derived all those Theorems and Problems that have been fo much admired; and this with so much ease too, that there is now no the common Geometry.

Thus, for example, in that Theorem of Dr. Barrow's, That the Sum of the Intervals between the Ordinates and Perpendiculars to the Curve, taken in, and applied to the Axis, is equal to the Semi-Quadrate of the last Ordinate

Let the Ordinate be x, the Abscissa y, the Interval between the Ordinate and Perpendicular p_3 it appears presently, by my Method, that pdy = x dx, which Differential Equation, turned into a Summatory one, makes Spdy = Sxdx. But, from what I have shewn in the Method of Tangents, $d_{\frac{1}{2}}x = x dx$, therefore contrarily, $\frac{1}{2}x = S dx x$, (for as in the vulgar Calculus, Powers and Roots are reciprocal; so in this, Sums and Differences, viz. S and d are reciprocal.) It follows therefore,

In the Notation I had rather make use of dx. and fuch like Symbols, to denote the differential Quantities, than other Letters, because that Expression dx, is a certain Modification of x: And lo by this means it comes to pass, that the Letter a alone (when 'tis necessary) together with its Powers and Differentials, enters the Calculus, and the Transcendental Relations between x and any

other are expressed.

By the same Method we may also explain the Nature of Transcendental Lines by an Equation; ex. gr. Let a be the Ark of a Circle, and x the

Versed Sine; then will $a = \frac{Sdx}{\sqrt{2x-xx}}$, and

if the Ordinate of the Cycloid be y, then will'

$$y = \sqrt{2x - wx + \frac{Sdx}{\sqrt{2x - xx}}}$$
, which Equa-

tion perfectly expresses the Relation between the Now this Method, applied to the Business of Ordinate y, and the Abstissa x; and from it all' Quadratures, or to the Invention of Quadratrices, the Properties of the Cycloid may be demonstra-

And thus is the Analytical Calculus extended

thought incapable of it.
Also Dr. Wallis's Interpolations, and innumera-

As to what remains, that I may not seem to ascribe too much to myself, or to detract too much from others, I will briefly shew what seems to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicians to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to be due to the chief Mathematicans to me to the chief ticians of our Age, with respect to this kind of

Geometr First of all, Galilais and Cavallerius began to explain the most involved Met ods of Conon and Ar chimedes; but Cavallerins's Geometry of Indivisi-bles was no more than the Infancy of the Science? Greater Improvements were made yet by those three famous Persons; Mr. Fermat, in his Method de Maximis & Minimis; Des Cartes, by shewing how to express the Lines of vulgar Geometry (for he excluded the Transcendental ones) by Equations; and Gregory St. Vincent, by several noble Discoveries: to which I add Guldinus's admirable Rule about the Centre of Gravity. But all thefe stopped within certain (comparatively) narrow Bounds, which the famous Geometers, Mr. Hr. more need of their being learned and kept in Bounds, which the famous Geometers, Mr. Hrimemory, than for a Man that understands Algegens and Dr. Wallis, went beyond, opening new bra to learn a great many of the Propositions of Ways. For 'tis probable enough, that Hugens's Inventions gave rise to that of Henraet; as those of Wallis might to those of Neil and Wren, who

were the first that rectified Curve Lines, and this without any Detraction from the just Praise of these noble Discoverers. These were follow'd by Mr. James Gregory, and Dr. If: Barrow, who wonderfully increased the Science with admirable Theorems of this kind. In the mean time, Mr. Nicholas Mercator, a Holfatian, and most excellent rem being wonderfully delighted, and not knowing that the same was known to any one else, I presently invented a Triangle, which in every Curve I called the *Charasteristick Triangle*, the Qurve I called the Characteristick Triangle, the Water, which is a Salt very fluid, volatile, and Sides of which should be indivisible (or speaking tasteless, is by Heat changed into Vapour, which more properly) infinitely small or differential Quanis a kind of Air; and by Cold, into Ice, which is tities; from whence I presently, and with ease, derived a vast Copia of Theorems, part of which I found afterwards in Barrow, and the Gregories. And as yet I made no use of an Algebraical Calculus, which when I did apply, I foon after found my Anithmetical Quadrature and several other things. But, I know not how, an Algebraical Calculus did not satisfy me in this Business, and I was forced to do a great many things (that I had a mind to in the Analytick way) by long Ambages of Figures, till at last I found out the true Supplement of Algebra for Transcendental Quantities, viz. my Calculus Infinitus parvorum, which I also call the Differential, Summatory, or Tetragonistick Calculus: And, if I am not mistaken, aptly enough, the Analysis of Indivisibles and Infinites. Which Method, once difcovered, all those things which I formerly had so and sometimes of a white Precipitate, and somemuch admired in this kind, seem'd meer Play and Sport to me. For from hence I was able, not only to find out admirable Compendiums, but also to attain that most universal Method above explained; by the help of which, either Quadratrices, or any other Lines fought, whether Algebraical or Transcendental, are determined as far as is possible.

Before I conclude, I would yet add this one Caution, that in managing Differential Equations,

Such as this before mentioned, $a = \frac{1}{\sqrt{2x-\alpha x}}$

arise innumerable Transfigurations and Equipol-not Nature turn Light into Bodies, and vice versa? lencies of Figures.

TRANSCRIPT, An. 34 and 35 H. 8. c. 14. is the Copy of any Original, written again, or exemplified; as the Transcript of a Fine.

TRANSÍRE, 14 Car. 2. C. 11. is the Term given in the Custom-house to a Warrant or Pass, to let Goods be removed from place to place.
TRANSMUTATION. Sir If. Newton, at the

Mathematician, was the first that I know of, who end of his Book of Opticks, Edit. Lat. seems to be exhibited any Quadrature by an infinite Series. of opinion, That Crasse, or thick Bodies, and Which Invention that profound Geometer, Sir If. Light may be mutually converted and transmuted Newton, did not only reach by himself, but also into one another; and that all Bodies receive compleat, by an universal way; and would he make their active Force from the Particles of Light which publick the Thoughts he has yet further on this enter into their Composition. For all fixed Bo-Subject, he would certainly open new ways to us, dies, when well heated, emit Light as long as they to the great increase, and yet abridgment, of the continue so: And on the other hand, Light inter-Science. As for myself, it happened when I was yet but a Tyro in these Studies, that the sight of a its Rays fall upon the solid Particles of those Bocertain Demonstration concerning the Magnitude dies, as he shews before. There is no one Body of a spherical Substance, suddenly gave me some (saith he) which is less apt to shine than Water Light; for I saw in general, that the Figure made, But yet Water, as Mr. Boyle sound by repeated by applying the Perpendicular to the Curve, as Distillations, is capable of being transmuted into a Ordinates to the Axis (which Perpendiculars in the fixed Earth; and that Earth will be capable of Circle are the Radii) was proportional to the bearing Heat enough to be made by that means to Surface of the Solid, generated by the Rotation of emit Light, and shine as well as other Bodies. the Figure about the Axis. With which first Theo- And he thinks this mutual Transmutation of Bodies and Light into one another, to be very agreeable to the Order of Nature, which seems to delight in fuch Transmutations.

a hard, transparent, fragile Stone, easily meltable; and this Stone is convertable into Water again by Heat, as Vapour is by Cold. Earth, by Heat, becomes Fire, and by Cold is turned into Earth again. Dense Bodies, by Fermentation, are rarefied into various kinds of Air; and that Air, by Fermentation. tation also, and sometimes without it, reverts into dense Bodies again. Quick-suver sometimes puts on the form of a sluid Metal, sometimes of a hard and fragile one: Sometimes it appears in the shape of a pellucid and fragile Salt, which they call Sublimate, and fometimes in that of a pellucid; volatile, tasteless white Earth, which is called Mercurius Dulcis: Sometimes it looks like a red, opake, and volatile Earth, and then 'tis called Cinnabar: Sometimes 'tis in the form of a red, times of a fluid Salt: By Distillation it becomes a Vapour, and by Agitation in Vacuo, it shines like Fire. And yet after all these, and many other Changes, is capable of being brought back again into running Mercury. The Eggs of Infects, &c. as far as Sense can judge, are by little and little evolved, explicated, and encreased in Magnitude, and se turned into Animals: Tadpoles are turned into

Frogs; little Worms, or Maggots, into Flies.
All Birds, Beafts, Fishes, Insects, Trees, and Plants, with all their so very different Parts, grow and encrease out of Water, and aqueous and sa-line Tinctures; and on Putrefaction, all of them In Tinctures; and on Putrefaction, all of them a Man should not rashly neglect the dx on this account, that it may be neglected when the x are Moreover, Water exposed a while to the open taken as increasing uniformly: For by this means a great many have gone wrong, and precluded the Way to themselves, in not allowing the Differentials, as dx, their own Universality: Putrefaction, yields Nourishment both for Ani-So that the Progression of the x might be assumed and Plants. Now among all these many at liberty. Whereas from this one thing alone various and wonderful Transsurgurations, why should arise innumerable Transsigurations and Equipolated Same Putrefaction, all of them revert into Water, or an aqueous Liquor again. Moreover, Water exposed a while to the open Air, puts on a Tincture, which (like the Tincture means a great many have gone wrong, and precludes of Barley, macerated without boiling) in process and Putrefaction, yields Nourishment both for Ani-so that the Progression of the x might be assumed and Plants. Now among all these many at liberty. Whereas from this one thing alone various and wonderful Transsigurations, why should be a process of the proc

The

The great Objection against the practical Joists, and other pieces of Wood, with Fascines, Transmuting of a baser Metal into a nobler, seems Stones, Earth, &c. in order to fill up the Ditch, to be, that the specifick Gravities of Metals can- and to carry a Gallery over it. Also a Wall of not be altered: But in Dr. Hook's Life, before Stone or Earth, built a-cross a Work which is his Opera Posth. I find, that Dr. Hook, in 1679, is faid to have made some Experiments about the mixing of Metals; and particularly, that in a Mixture of Copper and Tin, the specifick Gravity of the Compositum was really increased; for that of the Copper was $8\frac{1}{2}$ to one, and that of the Tin but 7 17 to 13 and yet that of the Mixture was

8 to 1.
TRANSOM, in Architecture, is the piece of Timber which is framed a-cross in a Double-

Light Window.

TRANSPARENT, the opakest Bodies that are, if their Parts be fubtilly divided (as Metals when dissolved in Acids, &c.) become perfectly Matters Transparent; from whence, and from some other Reasons, Sir Is. Newton, in his Opticks, concludes, That Water, Salt, Glass, some Stones, &c. and they may be as full of Pores or Interstices between their Parts, as other Bodies; yet their Parts and Interstices are too fmall to cause Reflexions in their common Surfaces. He shews also, that the lean-Parts of all natural Bodies are in some measure transparent; and that their Opacity arises from the multitude of Reflexions caused in their inter-'Tis plain also, as he shews, that opake Substances are rendered transparent, by fil-ling their Pores with any Substance of equal, or almost equal Density with their Parts.

Thus Paper dipped in Water or Oil, the Oculus Mundi Stone steep'd in the former of those Liquors, Linnen-cloth oiled or varnished, and many other Substances soaked in such Liquors as will intimately pervade their little Pores, become more transparent by that means than they were

before

And the true Reason why all opake Bodies, when reduced into very small Parts, become transparent, is because the thickness of the Particles being much less than the Intervals of the Fits of easy Reflexion and Transmission of the Rays of Light, the Body loseth its reflecting Power; for if the Rays, which at their entring into the Body, are put into Fits of easy Transmission, arrive at the furthest Surface of the Body before they be out of those Fits, they must be trans-,mitted.

TRANSVERSALIS Pedis. Dr. Douglas, in his comparative Description of the Muscles, saith that this is only part of the Musculus accelerator Uring, arising from the Knob of the Ischium; for it is not inserted into the Cavum Ovale, or Bulb of nemies. the Urcthra, but joins in with the Accelerator, of

which it makes a second beginning.

TRAVERSE, in Fortification, is a Trench with a small Paraper, and sometimes with two, one on each fide; it serves as a Cover from the Enemy, when they come on their Flank. Sometimes 'tis covered over with Planks on the top, and is also loaded with Earth; they are of good use to stop an Enemy's way, and to prevent being enfi-laded. It is also a good Defence in a dry Ditch, when the Parapet is made on that fide next the opposite Flank. There is also a Traverse in a wet Ditch, which is made by throwing into the Foss or Ditch over against the Place where the Miner is

commanded, in order to cover the Men, is called

a Traverse.
TREASURER, is an Officer of great Trust. The Treasurer of England is a Lord by his Office, and under his Charge and Government is all the Queen's Money in the Exchequer, and also the Clerks of all Officers any way employed in collecting the Imposts, Taxes, Tributes, or other Revenues belonging to the Crown. He hath alfo, by virtue of his Office, the Nomination of all Escheators yearly throughout England; and giveth the Place of all Customers and Searchers in all the Ports of the Kingdom, with divers other

TREASURER of the Queen's Houshold, is an Officer in the Court, who is of the Privy-Council, and in the Absence of the Steward of the Queen's fuch like Substances, are Transparent, because the' Houskold, hath Power, with the Controller and Steward of the Marshalsea, without Commission, to hear and determine Treasons, Misprissons of reason, Murder, Homicide, and Bloodshed, com-

mitted within the Queen's Palace.
TRENTALS, see Tricennalia, were thirty Masses, said in so many Days for the Souls of Perions deceased; and the Offerings which were made, and the Priests for this Service, were also called Trentals.

were Trentals, or, as they were called in English, a TRICENNALIA Months Mind, because the TRIGINTALIA' Service lasted a Month, or thirty Days; in which they faid to many Masses.

TRIDENT is a Name given by Sir If: Newton to that kind of Parabola, by which Des Cartes con-structed Equations of fix Dimensions. This Figure hath four infinite Legs, of which, two are Hyperbolical, tending contrary ways, but placed about an Asymptote; and the other two are Parabolical and Converging, and which, with the other two, form the Figure of the Trident. Curves

TRIMMERS, in Architecture, are those Pieces of Timber framed at right Angles to the Joysts against the ways for Chimneys, and Well-

holes for Stairs. Build. Diction.

TRINODA Necessitas, was a three-fold necesfary Tax, or Imposition, to which all Lands were Subject in the Saxons Time, i.e. towards the Repairing of Bridges, the maintaining of Callles and Garisons, and Expeditions to repel invading E-

TRINODA Terre, was a Quantity of Land,

containing three Rods or Perches.

TRISTIS, Trista, and Tristris, was formerly an Immunity, whereby a Man was freed from his Attendance on the Lord of a Forest, and should not be compelled to hold a Dog, follow the Chace, nor to stand at a Place appointed; which, other-

wise, he might be under pain of Amerciaments.

TRONAGE, is a Toll or Custom taken for weighing of Wool, especially in open Market or Staple, by a common Beam (Trona) or legal

Standard.

TROY-WEIGHT: the Original of all Weights here in England, was a Corn of Wheat gathered to be put to the Foot of the Wall, Saucissons, from the middle of the Ear, and well dried. Of these, 32 were to make one Penny-weight, 20 Pen- the space of 24 Hours. ny-weight an Ounce, and 12 Ounces a Pound; poses to move round the but afterwards, they came to divide the Penny-her menstrual Motion: But the five other Planets, weight into 24 equal Parts, which have ever fince Saturn, Jupiter, Mars, Venus, and Mercury, he been called Grains. See Tables of Weight under supposes to revolve round the Sun in their several Weights, in Vol. I. Formerly the Moneyers did, Periods; as the Sun doth round the Earth in a and perhaps do still, subdivide the Grain thus: Year's time. But this Hypothesis is so embaras's' Ward's Introduct. to Mathemat. p. 32. TUBA-Eustachiana, is the Canal of Communi-

cation between the Mouth and the Barrel of the Bar, 'tis so called by Antonius Valsalva from its Figure, and its first Discoverer, Barthol. Eustachius.

and was what we now call a Cucking-flool.

TUNICA Vaginalis, is the first of the proper Integuments of the Testes; 'tis formed by the Dilation of the Productions of the external Mem- of the Heavenly Bodies, are much better acbrane of the Peritoneum. Its internal Superficies is smooth, its external rough: It contains the Vasa Deferentia and Preparantia; it embraces loosely

TYCHONIAN System or Hypothesis, is so called from having been advanced to solve the Phæ-ropmena of Astronomy, by the Noble Tycho Brahe. Wool, Milk, Fowls, &c. (3.) Personal Tythes, He supposes the Earth fixed and immoveable in the which are the Profits arising from the Labour, Art, Centre of the Universe, or of the Sphere of Trade, Negotiation, and Industry of Men. Great the fixed Stars; so that all the Stars and Plances, are of the Tenths of Corn, Hay, and nets, are supposed to revolve round the Earth in Wood only. All others being called Small Tythes.

The Moon also he sup poles to move round the Earth, as the Centre of Weights, in Vol. I. Formerly the Moneyers did, Periods; as the Sun doth round the Earth in a and perhaps do still, subdivide the Grain thus: Year's time. But this Hypothesis is so embaras'd and perplex'd, that it hath had sew Espousers: Droites a Mite, and 20 Mites one Grain. See Ward's Introduct. to Mathemat. p. 32. may be called Semi-Tychonian; in which, holding all things according to Tycho, they allow a Diurnal Motion to the Earth, tho' they deny an Annual one. But tho' this be a good deal more probable than TUMBREL, Tumbrellum, Turbicketum, is the Tychonian System, yet it is still so intricate and an Engine of Punishment, which ought to be in confused, and so inconsistent with Observation, every Liberty that hath view of Frank-Pledge, and the simple Uniform Laws of Nature, which for the Correction of Scolds and unquiet Women; establish the Pythagorean or Copernican Hypotheestablish the Pythagorean or Copernican Hypothesis; that I shall say no more of it, but that 'tis not worth while for any one to enquire into it, nor to invent Laws to folve it; fince all the Phenomena counted for in the other System last mentioned.

See Greg. Astron. Book I. Sect. II.
TYTHES, are of three Sorts. (1.) Pradial the whole Body of the Testicle, adhering to one Tythes, which arise wholly or chiefly from the end of the Epydidimis; and on the out-fide of it Earth; as of Corn, Hay, Underwood, Fruits, runs the Muscle called Cremaster, which see. Beasts, and other Animals pastured or sed with the

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ACUUM: To what hath been said on this of different Matter, suppose one of Wood, and the Subject, under this Head in Vol. I. may other of Gold, if they had equal Diameters, be added by way of Illustration; That must have equal or the same Specifick Gravities. Since all Bodies do (by what Sir Isa. Newton aptly all this being directly contrary to all experience, calls the Vis Inertie) resist as are as they can, any Change or Alteration of their present State, whe-ther of Motion or Rest; and since this Resistance bulk for bulk, than that of Gold. The Planetary Regions in which the Heavenly

ferent Bodies is still Proportionable to the Quantity Bodies move, must need be almost devoid of all of Matter they contain: And fince also of conse-quence, if two Bodies contain equal Quantities accrue to the Planets Motions, which tho never of Matter, and move towards one another with so small, would in time be sensible, and have an contrary Directions, and equal Velocities; they effect in retarding the Motion of the Heavenly will necessarily both stop at the Point of Con-Bodies; but no such thing hath ever yet been obcourse: And Conversely, since its certain also that served or discovered, but the contrary is certain two Bodies moving thus, with contrary Directions And befides, such a thin Vapour as the Tail of a and equal Celerities, if at the Point of Concourse Comet, can move thro the Æther, as some will they do both rest, must be equally heavy: It call it, with incredible swiftness, without being plainly follows, that two Bodies, containing each dissipated or drawn from its natural Course; which an equal Quantity of Matter, must be equally is in it self a demonstration, that there must be a heavy; wherefore, were there no such thing as kind of Vacuum in those Celestial Regions. And Porosity or Vacuity, two Spheres of equal Diameters, must be a constituted on the Constitute of Matters, must be a Body so expensely the constitute of Matters and be according to the World of ter, and be equally heavy; that is, two Spheres ceedingly fluid, (that is, no Body at all) as hardly

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to hinder the Motion of any Body thro' it. Sir Isa. Newton shows, p. 213. of his Latin Opticks, at Paris: Or those of Mr. Townly, which, by a That if the Planetary Regions were, as the Planists long continued Series of Observations, hath sufaffert, entirely full of Matter, and without any ficiently proved, that in Lancashire, at the Foot interspersed Vacuities at all; let their Matter be of the Hills, there salls above 40 Inches of Water never so subtile and sluid, they would have a in a Year; from whence it is very obvious, that greater Resistance to any Bodies moving in them, the Sun and Wind are much more the Causes of than Mercury or Quick-tilver hath. a Medium as That, even a perfectly solid Globe must lose half its Mction, before it can move thrice the length of its own Diameter. And Globes or Spheres, such as the Planets are, would be stopt much sooner;

The feigned Romantick Subtile Matter, with no means useful to explain the Phænomena of ment was made in a Place as close from the Wind Nature: fince the Motions of the Planets and as could be well contrived. For which reason I tilis, nor I believe ever can be. And if there times as much more, without the Affistance of the were any fuch thing as that Matter, it would only Sun, which might perhaps have doubled it. By ferve to do mischief, to disturb and retard the Motions of the Heavenly Bodies, and the Order Evaporations in May, June, July, and August, and Course of Nature. And if there were any (which in each Month are nearly equal) are about such thing within the hidden Porcs and Meatus of three times as much as what evaporated in the Bodies, it would serve for no good purpose; it would only hinder and stop the vibrating Motion February, which are likewise nearly equal; March of their Parts, in which their Heat and all their and April answering nearly also to September and active Force confifts.

That Whim therefore of the Materia Subtilis,

VADIARE Duellum, was formerly to wage a Combat; that is, when any Person challenged another to decide a Controverfy by Camp-fight, or Duel, and threw down a Gauntlet, or made some such like sign of Desiance, then if the other took it up, or accepted of the Challenge, he was said Vadiare Duellum; to give and take a mutual Pledge of Fighting

VAGINALIS Tunica. See Tunica Vaginalis. VALE of a Pump, at Sea, is the Term for the Trough by which the Water runs from the Pump

along the Ship fides, to the Scupper-holes.

VAPOURS: In order to explain the Circula-tion of Vapour experimentally, Mr. Edm. Halley (See Philof. Trans. No 212.) caused an Experi-the one time, may be conceived to disappear at the other.

Sir Isa. Neveron in his Opticks, Book 2. p. 60. from the warmth of the Weather, without being thinks that the Azure Colour of the Sky, which exposed to either Sun or Wind, to be made in he takes to be a Blue, of what he calls the first great Care and Accuracy, by the Operator to the Royal Society. And having added up into one Sum, the Evaporations of the whole Year, he found that from a Surface as near as could be meafound, that from a Surface, as near as could be mea- constitute Clouds of other Colours: So that this fured, of eight Inches square, there did evaporate during the Year, 16292 Grains of Water, which is 64 Cubick Inches; and that divided by eight Inches, the Area of the Water's Surface, shews pours are not arrived to that Grossess requisite to that the Depth of Water evaporated in one Year amounts to eight Inches. But this is much too little to are from the Franciscopy of tle to answer the Experiments of the French, who

And found that it rained 10 Inches of Water in a Year And in such Evaporation, than any internal Heat or Agitation of the Water

The same Observations do likewise shew an odd. Quality in the Vapours of Water, which is that of adhering to the Surface that exhales them, which wherefore tis absolutely necessary for continuing they clothe, as it were, with a Fleece of vaporous the Motions of the Planets and Comets, that the Air; which once investing it, the Vapour rises af-Places they move in, be almost entirely devoid of terwards in much less quantity. And this was all Matter.

Thewn by the small Quantity of Water that was lost in 24 Hours time, when the Air was very still. which the Cartesians have filled the Celestial Re- from Wind, in proportion to what went away, gions, and all other Parts of the Universe, is by when there blew a strong Gale; altho' the Experi-Comets, is much better explained by Gravitation do not at all doubt (faith he) that had the Exwithout it, and the Cause and Nature of Gravity periment been made where the Wind had come hath not yet been explained by that Materia Sub-freely, it would have carried away at least three OEtober.

This Fleece of Vapour, in still Weather, hanging must be entirely banished out of our Philosophical on the Surface of the Water, is the occasion of ve-Faith; and then, along with it, will fink all those ry strange Appearances, by the Refraction of the ry strange Appearances, by the Refraction of the laid Vapours differing from that of the common plaining the Nature of the Phænomena of Light, Air, whereby every thing appears raised; Houses by the means of Pressure or the Motion of the like Steeples, Ships as on Land above the Water, and the Land raised and lifted up, as it were, from the Nature of the land raised and lifted up, as it were, from the Sea, and many times feeming to over-hang. And this may give a tolerable account of what I have heard of seeing the Cartel at High-water-time, in the Isle of Degs, from Greenwich, when none are to be seen at Low-water, (with some have and accounted to a making the second of the seco have endeavoured to explain, by supposing the Isle of Dogs to have been lifted up, by the Tide coming under it.) But the vaporous Effluria of Water having a greater degree of Refraction than the common Air, may suffice to bring those Beams down to the Eye; with which, when the Water is refined, and the Vapours subsided with it,

VA-

VARIABLE QUANTITIES, in Fluxions, are such as are supposed to be continually increafing or decreasing; and so do, by the motion of their said increase or decrease, generate Lines, Area's or Solidities.

VARIATION, or Permutation of Quantities; is the changing any Number of given Quantities, with respect to their Places. See Combination.

VASSAL, fignifies him that holds Land in Fee of his Lord, (now he is called usually a Tenant in Fee) whereof some owe Fidelity and Service,

and fuch are Vassalli Jurati.
VAVASOR, alias VALVASOR, is one that in Dignities is next to a Baron: vid. Bracton, l. 1.

c. 8. and Camden, p. 188. and Spelman's Glosfary.
VECTIS; when the Weight lies beyond the
Fulcrum or Hypomochlion with regard to the Power, then the Vectis is called Heterodromus; but when the Weight lies between the Fulcrum and the Power, so that 'tis not moved a contrary way with the Power, as in the former Case, but ascends or descends as the Power doth; then 'tis called Vettis Homodromus

VENA PNEUMONICA; is a small Vein which creeps along upon the Bronchia of the Aspera Arteria, or Trachea in the Lungs; 'tis described and so called by Sommichellius.

VENTRICULUS: the Stomach or Ventriculus is placed immediately under the Midriff; the Liver covers part of its Right-fide, and the Spleen touches it on its Left, and the Colon at its bottom; to which also the Cawl is tied. Its figure is like that of a Scotch Bag-pipe, being long, large, wide, and pretty round at the bottom, but shorter and less convex on its upper Part, where its two Orifices are. The lest Orifice is called Cardia; to it the Oesophagus is joined, and by it the Aliments enter the Stomach, where being digested, they ascend obliquely to the Pylorus or right Orifice, which is united to the first of the Intestines. At this Orifice the Tunicks of the Stomach are much thicker than they are any where else, and the inmost hath a thick and strong Duplicature in form of a Ring, which serves as a Valve to the Pylorus, when it contracts and shuts.

The Stomach is made of four Membranes or The first and inmost is made of short Fibres, which stand perpendicularly upon the Fibres of the next Coat; they are to be seen plainly towards the Pylorus. When the Stomach is distended with Meat, these Fibres become thick and short: whilst they endeavour to restore themselves by their natural Elasticity, they contract the Cavity of the Stomach, for the attrition and expulsion of the Aliments. This Coat is much larger than the rest, being full of Plaits and Wrinkles, and chiefly about the Pylorus. These Plaits retards the Chyle, that it runs not out of the Stomach before it be sufficiently digested. In this Coat there are also a great Number of small Glands, which separate a Liquor which besmears all the Cavity of the Stomach; therefore this Coat is called *Tunica Glandulosa*.

The Second is much finer and thinner; it is altogether Nervous; it is of an exquisite Sense,

and is called Nervoja.

The third is Muscular, being made of straight and circular Fibres; the straight run upon the upper part of the Stomach, between its superiour and inferiour Orifices; and the circular run obliquely from the upper part of the Stomach to the together, till the Water grows pale: Then they
H h h h h

bottom. These Fibres, by their Contraction and continual Motion, help the Attrition and Digestion of the Aliments.

The Fourth Tunicle is common; it comes

from the Peritonaum.

The Stomach receives Veins from the Porta, viz. the Gastrica, Pylorica, and Vas Breve, and Branches from the Gastroepiplois deutra & sinistra, which are accompanied with Branches of the Arteria Caliaca, all which lie immediately

under the fourth Coat of the Stomach.

The Eighth Pair of Nerves, or Par Vagum, gives two confiderable Branches to the Stomach, which descending by the sides of the Gullet, divide each into two Branches, the external and internal. The two external Branches unite in internal. one, and the internal do so likewise; both which piercing the Midriff, form, by a great Number of imall Twigs, upon the upper Orifice of the Stomach, a Plexus: and then the internal Branck spreads it self down to the bottom of the Stomach; and the external Branch spreads it self upon the infide, about the upper Orifice of the Sto-mach. This great Number of Nerves which is about the upper Orifice, renders it very fenfible, and from them also proceeds the great Sympathy be-twixt the Stomach, Head and Heart; upon which

account Van Helmont thought, that the Soul had its seat in the upper Orifice of the Stomach.

The Plexus Nervosus of the Hypochondria and Mesenterium, give several Branches to the bottom of the Stomach; therefore in Hysterick and Hypochondriack Passions, the Stomach is also

affected.

The Use of the Stomach is Digestion, which is the diffolution or separation of the Aliments into such minute Parts, as are fit to enter our Lacteal Vessels, and circulate with the Mass of Blood: Or it is the simple breaking of the Cohe-fion of all the little *Molecula*, which compose the Substances we feed upon. Now the principal Agents employed in this Action, are, first, the Saliva, the Succus of the Glands in the Stomach, and the Liquors we drink, whose chief Property is to soften the Aliments, as they are Fluids, which eafily enter the Porcs of most Bodies, and swelling them, break their most intimate Cohæsions. When the Aliments are thus prepared, their Parts are foon separated from one another, and diffolved into a Fluid, with the Liquors in the Stomach, by the continual Motion of its Side, whose Power in this Action, is, by that great Improver of the true Theory of Physick, the learned Pircairne, demonstrated to be equal to the Pressure of 12951 Pound weight: To which if we add the force of the Diaphragma, and Muscles of the Abdomen, which likewise conduce to Digestion, the Sum will amount to 261086 Pound weight. These two Actions we see more clearly in Birds, because they are performed in two Stomachs. In the first the Corn is only swelled and softened by the Liquor of its Glands, but broken and dissolved in the second, which is composed of very strong Muscles, because those of the Abdomen and Diaphragma are weak, neither do they act upon the Stomach, as in Men. Keil's Anatomy.

VERDITER, is made thus: Into an hundred Pound weight of Whiting put into a Tub, the Refiners pour their Copper Water, (see Refining) and stir them together every Day for some Hours

pour that away, and set it by for further use, and pour on more of the green Water, and so continue till the Verditer be made; which being taken out, is laid on large Pieces of Chalk in the Sun, till it be dry for the Market. The Water mentioned to be drawn or poured off from the Verditer, (which remains at the Bottom of the Tub) is put into a Copper and boiled, till it come to the thickness of Water Gruel, now consisting principally of Salt-Peter reduced, most of the Spirit of Vitriol being gone with the Copper into the Verditer; and a Dish full of this being put into the other Materials for Aqua-Fortis, is re-distilled, and makes what they call a Double Water, which is near twice as good as that made without it. Phil. Trans. No 142.

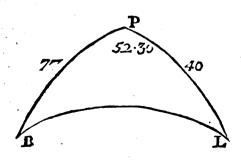
VERSED-SINE; what it is, see in Vol. I. under Trigonometry and Scale, as well as under Versed-Sine.

From the Radius or Sine of any Ark, to find

the Versed-Sine.

If the Ark be less than 90°. the Co-Sine taken out of the Radius leaves the Versed-Sine: But if the Ark be greater than a Quadrant, the Radius added to the Co-Sine, makes the Versed-Sine. By the Sector, the Distance from 90 to 30 on the Line of Sines taken laterally, is the Versed-Sine of 10°: The Distance between 90 and 70, the Versed-Sine of 20°. &c. But if the right Sine were 60° and you would have the Versed-Sine of 50° make a parallel entrance of the Sine given between 50 and 50 in the Lines of Sines; and by that means, the Distance between 90 and 90, will give the Length of the Radius: Then out of that Radius take parallelly sound the Sine of 40°. (the Co-Sine of 50°.) the Remainder will be the Versed-Sine 50°.

In Sir Jonas Moor's New System of Math. Vol. II. in the New Book of Logarithms, (and in some other Books) you have Tables of Versed-Sines, both natural and artiscial, whose Uses are very many; and especially in solving some of the most useful Cases of Spherick Triangles: As in calculating the Distances of Places on the Farth's Surface, according to the Arch of a great Circle, by having their Longitudes and Latitudes; The Distances of two Stars, by having their right Ascensions and Declinations, or their Longitudes and Latitudes; by which means, the Altitudes of two Stars not on the Meridian, or of the Sun, with the Difference of Time or Azimuth being observed, the Latitudes of Places may be sound.



As in the Spherick Triangle BPL, let the Lege BP, and PL be given, and the contained Angle BPL. To find the fide BL:

I say, as the Cube of Radius, to the Rectangle of the Sines of the Legs; so is the Square of

half the Sine of the contained Angle, to ! Difference of the Versed-Sines of the third Side, and of the Ark of Difference between the two containing sides.

Therefore, in Practice, double the Logarithmick Sine of half the Angle given, and to it add the Log. Sines of the Legs; and from the Left-hand of the Sum, strike out 3 for the Cube of the Radius, there will remain the Logarithm of half the Difference of those two Versed-Sines.

Which half Difference doubled, and added to the Versed Sine of the Difference of the Legs, gives the Versed Sine of the Side sought.

E X A M P L E.

The Log. Sine of 40°. - 9.8080675

The Log. Sine of 77°. - 9.9887239

The Log. Sine of 26°. 3- 19.2914116

The natural Sine against 39.882030 is 1227355

Whose double is ______ 2454710
The natural Versed Sine of 37°. the Difference of the Legs, is ______ 2013649

Their Sum is — 4468355

Which is the Versed-Sine of 57 deg. 53 minthe Side required or sought.

VERTICAL-PLANE, in Conicks, is a Plane passing thro' the Vertex of the Cone, and parallel to any Conick Section.

VERTICAL-LINE, in Conicks, is a right Line drawn on the Vertical-Plane, and passing thro

the Vertex of the Cone.

VERTICAL-LINE, in Dialling, is a Line on any Plane perpendicular to the Horizon; this is best found and drawn on an erect or reclining Plane, by holding up a String and heavy Plummet steadily, and then marking two Points of the Shadow of the Thread on the Plane, a good distance from one another, and then drawing a Line thro' those Marks.

Line thro' those Marks.
VIBRATING-MOTION, is a very quick and short Motion of the solid Parts of Bodies, caused by the Pulse or Stroke of some Body upon them. Thus the Rays of Light or Fire driking upon the small Particles of Bodies, do excite in them such Vibrations, and cause them to grow hot and shine. For all fixed folid Bodies when heated to a due degree, will emit Light, and shine; and Bodies which abound with earthy Particles, (as the Chymists speak) and especially sulphureous ones, do emit Light; which way soever their Parts come to be agitated into these vibrating Motions, whether by Heat, by Rubbing, by Striking, or by Putrefaction, or fome animal or vital Motion. Thus the Seaor some animal or vital Motion. Thus the Sea-Water Spines or burns, as they call it, in a Storm; Quick-silver emits a Light when shook in Vacuo: an Horse's Neck, or Cat's Back, when rubb'd with one's Hand in the dark; Wood, Flesh and Fish, when 'tis rotten and putressed: so shine Vapours arifing from putrid Waters, as the Ignes Fatui, &c. thus kindles wet Hay, &c. thus Diamonds rubb'd in the dark, emit a Light, like the Phosphorus; and thus Iron will grow hot, and burn with quick and forcible hammering on an Anvil.

Of the vibrating Motion of the Parts of folid Bodies, a good Instance also you have in Bells, or the Brims of Drinking-Glasses half full of Liquor, and then rubbed strongly with one's Finger a little

Dr. Hooke faith, he hath observed the Direction of this vibrating Motion, to be from the Center

outwards, & vice versa.

VICAR; the Priest of every Parish is called Restor, unless the Predial Tythes be impropriated; and then he is called Vicar, quasi vicem fungens Rectoris. The Vicar is called perpetual, because every Vicarage hath a constant Succession (like a Corporation) and never dies.

VICE-CHAMBERLAIN; is a great Officer in the Queen's Court, next under the Lord Chamberlain; and in his absence hath the Controul and Command of all Officers what soever, appertaining to that part of her Majesty's Houshold, which is called the Chamber, or above Stairs.

VIE prime, so the Physicians call the Stomach and Guts, accounting the whole length of the Canal which reaches from the Mouth to the

Sphinster Ani.

VIGIL; the the Civil Day begins from Midnight, yet the Ecclesiastical or Scriptural Day begins at fix in the Evening, and holds till fix in the Evening of the ensuing Day. Hence the Collect for every Sunday and Holiday (by Order of our Church) is to be read at the preceding Evening Service, or at the Vespers or Even-song at six a-tlock the Day before; from which Time the Religious Day was supposed to begin: and this first part of the Holiday, from fix a clock of the Day before, was by the Primitive Christians spent in Hymns, and other Devotions; and these being often continued till late in the Night, were thence called Vigils. Tho', by degrees, these Vigils became so enlarged, that at last all the Day preceding the Holiday, came to be called by this Name, as it is now.

VILLANIS Regis subactis reducendis, was a Writ that lay for bringing back the King's Bondmen, that had been carried away out of his Man-

nors to which they belonged.
VINCULUM, is a Term in Fluxions, implying that some compound surd Quantity is multiplied into a Fluxion, &c. Thus, in this Expresfion, $a \times \sqrt{a} \times -0$ a the Vinculum is the compound

Surd Vox--aa. which is $\times a$ into ax.

VIRGATE, or Tard-Land, was originally no more than a certain extent or compass of Ground, furrounded with fuch Bounds and Limits; and therefore the quantity was uncertain, according to the difference of Places and Customs.

VIRTUE; is a free elective and acquired Habit of the Mind, whereby we are constantly inclined to do, and do in Fact act or not act, pur-fue or avoid, according to the Rules of true Pru-

VISCOUNT, Vicecomes, Vicount, fignifies as much as Sheriff; betwixt which two Words there is no other Difference, but that the one comes from the Normans, and the other from the Saxons. See Sheriff. With us now, a Viscount or Vicount, is a Person having the next degree of Nobility be-low an Earl; and tho' it be an old Name of Ofgreater Antiquity in other Countries. See Selden's

Titles of Hon. fol. 761.
VISION: the Physical Cause of Vision scems to be, That the Rays of Light striking on the Bottom of the Eye, do there excite certain Vibrations in the *Tunica Retina*; which Vibrations being propagated as far as the Brain, by the folial Fibres of the Optick Nerves, do there cause the Sense of Seeing. For as Dense Bodies do retain their Heat longest, and that in proportion to their density, they retain it longer, as they are more dense; so the Vibrations of their Particles are of a more durable nature, than those of rarer Bodies, and therefore can be propagated to greater Distances: Wherefore the solid and dense Pibres of the Nerves, whose Matter is of an homogeneal and uniform Nature, are very proper to transmit to the Brain such Motions as are impressed on the external Organs of all our Senses. For that Motion which can preserve it self a good while, in one and the same Part of any Body, can also be propagated a great way from one Part of it to another; provided the Body be of an homogeneal Nature, and that the Motion be not reflected, refracted, interrupted, or disturbed by any Inequality in that Body.

Rays of Light therefore of divers kinds, will excite Vibrations in the Retina of different Magnitudes; and these Vibrations, according to such their different Magnitudes, will produce the Sensations of different kinds of Colours; just almost as in the Air, Vibrations of different Magnitudes produce the Sensation of different Sounds. v. gr. (as you will find under Colour) Such Rays of Light as are most Refrangible, excite the most short Vibrations, and cause the Sensation of a deep Violet Colour: While fuch Rays as are least Refrangible, do excite the longest Vibrations; and cause the Sensation of a deep Red Colour. And Rays of Light of all intermediate kinds, do excite accordingly intermediate Vibrations, and so cause the Semations of the other intermediate Colours, between the two Extremes of Violet

and Red.

VIS INERTIÆ Materiæ: This Vis Inertiæ is no where more conspicuous, than in the sudden Motion of a Vessel suil of Liquor upon a horizontal Plane; at first the Liquor seems to move with a Direction contrary to that of the Vessel, not that there is any such Motion really impress'd upon the Liquor, but that the Vis Inertiæ endeavouring to continue it in its state of Rest, the Vesfel cannot immediately communicate its Motion to the Liquor: But the Liquor perseveres in its state of Rest, whilst the Vessel moves forward, and so feems to move a contrary way. But when once the Liquor has the Motion of the Vessel communicated to it, and begins to move with a Velocity equal to that of the Vessel; if the Vessel be suddenly stop'd, the Liquor continues its Motion, and dashes over the sides of the Vessel.

The Resistance of all fluid Mediums against Bodies moving thro' them, is chiefly owing to this Vis Inertie; as you will find under Refigence

in this Vol.

VIS STIMULANS; a Term used by Dr. Cheyne in his Book of Fevers, and by some other Phy-ficians, and they understand by it such a Quality fice, 'tis a new one in Dignity, being not in use in any Fluid, whereby the Particles of it are diswith us till the time of Hen. 6. But 'tis of posed to make a real Division, or a violent Inflexion of the nervous and membranous Fibres of Hhhhha

the Body; which occasions frequent and forcible Reciprocations, Succussions, and Derivations of the Liquidum Nervorum into the Muscles and Contractile Fibres of the Canals of the Body, whereby all the involuntary Muscles are brought into violent Contractions, and the Emissaries of the Glands are squeezed. See Bellini de Urinis & Pulsibus, & de Motu Cerdis.

VISUAL-ANGLE, is the same with the Optick-Angle; which you will find under Optick Pyramid and Optick Triangle.

VITRIOL or Copperas, is made at Bricklesey in Effex, according to Mr. Ray's Account thus:

They lay the Copperas Stones (which Wormius in his Mars. c. 13. Sect. 2. faith, are chiefly found in the life of Shapey, but are indeed gathered upon the Isle of Shepey; but are indeed gather'd upon the Coasts of Kent and Suffex in many Places) on a large Bed or Floor prepared in the open Air, under-neath which there are Gutters or Troughs, dispo-fed to receive and carry away the Liquor impregnated with the Mineral to a Cistern, where it is reserved. For the Air and Weather dissolving the Stones, the falling Rain carries away along with it, the Vitriolick Juice or Salt which is dissolved there-by. This Liquor they boil in large Leaden-Pans, putting in a good quantity of old Iron: When tis fufficiently evaporated, they pour it out into large Troughs wherein it cools; and the Vitriol chrystallizes to the Sides, and to Cross-Bars of Wood, which are placed in the Troughs. The Liquor remaining after this Chrystallization, they call the Mother, which is referved to be boiled and evaporated again.

D'ormius saith, the Liquor is fix or seven Days boiling to a due confishence; and that it can be

boiled in nothing but a Leaden Vessel.

Matthiolis describes the way of making Vitriol in Italy, to be semething different from ours; for, be faith, they burn the Copperas Stones in small heaps, till the greatest Part is reduced to a Calx or Ashes, which being poudered, is mingled and agitated with Water, in large Vessels, to get out the Vitriolick Matter; then they draw off the clear Water after the groffer Matter hath subsided, and boil it to a due confistence, throwing in pieces of old Iron or Brass (according to the design of the Operator) and then put it to chrystallize in wooden Vessels.

VIVO, is the Shaft of a Column in any of the Orders of Pillars in Architecture.

UNCUTH, in Saxon is unknown, and, in the old Saxon Laws, is used for a Person that comes to an Inn, and lies but one Night: In which Case this Host was not answerable for any Offence he Should commit, whereof he was guiltless himself. But if he lay there a second Night, then he was called a Gust, Hospes; and then the Host was to answer for him, as for one of his Family. If he !tarried any longer, he was then called Agenhine, (or, as some write it, Hogenhine) and the third Night, Awnhine, that is, Familiaris: and then if the offended against the King's Peace, his Host was to fee him forth-coming; and if he could not produce him in a Month and a Day, he was obliged to fatisfy for his Offences.

UNDER-Chamberlain of the Exchequer, is an Officer there that cleaves the Tallies, and reads the same, so that the Clerk of the Pell, and the Controllers thereof, may see that the Entries be true; he also makes searches for all Records in the Treasury, and hath the Custody of the

Doomfday-Book. There are two Officers there of this Name.

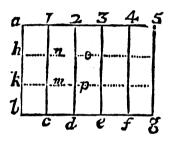
UNGULA, in Geometry, is the Section of a Cylinder cut off by a Plane, which passesobliquely thro' the Plane of the Basse, and part of the Cylindrick Surface.

Uniform Motion.

UNIFORM or equable Motion, and all its Properties, may be very well explained by the equiangular Parallelograms in this Figure. Where the Dirigent a 5 represents the Time, and the Lines a b. 1 c, 2 d, &c. the uniform or equable Velocities with which any Body is moved, in any Parts or Moments of Time. And the Parallelograms ac, c2, e, e 4, 4 g, do truly represent the Spaces described or run thro' with the Velocity ab, in the

Times a 1; 1,2; 2, 3; 3, 4; 4, 5, From the bare Confideration of which only, it

will follow;

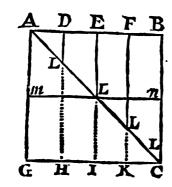


1. That the Spaces described by any Moveable, with an equable or uniform Velocity, are always as the Times.

For the Parallelograms ac, ad, &c. having all the same Altitude, must be as their Bases, bc, c d,

- 2. Or if the Times be equal, the Spaces must be as the Velocities; that is, the Parallelograms an to a m, will be as a b to a k, &c.
- 3. And from hence it will follow, that if the Spaces are as the Velocities, the Times will be equal; if as the Times, the Velocities will be equal,
- 4. Where the Spaces are equal, the Times must be reciprocally as Velocities: for the fimilar and parallel Rectangles have their Sides reciprocally proportionable; and vice versa, where the Times and Velocities are reciprocally proportionable, the Spaces must be equal.
- 5. Wherefore the Ratio's of the Spaces are always compounded of the Ratio's of the Times and Velocities: And consequently, deducting the Ratio of the Time out of that of the Velocity; or, which is all one, dividing the Space by the Time, there will result the Velocity; dividing by the Velicity, the Quotient will be the

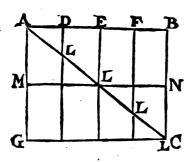
After much the same manner also may the uniform or equable Acceleration or Retardation of any Motion, be expressed very easily and clearly by Lines.



As suppose the right-lined Triangle ABC, the Side AB denotes the Time in which a Body may move from a Point of Reft, as in A; and having its Velocity continually encreasing in the uniform Ratio of the Lines DL, EL, FL, and BC; or decreasing equally back again in the same Ratio, from any determinate degree of it

in BC, to none at all in A.

In this Figure then, the Triangles ALD, ALE, ALF, and ABC, will very appointely represent the Spaces described in the several Times AD, AE, AF, and AB; and consequently the Trapezia DL, DC, &c. will represent the still aggregated Velocity, and the Spaces corresponding there-And from hence all the Laws and Affections of equable accelerated Motions will be eafily accounted for; which are fuch as these, viz.

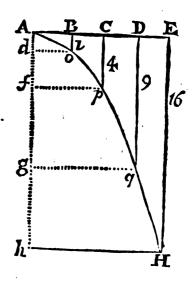


1. That the Space described at the end of the accelerated Motion, will be equal to that which would have been described by an uniform equal Motion in the same time, and with half the degree of Velocity which the accelerated Body did at last acquire: For the Triangle ACB is equal to the Square MB; each being the half of the Square GB.

That the Spaces described by the Motion of a Body, beginning from Rest, and uniformly accelerated, are as the Squares of the Times. For the Area's of the similar Triangles ADL, AEL, &c. are as the Squares of AD, AE, &c.

3. And comparing divers Motions, thus uniformly accelerated one with another, it will be plain that the Spaces run thro', will be to one another in a Compound Ratio of the Times, and of the greatest Velocities at any time acquired, (because similar Squares are in a Ratio compounded of that of their Sides.)

4. And from hence 'tis plain, that the Case of Bodies accelerating their Motion uniformly, so as that the Spaces described, shall be as the Squares of the Times, (which is the known Case of the Descent of heavy Bodies towards the Centre of the Earth) may be very well expressed by the Complement of the Semi-parabola AEH;



where the vertical Tangent AE, represents the determinate Time divided into equal Parts; and the Lines BO, CP, Dq, and EH, the several Velocities required in the several Descents. Now the Spaces described, ABO, ACP, &c. are as the Squares of the Times AB, AC, &c. that is, as the Squares of the Ordinates do, fp, gq, &c. which Squares are (by the Parabola) as the Abscissa Ad, Af, Ag, &c.

Wherefore the Velocities acquired at the end of

any Descents, will be as the Squares of the Times

in which these Descents are made.

That is, the Velocity at the end of the second Moment, or Part of Time, to the Velocity at the end of the first Moment, will be as the Square of the second to the Square of the first, or as the fourth to the first, &c.

UNION of two Churches, is a confolidating or combining them into one, which may be done by the Consent of the Bishop, Patron, and Incumbent. See Linwood's Provincials, and 37

H. 8. c. 21 as also 17 Car. 2. c. 3.

UNISONS. It hath been long fince observed, that if a Viol-String, &c. be struck with the Bow or Hand, another String on the same, or another Instrument not far from it, will (if an Unison to it) tremble at the same time of its own accord. But Dr. Wallis, in Philos. Trans. No. 134 tells us, that 'tis not the whole of the unstruck String that trembles, but the several Parts severally, according as they are Unrions to the whole, or the Parts of that String which is so struck: v. gr. If one String be an upper Octave to another, and therefore an Unison to each half of it when 'tis stopt in the middle; then I say, if the former be struck while the latter is open, the two halves only of the latter will tremble, and not the middle Point: as you may eafily try, by laying a bit of Paper lightly wrapt about the middle of the fecond String. See a Solution of this in Plot's Hift. of Oxfordsbire, by Dr. Narcissus Marsh, and of other fuch Phænomena.

UNMOOR, a Term used at Sea for a Ship that before rid, or was held by two Anchors, to begin to get them up, and prepare to weigh.

See Moor.

VOLVA,

VOLVA, the great Kepler confidering how our Earth will appear to the Inhabitants of the Moon, if there be any fuch, viz. that it will feem a large Moon to them 15 times greater than their Planet doth to us at the full, in 24 Hours time revolving round its Axis (as will be eafily difcovered by the Spots that must appear in it) but yet also fix'd like a fix'd Star in one determinate Place in the Heavens, and moving only as they appear to do 1 this being the Phænomenon of the Earth to a Lunar Spectator, (i. e. to fuch as live on that fide of the Moon, which is always turn'd towards the Earth; for those in the other Hemisphere can never see the Earth at all) he fancies that they would give it a Name fomething like that of Volva; and while they would consider their own Earth as a Vesta, an immoveable Seat or Habitation. In pursuance of this imaginary State of Things, Kepler calls the Inhabitants that live in that half of the Moon's Sphere, which is turned towards the Volva, Subvolvæ; and the others that never see the Earth, Privolve.

VOMITIVE Medicines, see Emeticks; where there is an Account of their Operation, in Vol. I.

URBICARIÆ Regiones. See Suburbicariæ. USE in the Civil Law, is one of the Personal Services, and fignifies a Right that a Man hath of using a corporeal thing belonging to another, without prejudice to the Proprietor of it: This Right is not so great as an Usinfrust; for he that hath this Right, cannot take the Profits generally, but only for his daily Use and necessary Subfistence.

Exchequer, of which fort three or four attend the chief Officers and Barons at the Court at Westminster; and Juries, Sheriffs, and all other Accountants, at the pleasure of the Court. There are also Usher's in the Queen's House, as of the Privy-Chamber, &c.

USUFRUCT, is a Petsonal Service, whereby a

Man hath a Right of using and taking all manner of Profits, of a corporeal thing belonging to another Person, so it be without diminution or prejudice to the Propriety of it; and he that hath

this Right, is called an Usufructuary.

UTAS Octava in the Law is used for the eighth Day following any Term or Feast; as the Utas of St. Michael, of St. Hillary, of St. John Baptist, &c. and any Day between the Feast and the Ostave, is said to be within the Utas. The Use of this is in Return of Writs, as appears by.

UTFANGTHEF, Fur extra captus, is an antient Privilege or Royalty granted to a Lord of a Mannor by the Sovereign, giving him a Power to punish a Thief dwelling out of his Liberty, and committing the Theft also without the same, if so be that he be taken within the Pee of that Lord.

UVEA, this is reckoned the fifth Coat of the Eye, and seems to be only the Circumserence of the Pupilla; it is composed of circular and strait Fibres, to contract and dilate according to the Strength or Weakness of the Light: for when the Light is too strong, the circular Fibres contract the Pupilla, that the Force of the Rays may not hurt the Eye; and when the Light is too weak, the strait Fibres dilate the Pupilla, to let in more USHER, Oftiarius, from the French Huissier, Rays, in order to form the Vision of Objects a Door-keeper of a Court, is an Officer in the more distinctly.

WAR

WAR

AGA, or VAGA, the same with Weigh, which see in this Vol.

WAGE, Vadiare, from the French Gager, dare Tignus, fignifies in our Law the giving Security for the Performance of any thing: As, to wage Law, is to put in Security, that you will make Law at a Day affigned; and to make Law, is to take an Oath that a Man owes not a Debt which is claimed of him, and also to bring with him so many Men as the Court should asfign, to avow on their Oaths, that they believe he fwears truly

WAGER of Law. See Law.
WARDAGE, the same with Ward-peny.
WARDECORN, is the Duty of keeping Watch and Ward, with a Horn to blow, on any occasion

of Surprize, &c. WARD-PENY, Warpen, Warthpenny, Warscot, Warth, was formerly a customary Due paid to the Sheriff; and other Officers, for maintaining abolished, lay for him who was challenged, when Watch and Ward; it was payable at the Feast of St. Martin. This customary Acknowledgment is thill paid within the Mannor of Sutton Colfield, in was bought by the Ancestors of the Ward, was

Warwick/bire; and with some Ceremonies that are as fingular as furprizing. Covel's Interp.

WARDMOTE, in London, is a Court so called, and which is kept in every Ward.

WARDEN of the Mint. See Master.

WARDS and Liveries, was a Court first erected. by King H. 8. and afterwards augmented by him with the Office of Liveries: But 'tis now absolutely taken away and abolished, by a Statute

made 12 Car. 2. cap. 24.
WARD-STAFF, was formerly the Term for a Constable's Watchman's Staff: And the Mannor of Lamborn in Essex, is held by Service of the Ward-Staff, viz. to carry a Load of Straw in a Carr, with fix Horses, two Ropes, and two Men in Harness, to watch the Ward-Staff, when it is

brought to the Town of Aibridge. WARRANTIA Custodie, is a Writ judicial; and formerly, before the Court of Wards was abolished, lay for him who was challenged, when

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warranted, to be free from fuch Thraldom; and it lay against the Warranter and his Heirs.
WARRECTUM and Warresta Terra, is Land

long neglected and uncultivated; for in old Records you will find, that Tempus Warretti fignifies the Time that Land lies fallow. Warrettare

also fignifies to fallow Land.

WARREN, is a Franchise, or Place privileged, either by Prescription or Grant from the Crown, to keep Beafts and Fowl of Warren; which are Hares and Conies, Partridges and Pheafants: And if any Person be found an Offender in any such Fee-Warren, he is punishable for the same at Common-Law; and by the Statute 21 Ed. 3. a Fee-Warren may lie open, and there is no necessity of closing that in, as there is of a Park; for that ought to be seized into the Queen's hands, if it be not enclosed:

WASSEL-BOWL, was a large Cup or Bowl of Silver or Wood, wherein the Saxons at their publick Entertainments drank a Health to one another, in the Phrase Was-heal (i.e.) Health be to you. This Wasel-Bowl feems plainly to be meant by the word Vastellum, in the Lives of the Abbots of St. Albans, by M. Paris, p. 144. where he saith, Abbas solus prandebit supremus in Resectorio habens Vastellum; that is, the Abbot had set by him at the upper-end of the Table, the Wastell, or Wasfel-Bowl, to drink a Health to the Fraternity, or the Poculum Charitatis. So Cakes and White-Bread (which were commonly sopped in this Bowl) are called Wastell-Bread. And hence the Custom of going a Wasfailing, as 'tis still called and used in Suffex, and some other Places, seems to have taken its Name.

WATER. Sir If: Newton defines Water (when pure) to be a very fluid Salt, volatile, and void of all Sapor or Taste, and it seems to confist of finall finooth hard porous spherical Particles, of equal Diameters, and of equal specifick Gravities, as Dr. Cheyne observes; and also that there are between them Spaces so large, and ranged in fuch a manner, as to be pervious on all fides. Their Smoothness accounts for their sliding easily over one another's Surfaces; their Sphericity keeps them also from touching one another in more Points than one; and by both these, their Frictions in sliding over one another, are rendered the least possible. Their Hardness accounts for the Incompressibility of Water, when 'tis free from the Intermixture of Air.

The Porofity of Water is so very great, that there is at least 40 times as much Space as Matter in it; for Water is 19 times specifically lighter than Gold, and consequently rarer in the same Proportion: but Gold will, by Pressure, let Water pass through its Pores, and therefore may be supposed to have (at least) more Pores than solid Parts. Now 'tis this great Porosity of Water that accounts for its different specifick Gravity, in comparison of Mercury or other Fluids; and also why tis more easily concreted into a solid Form, by adventitious Matter in freezing, than other

Fluids are.

Dr. Cheyne observes rightly, that the Quantity of Water on this side our Globe, doth daily decrease, some part thereof being every day turn'd into Animal, Vegetable, Metalline, or Mineral Substances; which are not easily dissolved again into their component Parts; for separate a severn; near the Wrekin in Shropshire, extending itself to Anglesey in Wales. Anno 39 Elizated Particles of any Fluid, and fasten them to a c. 2. folid Body, or keep them afunder one from ano-

ther, and they are no more fluid; for to produce Fluidity, a confiderable number of fuch Particles is required. (See Fluidity in this Vol.) Most of the Liquors we know are formed by the Cohesion of Particles of different Figures, Magnitudes, Gravities, and attractive Powers, (See Attraction and Particles) swimming in pure Water, or an aqueous Fluid; which seems to be the common Basis of all. And the only Reason why there are so many forts of Water differing from one another, by different Properties, certainly is, here the Corpuscles of Salts and Minerals, with which that Element is impregnated, are equally various. Wine is only Water impregnated with Particles of Grapes, and Beer with Particles of Barley. All Spirits seem to be nothing but Water, saturated with faline or sulphureous Particles. And all Liquors are more or less fluid, according to the greater or smaller Cohesion of the Particles which swim in the aqueous Fluid; and there is hardly any Fluid without this Cohesion of Particles, not even pure Water itself; as is apparent from the Bubbles which sometimes will stand on its Surface, as well as on that of Spirits, and other Liquors. WATER-Bayliff, was an Officer in Port-Towns,

appointed for the searching of Ships, as seems from 28 H.6. c. 5. Now there is such an Officer in the City of London, who supervises and searches all Fish brought thither; and he gathers the Toll arising from the River Thames. He also attends on the Lord-Mayor, and hath the principal Care of marshalling the Guests at the Table. And he arrests Men for Debt, or other personal or criminal Matters, on the River of Thames, by Warrant of his Superiors,

WATER-Measure, is a Measure mention'd in the 22 Stat. of Car. 2. and exceeds the Winchester Measure by about 3 Gallons in a Buthel. 'Tis now used for selling of Coals in the Pool,

WATER-Ordeal, was one of the old Saxon Ways of Purgation, or Tryal of a Person's Innocence, when suspected of a Crime; 'twas called Judicium Dei, as the Fire-Ordeal was. This by Water, was, for the Person accused either to put his Hands into scalding Water, or to be thrown into some River, Pond, &c. if he escaped being burnt or scalded, or of being drowned, he was concluded innocent. This Water-Ordeal was for Churls, Bondmen, and other Rusticks: But the Fire-Ordeal was for Freemen, and Persons of better Condition.

WATER-Table, in Architecture, is a fort of Ledge left in Stone or Brick-Walls, about 18 or 20 Inches from the Ground, and there the Thick-

ness of the Wall begins to abate.

WATLING-Street, is the Name of one of the four Roman Ways, by that Nation made here in England, and by them were called Confulares, Pretorias, Militares, & Publicas. In the Laws of Edw. the Confessor, it appears that these Publick Ways, had the Privilege of the King's Peace. This of Watling-street, or otherwise Werlam-street, (see Hoveden, Part. prior. Annal. Fol. 248.) was made from Dover to London, thence to St.

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The second of these Ways is called Ikemildftreet, (ab Icenis) and reached from Southampton over the River Isis, at Newbridge; thence by Cambden and Litchsfeld, and so over the Derwent by Derby, thence to Bolseover-Castle, and ends

at Tinmouth.

The third was called the Fosse, because in some Places it was never finished, but lies as a large Ditch, leading from Cornwall thro' Devensbire, by Tetbury, near Stow in the Wold, and besides Coventry to Leicester, Newark, and so to Lin-

The fourth was called Ermine, or Erminage-fireet, beginning at St. David's in Wales, and going to Southampton. See Holling shed's Chron. Vol. 1. c. 19. and Henry of Huntington, Book 1.

at the beginning.
WAVESON, is the Term for such Goods as, after Shipwreck, do appear swimming on the

WEALD, or Weld, is a Saxon Word, fignifying the woody part of a Country: As the Weald of Suffex and of Kent, in the Collect. of Statutes, 14 Car. 2. c. 6. 'Tis mif-printed, as 'tis vulgady pronounced, The Wild of Suffex, &c.

WEAR, a Term used by the Seamen for

bringing a Ship to, on a different Tack.
WEED, in the Miners Language, is the Degeneracy of a Load or Vein of fine Metal, into an useless Marchasite.

WEDGE. See Cuneus in this Vol.

WEIGH, a Term used by the Seamen, for taking up a Ship's Anchor, and getting ready to fail; which they call Weighing Anchor.
WEIGH of Cheefe, Wool, &c. Waga, alias

Vaga, is 256 Pound Weight Averdupois; for by 32 Cloves, and each Clove 8 Pound; the fome fay but 7.

WEDBEDRIP, was formerly a customary Service that inferior Tenants paid to their Lords, in cutting down their Corn, or doing other Harvest

Dutics, &c.

WEIGHTS, in use in England, are chiefly of two forts: One called Troy-Weight, having 12 Ounces in the Pound; and by this, Jewels, Silver, Gold, Corn, Bread, and all Liquors are usually weighed; and the other is called Averdupois, containing 16 Ounces in the Pound; by this all coarse drossy wastable Wares, such as Grocery, Pitch, Tar, Rosin, Wax, Tallow, Copper, Tin, Lead, Iron, &c. are weighed.

Georg. Agricola, in his Book de Ponderibus & Mensieris, calls the Pound of twelve Ounces, or the Pound Troy, Libram Medicam, which we retain in our Apothecaries Weight, (see the Table of it under Weights, in Vol. I.) and the other Pound of 16 Ounces, he calls Libram Civilem: and he faith also, that Medica & Civilis Libra Numero non Gravitate Unciarum differunt.

The Original of all our English Weights was a Corn of Wheat, gathered out of the middle of the Ear; and being well dried, 32 of these made one Penny-Weight, or were the Weight of the Penny-Sterling; twenty of these Pence or Penny-Weights, were to make an Ounce, and twelve fuch Ounces made the Pound Troy. See

51 H. 3. 31 Edw. 1. and 12 H. 7.

But in latter Times, it was thought fufficient to divide the aforefaid Penny-Weight into

mon Use; tho' the Moneyers subdivide the Grain

24 Blanks
20 Periots make 51 Periot.
Droite. 24 Droits 3 I Mite. Li Grain.

WELDING-HEAT, is a Degree of Heat which Smiths give their Iron in the Forge, when there is occasion to double up the Iron, and to weld or work in the Doublings, so that the Iron shall grow a Lump thick enough for your purpose: Tis used also when two Bars of Iron are to be joined together at the ends, to make a Length.

WEREGILD, Wergeld, Wergildus, also Were (Werræ) alone without Gild, was formerly the Price that was paid partly to the King, and partly to the Relations of the Deceased, for killing a Man; when such Crimes were not punished with Death, but with pecuniary

Mulcts.

WHEEL, in the Art Militay, is the Word of Command, when a Battalion is to alter its Front, either one way or other. If the Battalion is to wheel to the Right, the Man in the right Angle turns very flowly, and every one else moves and wheels from the Left to the Right, regarding him as the Centre; and vice versa, when they are to wheel to the Left. When a Division of Men are on a March, if the Word be, Wheel to the Right, or to the Left, then the Right or Left-hand Man keeps his ground, turning only on his Heel, and the rest of the Rank move about quick, till they make an even Line with the faid Right or Left-band Man. Squadrons of Horse wheel much after the same manner.

WHERLICOTS, were the open Chariots used here in England by Persons of Quality, before the Use of Coaches. See Stow's Survey of London, p. 70. Perhaps hence comes our Word Whirligig.

WHITE or Flame Heat, is a Degree of Heat given by Smiths to their Iron in the Forge. when it hath not yet its Form and Size, but must be forged into both; this is a less Heat than a Welding Heat: Iron in this Heat is batter'd or drawn out usually with the Pen or Edge of the Hammer; and afterwards hath the Dents of the Pen smoothed out with the Face of the Hand-Hammer.

WHITENESS. The excellent Sir If. Newton, in his late Book of Opticks, demonstrates, that Whiteness is a dissimilar Mixture of all Colours, and that the common Light of the Sun is a Mixture of Rays, endued with all those Colours; for by the multitude of those Rings of Colours, which appear in the Compression of the two Prisms, or Object-Glasses of Telescopes together, (see Observ. 3, 12, 24. Book 2. Part 1.) it is manifest, that these do so interfere and mingle with one another at last, as after 8 or 9 Revolutions, to dilate one another wholly, and constitute an even and sensibly uniform Whiteness. Wherefore it appears from hence, as well as from other Experiments, mention'd elsewhere, that Whiteness is certainly a Mixture of all Colours, and that the Light which conveys it to the Eye, is a Mixture of Rays indued with all those Colours. And he shews that Whiteness, if it be most strong and luminous, is to be reckoned of the first Order of 24 equal Parts, which came to be called Colours, but if less, to be a Mixture of the Co-Grains, being the smallest Weight now in com-lours of several Orders: Of the former sort, he

reckons

reckons White Metals; and of the latter, the Whiteness of Froth, Paper, Linen, and most other white Substances. And as the White of the first order is the strongest that can be made by Plates of transparent Substances, so it ought to be fronger in the denser Substances of Metals, than in the rarer ones of Air, Water, and Glass. Gold or Copper, mixed either by Fusion or Amalgamation, with a very little Mercury, with Silver, Tin, or Regulus of Antimony, becomes White; which shews both that the Particles of White Metals have much more Surface, and therefore are smaller, than those of Gold or Copper; and also that they are so Opake, as not to suffer the Particles of Gold or Copper to shine through them: And as he doubts not but that the Colours of Gold and Copper are of the second or third Order, therefore the Particles of White Metals can't be much bigger than is requifite to make them reflect the White of the first Order: And this he concludes also from other Observations and Experiments.

WHITE-Hart Silver, is a Mulct paid into the Exchequer out of certain Lands, in or near the Forest of White-Hart; and it hath continued ever since Henry the Third's time, who imposed it upon Thomas de Lynde, for killing a most beautiful White Hart, which the King had before purposely

spared in Hunting. Camd. Brit.

WHITSON Farthings. See Pentecostals.

WIDOW of the King, was she who after her Husband's Death, being the King's Tenant in Capite, was forced to recover her Dower by the Writ de Dote assignanda, and could not marry again without the King's Consent.

WILL. See Testament.

WINDAGE of a Gun, is the Difference between the Diameter of the Bore, and the Diameter of the Balls.

WIND. The Reverend Mr. Derham, of Upminster in Essex, and F. R. S. in a curious and
accurate Discourse about the Motion of Sound, in
Phil. Trans. No 313. takes occasion to say
something of the Velocity of the Motion of
Wind: And by many Trials he found, that the
Wind in the greatest Storm doth not move above
so or 60 English Miles in an hour: That a
common brisk Wind moves about 15 Miles in an
hour: But that the Course of many is so gentle,
as not to exceed, if they come up to, one Mile in
an hour.

WINDING-STAIRS, are such as wind round

a Newel, either Circular or Square, Close, i. e. Solid, or Open.

WOLD, Walda, is a Down, or Champaghe-Ground, Hilly, and void of Wood; as Stow in the

Wold, and Corfixold in Gloucestershire.

WORD, in an Army or a Garison, is some peculiar Word or Sentence, by which the Soldiers know and distinguish one another in the Night, &c. and by which Spies and treacherous Persons are discovered: 'Tis used also to prevent Surprizes. It is given out in an Army every Night by the General to the Lieutenant or Major-General of the Day, who gives it to the Majors of the Brigades, and they to the Adjutants, who give it first to the Field-Officers, and afterwards to a Serjeant of each Company, who carry it to the Subalterns. In Garisons 'tis given after the Gate is shut, to the Town-Major, who gives it to the Adjutants, and they to the Serjeants.

WRIT Breve, is the Queen's Precept, whereby any thing is commanded to be done touching a Suit or Action: As the Defendant or Tenant to be summoned, a Distress to be taken, a Disseisin to be redressed, &c. And these Writs are diversly divided in divers respects; some in respect of their Order or Manner of granting, are called

their Order or Manner of granting, are called WRITS Original, which are fent out for the fummoning of the Defendant in a personal, or the Tenant in a real Action, before the Suit begins; or indeed rather to begin the Suit.

WRITS Judicial, are such as are sent out by Order of that Court where the Cause depends, on Occasion after the Suit is begun. And these are distinguished from the Original Writs thus: The Teste of the Judicial Writ bears the Name of the Chief Justice of that Court whence it issues; whereas in the Teste of the Original Writ, the Queen's Name is inserted. Again also, there are

WRITS Personal and Real, Writs of Entry, Writs of Right, Writs of Privilege, &c. of which, see the New Book of Entries.

WRIT of Rebellion. See Commission of Re-

bellion

WRIT of Assistance, issues out of the Exchequer to authorize any Person, to take a Constable or other Publick Officer, to seize Goods or Merchandise uncustomed or prohibited. There is also a Writ of Assistance which issues out of the Chancery, to give a Possession.

YARD-

ARD-LAND, Virgata Terre, is a Quantity of Land, various according to the Place:

several Makes and Forms.

YEARS-MIND, See Annualia, this Vol.

At Wimbleton in Surrey 'tis accounted fifteen Acres; in other Counties 'tis twenty; in fome twenty-four, in fome thirty, and in others even four Acres. In a MS. of the Abbacy of Maimeshury, a Virgate of Land is faid to contain twenty-four Acres. This uncertain Quantity in 28 E. 1. is called a Verge of Land.

YATCHES, are Veffels with one Deck, carrying from 4 to 12 Guns, with from 20 to 40 Men; and are of Burden from 30 to 166 Tun. They draw little Water, and are used for run-ing and making short Trips, &c. They are of serving.

ZAC

ZOP

ACCO, is the Term fometimes used for the ZOPERUS, a Term is lower part of the Pedestal of a Column; and ing the same with Frieze. ZOPERUS, a Term in Architecture, fignifyis in the form of a square Brick or Tile.

I N I



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TABLE

OF.

Natural and Artificial Sines, Tangents, and Secants, to every Degree and Minute of the

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The Radius of the Artificial being 10,0000000 and of the Natural 10,000,000:

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3	8727	9999996	I	8727	114591530		10000004	114591574	57
4	11636	9999933	1	11636	85943630		10000007	85943689	56
5	14544	9999989	1	14544	68754887 5 7295721		10000011	68754960 572958 0 9	55
6	17453	9999999	l	17453	7/-97/21	1	10000010	7/295009	54
7 8	20362	9999979		20362	49110600		10000021	49110702	53
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15	43633	9999905	- 1	43033	22918166		10000095	22918385	45
16	46542	9999892	1	46542.	21485762		10000108	21485995	` 44
17	49451	9999878	•	49451	20221872 19098419		10000122	19098680	43
18	52360	999900		52360			10000137		42
19	55268	9999847		55269	18093200		10000153	18093496	4:
20	58177	9999831		58178	17188540 16370019		10000170	17188831	40
21	610 86 6399 5	9999813 9999795		61087 63966	15370019 15625 9 08	1 4	10000187	#5616228	39 38
22 23	66904	9999776		66905	14946502		10000224	14946837	37
24	69843	9999756		69814	14323712		10000244	14324061	36
	72721	9999736		72723	T3750745		10000265	13751108	36
25 26	75630	9999714		75632	13221851		1000286	13222229	35 34
27	78539	9999692		78541	12732134		10000308	12732526	33
28	81448	9999668		81450	12277396		10000331	12277 03	32
29	84357 87265	9999644 9999619		84360 .87269	11854018		10000355 1000380	11854440 11459301	31 30
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31	90174	9999593		90178	11089205		10000406	11089656	29
32	93283	9999566 9999539		93 087 95996	10742648		10000461	10743114 10417574	28
33	9599 2 98900	9999511		98905	10110690		10009489	10111185	27 26
34 35	101809	9999482		101814	98217943		10000518	98223033	25
36	104718	9999452		104724	95489475		10003543	95494711	2.4
77	107627	9999421		107633	92908487		10100579	92913865	23
37 38	110532	9999389		110542	90463336		100000614	90468863	22
39	113444	99993 5 6		113451	88143572		10000644	88149244	21
40	116353	9999323		116361 119270	85939791 83843 5 07		10000677 1000 0711	85945509 83849470	20
41	119261 122170	9999289 999 9254		122179	81847041	' .	10000746	81853150	19
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43	125079	9999218	1	125088	79943430	1	10000782	79949684	17
44	127987 130896	9999181 9999143		127998 13090 7	78126342 76390009		10000819	78132742 7 6396554	16
. 45 46	133605	9999143		133817	74729165		10000896	74735856	15
47	136713	9999065		136726	73138991		10000935	73145827	13
48	139622	9999025		139635	71615070	٠.	10000975	71622052	12
40	142530	9998984	l	142545	70153346		10001016	70160474	11
49 50	145439	9998942		145454	68750087		10001058	68757360	10
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54				- 11-73					<u> </u>
55	159982	9998720	1	160002	62499154	1	10001280	62507153	5
56	162890	9998673 9998625	1	162912 165821	61382905	1	10001327	61391050	4
57 58	165799 168707	9998576	ţ	168731	59265872	1	10001424	59274308	3 2
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2	6.7647561	9.9999999	6.7647562	13.2352438		10.0000001	13.2352430	58
3	6.9408473	9. 9999998	6.9408475	13.0591525		10.0000002	13.0591527	57
4	7.0657360	9.9999997	7.0657863 7.1626964	12.9342137 12.8373036		10.0000003	12.9342140	56
5	7.1626960 7.2418771	9 9999995	7.2418778	12.7581222		10.0000007	12.8373040	55
	7.2410//1	9.9999993	7.2410770				110/501229	54
7	7.3088239	9.9999991	7.3088248	12.6911752		10-0000009	12.6911761	53
8	7.3668157	9.9999988	7.3668169	12,6331831		10,0000012	12.6331843	52
9	7.4179681	9.9999985	7.4179696	12:5820304		10.0000018	12.5820319	51
10	7-4037255	9.9999982	7·4637273 7 ·5 051203	12.5362727 12.4948797		10.0000022	12.5362745	50
12	7.5051181 7.5429065	9.9999978 9.9999974	7.5 129091	12.4570909	·	10,0000026	12.4570935	49 48
		9.9999974						4°
13	7.5776684	9.9999969	7.5776715	12.4223285		10.0000031	12.4223316	47
14	7.6098530	9.9999964	7.6008566	12.3901434		10.0000036	12,3901470	46
15	7.6398160	9.9999955	7.6398201 7.6678492	12.3601799		10.0000041	12.3601840	45
16 17	7.6678445	9.9999953	7.6941786	12,3321508 12,3058214		10.0000047	12.3321555	44
18	7.6941733 7.7189966	9.9999947 9.9999940	7.7190020	12-2809974		10.0000000	12.2810034	43
	75/ - 09900							42
19	7.7424775	9.9999934	7.7424841	12.2575159	•	10.0000066	12.2575225	41
20	7.7647537	9.9999927	7,7547610	12,2352390	, ,	10.0000073	12.2352463	40
21	7.7859427	9.9999919	7.7850508 7.8061547	12,2140492		10.0000089	12.2140173	39
22	7.8061458 7.8254507	9.9999911	7.8254604	1241938453 12.1745396		10.0000097	12.1938542 12.1745493	38
24	7.8439338	9.9999993 9.9999994	7.8439444	12.1560556		10,0000106	12.1560662	37 · 36
	7-0439330							. 30
- 25	7.8616623	9.9999885	7.8616738	1211383262		10.0000115	12.1383377	35
26	7.8786953	9.9999876	7.8787077	12-1212923		10,0000124	12.1213047	34
27 28	7.8950854	9.9999866	7.8950988 7.9198938	12-1049012 12-0891062		10.0000134	12.1049146 12.0891207	33
29	7.9108793 7.9261190	9.9999845	7.9261344	12.0738656		10.0000144	12.0738810	3 2
30	7.9408419	9.9999835	7.9408584	12,0591416		10.0000165	12.0591581	31
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31	7.9550819	9.9999823	7.9550996	12.0449004		10.0000177	12.0449181	29
32	7.9688 6 98	9.9999812	7.9688886	12:0311114		10,000,0188	12-03113.32	28
33	7.9822334	9.9999800	7.9822534 7.9952192	12:0177466		10.0000200	12:0177066 12:0048020	27
34 35	7.9951980 8.9077867	9.9999788	8 0078092	11,9921908	1	10.0000212	11.9922133	26
36	8.0200207	9.9999762	8.0200445	1169799555	1	10.0000238	11.9799793	25 24
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37	8.0319195	9-9999748	8.0319446	11.9680554	•	10.0000252	11.9680805	23
38	8.0435009	9.9999735	8.04352 74 8.0548094	11.9564726	ł	10.0000265	11.9564991	22
39	8.0547814	9.9999721	5.0658057	11.9451966		10.0000279	11,9452186	21
40 41	8.c764997	9.9999706 9.9999691	8.0765306	11.9234694	1	10.0000309	11.9342237 11.9235003	20
42	8.0869646	9.9999676	8.0869970	11.9130030	l	10.0000324	11.9130354	18
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43	8.0971832	9.9999660	8.0972172	11,9027828	1	10.0000340	11.9028168	17
44	8.1160962	9.9999644	8.1072025 8.1169634	11.8927975	1	10.0000356	11.8928331	16
45 46	8.1169262	9.9 9 99 62 8 9.9999611	8.1265099	11,8734901	1	10.00003/2	11.8830738	15
47	8.1358104	9.9999594	8.1358510	11.8641490	1	10.0000406	11.8641896	14
48	8.1449532	9.9999577	8.1449956	1148550044	ł	10.0000423	11.8550468	13
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49	8.1539075	9.9999559	8:1539516	11.8460484	1	10.0000441	11.8460925	11
50	8.1626808	1 / //// 1 .	8.1627267 8.1713282	11.8372733		10.0000459	11.8373192	10
51 52	8.1712804		8.1797626	11.8200/18	1	10.0000478	11.8287196	2
53	8.1879848		8.1880364	11.8119636	1	10.0003497	11.8202671	8
54	8.1661020		8.1961556	11-8038444	1	10.0000536	11.8038980	7 6
		·			1			<u> </u>
55	8.2040703	9-9999444	8.2041259	11.7958741	1	10.0000556	11.7959297	5
56	8.2118949		8.2119526	11.7880474	į	10.0000576	11.7881051	4
57 58		9-9999403	8.2196408 8.2271953	11.7803592	I	10.0000597	11.7804189	3
59		9.9999360	8.2346208	11.7653792		10.0000618	11.7728665	2
60		9.9999338	8.2419215	11.7580785	1	10.00000662	11.7581447	0
	L. Co Sine	1	L. Co-Tang	I. Tangent	1	L. Co-Secant	L. Secant.	$\left \frac{0}{N_{\star}} \right $
		=======	0		5			
	. L. Co sine	L. Sine.	0	EGREE	S.	L. Co-Secant	L. Secant.	<u>i</u> y

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A TABLE of Natural and

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					4 4 A D 3				
M	N. Sine	N. Co-Sine		N. Langent.	N. Co-Lang.		N. Secant	N. Co-Secant.	
0	174574	9998477		174551	57289962		10001523	57298688	60
1	177432	9998426		177460	56350590		10001574	56359462	59
2	180341	9998374		180370	55441517		10 01626	55450534	58
3	183249	9998321		183280	54561300		10001679	54570453	57
4	186158	9998267		186190	53708587		10001733	53717896	56
5	189066	9998212	,	189100	52882109		10001788	52891564	55
6	191974	9998157		192010	5208 0 67 3		10001843	52090272	54
7 8	194883	9998101		194920	51303157		10001899	51312902	53
	197791	9998044		197830	505485~6		10001956	50558356	52
9	200699	9997986		200740	44815726		10002014	45825762	51
10	203608	9997927		203650	49103881		10002073	49114062	ŞΟ
11	206516	9997867 99978c6		206560	48412084		10002133	48422411	43
12	209424	9997000		209470	47739501	1	10002194	47749974	48
13	212332	9997745		212380	47085343		10002255	47095961	45
14	215241	9997682		215291	46448862		10002317	46455625	47
15	218149	9997620		218201	45829351	i 1	10202380	45840260	46
16	221057	9997556		211111	45226141		10002444	45237195	45 44
17	223965	999749₹		224021	44628596		10002509	44649795	43
18	226873	9997425		226932	44066113		10002575	44077458	42
19	229781	9997359		229842	43508122	l l	10002641	43519612	41
20	232690	9997292		232752	42964077	l 1	10002708	42975713	40
21	235598	9997224		235663	42433464		10002776	42445245	39
22	238506	9997155		238574	41915790		10002845	41927717	38
23	241414	19997085		241484	41410588		10002915	41422660	37
24	244322	9997014		244395	40917412		10002986	40929629	36
	045300	9996913		24224	40435837		10003058	40448201	
25 26	247230 250138	9996871		247305	39965460		10003430	39977969	35
27	253046	9996798		253216 253127	39505895		10003130	39518549	34
28	255954	9996724	·	256038	39056771		10003277	39069571	33
29	25862	9996649		258948	38617738		10003352	38636683	32 31
30	261769	9996573		261859	38188459		10003428	38201550	30
31.	2 6 4677	9996496		264770	37768613		10003505	39781849	29
32	267585	9996419		26 7681	37357892		10003582	37371273	28
33	277493	9996341		270592	36956001		10003660	36969528	27
34	273401	9996262		273503	36562659		10003739	36576332	26
35	276309	9996182		276414	36177596		10003819	36191414	25
36	279210	9996101		279325	35800553		10003000	35814517	24
	282124	9996019		282236	35431282		10003982	35445391	
37 38	285032	9995936		285148	35069546		10004065	35033800	23
39	287940	9995853		288059	34715115	`	10004148	34729515	22
40	290847	9995769		290970	34367771		10004232	34382316	20
41	293755	9995684		293882	34027303		10004317	34041994	19
42	296662	9995598		296793	33693509		10004403	33708345	18
43	299570	9995511		299705	33366194		10004490	33381167	17
44	302478	9995424		302616	33045173		10064578	33060300	16
45	305385	9995336		305528	32730264		10004667	32745536	15
46	308293	9995247	[·	308439	32421295		10004756	32436713	14
47	311200	9995157 9995066		311351	32118099 31820516		10004846	32133663	13
48	314108	2797000		514403	5.020510		1000495/	31836125	12
49	317015	9994974		317174	31528392		10005029	31544246	1
50	319922	9994881		320086	31241577		10705122	31257577	10
5 I	322830	9994788		322998	30959928	•	10005215	30976074	
52	325737	9994694		325910	30683307	1	10004309	30699598	8
53	328644	9994599		328822	30411580	ŧ	10005405	30428017	7
54	331552	9994503		331734	30144619	ł	10005501	30161701	6
			١ ١			1			
55	334459	5994406		334646	29882299	Ī	10005598	29899026	5
56	337366	9994308	.	337558	29624499		10005696	29641373	4
57	340273	9994209	i i	34047I	29371106	}	10:05795	29388124	3
58	343181	6994109	i l	343383	29122005	Ì	10005894	29139169	2
59	346088	9994009		346295	28877089	I	10005995	28894398 28653 7 08	1
60	348995 N. C. Sine	9993908	l i	349208	28636253	ł	10006095		c
	N. Co-Sine.	N. Sine	<u> </u>		N. Tangent.	_	N.Co-Secant	N Secant.	M.
<u> </u>				88 D E	GREES	·		,	

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-	·				GREE.				
T _V T	L. Sine.	L. Co-1717.0	i	L. Tangent	L. Co.14 g.	1	L. Secant.	L. Co-Vecant	1
0	8-2418553	9.9999338	l	8-2419215	11.7580785	ı	10.000661	11.7581447	50
			1	8.2491015			10.0000684		
1	8.2490332	9.9999316	l	8.2561649	11.7500905	'i	10.0000004		. , ,
2	8.2560943	9.9999294		0.2501049			10.0000706	11.7439057	58
3	8.2630424	9.9999271	1	8.2631153	11.7368847	1	10.0000729		
4	8.2698810	9.9999247	l	8.2699563		i	10.0000753	11.7301890	
5	8.2766136	9.9999224	l	8.2766912		1	10.0000776	11.7233864	55
6	8.2832434	9.9999200	i	8.2833234	11.7166766	1	10.0000080c	11.7167566	54
<u> </u>			ł						
7	8.2897734	9.9999175	İ	8.2898559	11.7101441	1	10.0000825	11.7102266	53
7	8.2962067	9.9999150	ľ	8.2962917	11.7037083	1	10.0000850	11.7037933	52
9	8.3025460	9.9999125		8.3026335	11.6973665	1	10.0000875	11.6974540	51
10	8.3087941	9.9999100		8.3088842	11.5911158	i .	10.0000000	11.6912059	50
11	8.3149536	9.9999074		8.3150462	£1.6849538	1	1000000926	11.6850464	
12	8-3210269	9.9999047		8.3211221	11.6788779	I .	10.0000953	11.6789731	49 48
		3777741					775		40
*2	8.3270163	9.9999021		8.3271143	11.6728857	ł	10.0000979	11.6729837	
13	8.3329243	9.9998994		8.3370249	11.6669751		10.0001006	11.6670757	47
14	8.3387529	9.9999994		8.3388563	11.6611437	1	10 0001034	11.6612471	46
15	8 244424	9.9998966		8.3446105	1 1 6 4 2 2 2	1	10.0001061	11674471	45
16	8.3445043	9.9998939		8.750000	11.6553895	l		11.6554957	44
17 18	8 2501805	9.9998911		8.3502825	11.6497105	l	10.0001089	11.6498199	43
18	8.3557835	9.9998882		8.3558953	11.6441047	l	10.0001118	11.6442169	42
	0			9 . 4 .	1. ()	1		- (2 ::	
19	8.3613150	9.9998853		8.3614297	11.5385703	Ι.	10.0001147	PI.6386850	41
20	8-3667769	9.9998824		8.3668945	11.6331055		10.0001176	11.6332231	40
21	8.3721710	9-9998794		8.3722915	11.6277085	1	10,0001206	11.6278293	39
22	8.3774988	9.9998764		8.3776223	\$1.6223777	1	10,0001236	11.5225012	38
23	8.3827620	9.9998734		8,3828886	11.6171114	l	10,0001266	11,6172380	37
24	8.3879622	9.9998703		8.3880918	11.6119082	l	10-0001297	11.6120378	36
						l			
25	8-3931008	9-9998672		8.3932336	11.6067664	l	10.0001328	11.6068991	
26	8 3981793	9.9998641		8.3983152	41.6016848		10.0001359	11,6018207	35
27	8.4031990	9.9998609		8-4033381	11.5966619		10.0001391	11.5968010	34
28	8.4081614	9.9998577		8.4083037	11-5916963		10.0001423	11.5918386	33
	8-4130676	9.9998544		8.4132132	11.5867868		10.0001456	11.5869324	32
29	8 4170100	9.9999344		8.4180679	11.5819321		10.0001488	11.5820810	31
30	8.4179190	9.9998512		••4100079	11.5019321	1	10.0051466	11.5020010	30
	8.4227168	2 2 2 2 2 4 3 2		8 4008600	11 (77)040	1	10-0001522	11 4500 000	
31	0.4337100	9.9998478		8-4228690	11.5771310	1	10.0001555	11.5772832	29
32	8.4274621	9 9998445		8-4276176	\$1 5723824		10.0001555	11.5725379	28
33	8.4321561	9.9998411		8-4323150	11.5676850		10.0001589	11.5678439	27
34	8.4367999	9.9998376		8.4369622	11.5630378		10.0001624	11.5632001	26
35	8-4413949	9-9998342		8.4415603	11.5584397		10.0001658	12.5586056	25
36	8-4459409	9 9 9 98 306		8.4461103	11.5538897	1	10.0001694	11.5540591	24:
						l i	-	-	
37	8.4504402	9.9998271		8.4506131	11.5493869		10.0001729	11.5495598	. 23
38	8.4548934	9 9998235		8.4550699	11.5449301	1 1	10.0001765	11.5451066	22
39	8.4593013	9.9998199		8.4594814	11.5405186		10.0001801	11.5406987	21
40	8.4635649	9.9998162		8 4638486	11.5361514		12.0001838	11.5363351	20
41	8.4679850	9.9998125		8.4681725	11.5318275		10.0001875	11.532015C	19
42	8 4722626	9.9998088		8.472453	11.527.5462		10.0001917	11.5277374	18
				··································					
43	8.4764984	9.9998050		8 .476693 3	11.5233067		10.0001950	11.5235016	
44	8.4806932	9.9998012		8.480892:	11.5191080		10.0001980	11.5193068	17.
45	8.4848479	9.9997974		8.4850505	11.5149495]	10.0002020	11-5151521	16
46	8.4889632	9.9997974 9.99 97 935		8.4891696	11.5108304		10.0003064	11.511036	15
	8.4930398	9.9997896		8.4932502	11.5067498	l l	10.0002104	11.506960	14
47	8.4970784	0.0007844		8.4972928	11-5027072		10.0002144	11.5029216	13
48		9.9997856						- 117029210	12
	8.5010798	9-9997817		8.5012982	11.4987018		10,0002183	11.408000:	-+1
49	8.5050447			8.5052672		1	10,0002103	11.4989202	11
50	8 3003-4	9.9997776		8.5092001	11.4947329		10,0002221	11.4949553	2 0
51	8.5085736	9-9997736		8.5130978	11.4907999 11.4869022			11.4910264	9
52	8.5128673	9.9997695					10,0002365	11.4871327	
53	8.5167264	9.9997653	. 1	8.5169610	11-4830387		10,0002347	11.4832736	7
54	8.5205514	9.9997612		8.5207902	11.4792098		10.0002388	r 1-479448¢	4
	9 40 45 45			9 504 5950			10.0000100		
55	8.5243430	9.9997570		8.5245860	11.4754140		10,0002430	11.475657	5 I
56	8.5281017	9-9997527	1	8.5283490	11.4716510		10.0002473	11.4718983	5 4
57	8.5218281	9.9997484		8,5320797	11-46 792 03		10.0002516	11.4681719	3
58	8.5355228	9.9997441		8.5357787	11.4642213		100002559	11.4644772	2
59	8.5391863	9-9997398	1	8.5394466	# 1.4605534		10.0002602	11.4608137	il
6 0	8.5428192	9-9997354		8.5430838	£1.4569162	i 1	10.0002646	11.4571808	0
	L. CoSine.	L. Sine		L- Co. Tang.	L. Tangent.	1 1	L Co-Secant.	L. Secant.	M
						<u>'</u>		J	
				88 DEG	REES.				

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	N. Since	NA 21 - 1			GREES.		A. Nagaria	N Co North	
_M	N sine.	N. Co-Sine		N. Langent.	N. Co-Lang.			N. Co- secons.	
_ c	348995	9993908		349208	28636253		10006095	28653708	60
1	351902	9953805		352120	28399397		10009197	28416997	58
2	354809	9993703		355033	28166422		10005300	28184168	58
3	35771 6 360623.	9993599 9995495		357945 360858	27 93 72 33 277 11 7 40		1000 6404 1000 6509	27955125 27729777	57 56
4 5	3635 3 0	9993390		36377 I	27489853		10006615	27508035	55
6	366437	9993284		366683	27271485		10006721	27289314	54
7	369344	9993177		369596	27056557	1	10006828	27075030	53
8	372251	9993063	- 1	372509	26844984	1	10006936	26 863603	52
9	375158	9992960		375422	26636690	1 1	10007045	25655455	5 I
10	378065	9992851		378335	26431600	1 1	10007155 1000726 6	26450510	50
11 12	380071 3 8887 8	9992740 9 992629	1	381248 384161	26229638 26030736		10007377	26 248694 26 049937	49 48
	3,00/0	3992029		504101	20030730			20049937	40
13	386785	9992517		387074	25834823		10007489	25854169	47
14	389691	9992404		389988	25641832		10007602	2,661324	46
15	372598	9992290		392901	25451700		10007716	254713'7	45
16	3 9 550 5	9992175		395814	25264361		10007831	25284144	44
17	398411	9992060		398728	25079757		10007947	25099685	43
18	401318	9991944		491641	24897826		10008063	24917900	42
	401024	9991827		404555	24718512		10008180	24738731	
19 2 0	404224 .	9991027		404555 407469	24541758		10008298	24562123	41 40
21	410037	9991790		417383	24367509		10008417	24388020	39
22	412944	9991440	1	413296	24195714	[]	10008537	24216370	38
23	415850	9991349		416210	24026320		10008658	24047121	37
24	418757	9991228		419124	23859277		10008780	23880224	36
1							<u></u>		
25	421663	9991106	•	422038	23694537		10008902	23 715636	35
26	424569	9990983		424952	23532052		10009025	23553290	3∔
27	427475	9990859		427866	23371777		10009149	23393161	33
28	430382	9999734	-	430781	23213666 23057677		10009274 10009400	23235196	32
2 9	433288 436194	9990608 9990482	:	433695 436609	22903765		10009400	23079351 22925586	31
30	750194	7990402		4,0009			10009,17		30
31	439100	999035 5		4395 24	22751892		10009655	22773857	29
32	44200 6	9990227	i !	442438	22602015		10009783	22614126	28
33	444912	9990098	;	445353	22454096		10009912	22476352	27
34	447818	9989968		448268	22308097		10010042	22330499	26
35	450724	9989837		451182	22163980		10010173	22186528	² 5
36	453630	9989705		454097	22021710		10010305	2204440	24
27	456536	9989573		457012	21881251		10010438	21914090	23
.37 .38	459442	9989445	;	459927	21742569		10010571	21765553	22
39	462347	9989306		462842	21605630		10010705	21628755	2:
40;	465253	9989171		4657 57	21470401	ı	100'0840	21493676	20
41	468159	9989035		468673	21336851	l	10010976	21360272	15
42	471064	9988898	•	471598	21204949		1001:113	21228515	10
	472070	9988761		474503	21074664	· ·	10011255	21098375	
43	473970 476376	9988623		474503	20945966		10011251	21098375 20969824	17 16
44 ⁴	479781	9988484		480334	20818828		10011390	2084283n	15
45	482587	9988344		483250	20693220		10011670	20717368	14
47	485592	9038203		, 486166	20569115		10211811	205934091	13
48	488498	998806i		489082	20446486		10011953	20470925	12
								}	
49	491403	9987918		491997	20325307	1	10012096	203498;2	11
. 20	494308	9987775		. 494913 49 78 2 9	20205553		10012240	20230284	10
51	497214	9987631 9987486	l '	497°29 500745	20087199 19970219		10012385	20112075	9
52	500119 503024	9937480	1	503562	19854591	1	10012530 10012676	19795241. 19875758	8
53 54	505929	99 ⁷ /340 99 ⁸ /193		506578	19740291		10012823	19765603	7 6
- '-			1						
55	508835	5587045		509495	19627296		10012971	19652754	5
56	511740	9986897		512411	19515584		10013120	1954118	á
57	514645	9986748		515328	19405133		10013270	19430882	3
58	517550	9986598	ł	518244	19295922		10013420	19321816	2
- 49	520455	9986447	1	521161	19187930		10013571	19213970	1
65	523360	9986295 N Sine.	l	524078 N. C. T.			10013723	1910732	
1	N Co-Sinc.	Iv ome.	٠	N. Co-Tang.	N. Tongent.		N. Co-Secant.	N. Sec.n.	<u>(</u> }}
-				87 DE	GREES.				

1			2 D	EGREE	S.			-
M	L. Sine.	L. Co-Sine	L. Tangent			L. Secant.	L. Conte. int	-1
0	8.5428192	9.9997354	7.543c838	11.4569162	l	10.0002646	11.4,7 000	. 1 .
	8.5464218	9-9997309	8.5466909	-	•	10.0002691		
1 2	8.5499948	9.9997265	8.5502683		1	10-0002735	11:4535782	,,,
3	8,5535386	9.9997220	8.5538166	11.4461834		10.0002789		58
4	8.5570536	9.9997174	3.5573362	11-4426638	l	10.0002826	11.4419464	56
5	8.5605404	9-9997128	8.5608276			10-2002872	11.4394596	55
6	8. 5639994	9.9997082	8.5642912	11-4357088	1	10.0002918	11.4360006	
_	0 . (5.15.15		8.5677275		1			
- 7 8	8.5674310	9.9997036	8.5711368	11.4322725	}	10.0002964	11.4325690	
	8.5708357 8.5742139	9.999698y 9.9996942	8.5745197	11.4254803		10.0003011	11.4291643	
9	8.5775660	9.9996894	8.5778766	11.4221234		10.0003106	11.4257861	51
11	8.5808923	9.9996846	8.5812077	11.4187923	•	10,0003154	11.4191077	
12	8.5841933	9.9996798	8.5845136		ł	10.0003202	11.4158067	
								-
13	8.5874694	9.9996745	8-5877945	11.4122755		10.0003251	11.4125306	47
14	8.5997209	9.9996700	8.5510509	18.4089491		10.0003300	11-4092791	46
15	8.5939483	9.4596650	8.5942832	17.4057168		10 0003350	11.4060517	
16	8.5971517	9.9996601	8.5974917 8.6006767	11.4025083		10-0003399	11.4028483	
17 18	8 6003317 8,6034886	9.9996550	8.6038386	11.3993233		10.0003450	11.3996683	1 , , 1
10	-,~,54000	9.9996500					11.3965114	42
19	8-6066226	9.9996449	8.6069777	11.3930223		10.0003551	11.3933774	
20	8-6097341	9.9996398	8.6100943	11.3899057		10.0003602	11.3902650	41 40
21	8.6128235	9-9996346	8.6131889	11.3868111		10,0003654	11.3871765	39
22	8.6158910	9.9996264	8.6162616	11.3637384		10.0003706	11.3841000	38
2 3	8.6189369	9.9996242	8.6193127	11.3806873		10.0003758	11.3810631	37
24	8.6219616	9.9996189	8.6223427	11-3776573		10-0003811	11-3780384	36
	8.6249653	9.9996136	8.6253518	11.3746482		10.0003864	11 2710245	
25 26	8.6279484	9.9996082	8.6283402	11.3716598		10.0003918	11.3750347	, , ,
27	8.6309111	9.9996028	8.6313083	11.3686917		10.0003972	11.3690889	34
28	8.6338537	9.9995974	8.6342563	11.3657437		10 0004026	11.3661463	33 32
29	8-6367764	9.9995919	8.6371845	11.3628155		10-0004181	11.3632236	31
30	8.6396796	9.4995865	8.6400931	11-3599059		10.0004135	11.3603204	30
	9.5.0.50		8.6429825	*****		10.000.10		
31	8.6425634	9.9995809	8.6438528	11.3570175		10-0004191	11.3574366	~/
32	8.6454282 8.6482742	9 9995753	8.6487044	11-3541472 11-3512956		10.0004247	11.3545718	28
33 34	8.6511016	9- 9 995697 9-9995641	8.6515375	11.3484625	1	10.0004359	11.3517258 11.3488984	
35	8.6539107	9.9995584	8.6543522	11.3456478		16,0004416	11-3460893	
36	8-6567017	9.9995527	8.6571490	14.3428510		10.0004473	11-3432983	24
				-				
37	8.6594748	9.9995469	g.6599279			10.0004530	11.3405252	
38	8.6622303 8.6645684	9.9995411	8.6654331	11.3373109 11.3345669		10.0004589	11.3377697	
39 40	8.6676893	9•9995353 9•9995295	8 6681598	11.3318402		10.0004047	11.3350316	21
41	8.6703932	9.9995236	8.6708697	11-3291303		10.0004764	11,3296068	20
42	8-6730804	9-9995176	8.6735528	11.3264372		10.0004824	11.3269196	19 18

43	8.6757510	9.9995116	8.6762393	18.3237607		10.0004884	I 1°3242490	17
44	8.6784052	9.9995056	8.6788996 8.6815437			10.0004944	11.3215948	16
45	8.6810433 8.6836654	9.9994996	8.6841719	11.3184563 11.3158281		10-0005004	11.3189567	-,
46	8.6862718	9 .999 4935 9.99 94874	8.6867844	11.3132156		10.0005126	11.3163346 11.3137282	
47 48	8.6388625	9.9994812	8.6893813	11.3106187		10.0005188	11.3111375	13
			r	-			73/7	12
49	8.6914379	9-9994750	6. 6919629	11.3080371		10.0005250	11.3085521	11
50	8.6939980	9.9994688	8.6945292	11.3054708		10.0005312	11.3067019	:0
51	8.6965431	9.9994625	8.6970806			10.0005375	11.3034569	9
52	8.6990734	9.9994562	8.6996173 8.7021390	11.3003828		10.0005438	11.3009266	
53	8.7015889 8.7040899	9.9994498	8.7046465	11.2978610		10.0005502	11.2984111	7
54	0.7040099	9-9994435		*********		20,0005505	11.2959101	6
55	8.7065766	9-9994370	8.7071395			10.0005630	11.2934234	
56	8.7090490	9-9994306	8.7096185	11.2903815		10.0005694	11.2909510	
57	8.7115075	9.9994241	8,7120834	11.2879166	}	10.0005759	11.2884925	3
57 58	8.7139520	9.9994176	8.7145345	11.2854655		10-0005824	11.2860480	2
59	8.7163829	9.9994110	8.7169719	14.2830281		10.0005890	11.2836171	1
60	8.7188002	9:9994044	8.7193958	14.2806042		10,0005956	11.2811998	
	L. Co Sine.	L. Sine	L- Co. Tang.			L Co-Secant.	L. Secant.	M
1			87 DE (REES.		_		
•								

1				3 D E	GREES			***	
M	N. Sine.	N. Co-Sine.		N. Tangent.	N. Co-lang.	<u>``</u>	N. Secant.	N. Co- Secan:	
-0	523360	9986295		524078	19081137		10013723	19107323	60
-;	526264	9986142			18975523				
2	529169	9935142		526995 529912	18871055	l	10013876	19004854 188 975 45	59 58
3	532074	9985835		532829	18767754	1	10014185	18794376	57
4	534979	9985680		535746	18665562	1	10014341	18692330	56
5	537883	99 ⁸ 5524		538663	18564473	1	10014498	18591387	55
6	540788	998 5357		541581	18464471	1	10014655	18491530	54
7	543693	9985209		541498	18365537	1	10014813	18392742	
8	546597	9955350		547416	18267654	1	10014072	18295005	53 52
9	549502	9984891	1	550333	18170807	1	10015132	18198303	51
10	552405	9/84731		55325I	18074977	ı	10015293	18102619	50
11	555311	9984570	-	556169	17980150	1	10015455	18007937	49
12	558215	9984408		559087	17886310	1	10015617	17914243	48
13	561119	9984245		562005	17793442		10015780	17821520	47
14	564024	9984081		564923	17701529	i	10015944	17729753	46
15	566928	9983916		567841	17610559	[10016109	17638928	45
16	569832	9983751		570759	17520516	i	10016275	17549030	44
17	572736	9983585		573678	17431385	ł	10016142	17460945	43
18	575640	9583418		576596	17343155	1	10016610	1737196	42
19	578544	9983250		579515	17255809		10016778	17284261	41
20	581448	9983081		582434	17169337	1	10016947	17198434	40
21	584352	9982911		585352	17083724	•	10017117	17112965	30
22	587256	9982741		588271	16998957	1 .	10017288	17028346	38
23	590160	9982570		591190	16915025	l	10017460	16944559	37
24	593064	9972398		594109	16831915	}	10017633	16861594	36
25	595967	9982225		597029	16749614	•	10017807	16779439	75
26	598871	9982051		599948	16668112		10017981	15698082	35 34
27	601775	9981876		602867	1 6 587396		10018156	16617512	33
28	604678	9981701		605787	16507455		10018332	16537717	32
29	607582	9981525		608706	16428279		10018509	16458686	31
30	610485	9981348		611626	16349856		10018687	16380408	30
31	613389	9981170		614546	16272174		10018366	16302873	30
32	616292	9980991		617466	16195225		10019046	16226069	29 28
33	619196	9980811		627386	16118998		10019226	16149987	27
34	622099	9980630		623306	16043482		10019407	16074617	26
35	625002	9980449		626226	15968667		10019589	15999948	25
36	627905	9980267		629147	15894545		10019772	15925971	24
37	630808	9980084		632067	15821104	Ì	10019956	15852676	23
38	633711	9979900		634988	15748337	1	10020141	15780054	22
39	636614	9979715		637908	15676233	•	10020326	15708096	21
40	639517	9979529		640829	15604784	ł	10020512	15636793	20
41	642420	9979343		643750	15533981		10020699	15566135	19
42	645323	9979156		646671	15463814	Ì	10020887	15495114	18
43	648226	9978968		649592	15394276		10021076	15426721	17
44	651129	997 ⁸ 7 7 9		652513	15325358		10021266	15357949	16
45	654031	9978589	.	655435 658356	15257052		10021457	15289785	15
46	656934	9978398		,658356	15189349		10021649	15222231	14
47	659836	9978206		661278	15122242		10021841	15155270	13
48	662739	9978014		664199	15055723		10022034	15088896	12
49	665641	9977821		667121	14989784		19022228	15023103	11
50	663544	9977627		670043	14924417	, I	10022423	14957882	10
51	671446	9977432		672965	14859615	.	10022619	14893226	
52	674348	9977236		675837	14795372		10022816	14529128	9
53	677251	9977039	.	678809	14731679		10023013	14765580	7
54	680153	9976842	,	681732	14668529		10023211	14702576	6
55	683355	9976644		684654	14605916		10023410	14640100	5
56	685957	99764.15		687577	14543833		10023610	14578171	4
	688859	9976245	!	690499	14482273	1	10023811	14516767	3
57 58	691761	9976044	l' -	693422	14421230	'	10024013	14455859	2
59	694663 6975 65	9975842		, 69 6345 699 2 68	143 6 0696 14300666		10024216	14395471	1
6	V. Co Sine.	9975640 N Nine.		N. Co-Tang.	N. Tangent.		10024419 N. Co-Secant.	143355×7	0
	I.V. CO-STAC.	ואיי דע.		<u> </u>			iv. Co-Secant.	N. Secant.	<u>M</u>
				86 DEG	REES.				

Artificial	Sines.	Tangents and	! Secants:
211 00 1 800 0000	Olympia'	T MINE OTHER MAIN	. Occurred.

3 DEGREES.									
M	L. Sine.	L. Co-Sine		L. Tangent	4. Co.Tavg.		L. Secant.	L. Co-Secart	
0	8.7188002	9.9994044		8.7193958	11.2806042		10.0005956	11.2811998	50
1	8.7212040	9.9993978	:	8.7218063	11.2781937		10.0006022	11.2787960	59
2	8.7235946	9.9993911	:	8.7242035	p1.2757965		,10.0006089	11.2754054	58
3	8,7259721	9.9993844		8.7265877	111-2734123		10.0006156	11.2740276	571
4	8 .7 283365 8 .73 06882	9-9993776 9-9993 7 08	j	3.72 8 9589 8.73131 7 4	L1.2710411		10.0006224 10.0006292	11.2716634 11.2693118	56
5	8.7330272	9.9993640	;	8,7336631	41.266336 €	١. ا	10.0006350	11.2669728	55
			•		-	r			-,4
7	8.7.353535	9.9993572	4	8.7359964	ri. 2640036		110.0006428	11:2646465	53
8	8.7376675	9.9993503		8.7383172 8.7406258	11.2616828 11.2593742		10.0006497 10.0006367	11.2623325 11.2600300	52
9	8.7399591 8.742 2 586	9 .9993433 9 .9993 364	;	3.7429222	11.2570778		10.0006636	11.2577414	, 50
11	8.7445360	9.9993293	•	8.7452067	£1-2547933		10,0006707	11.2554640	: 49
12	8.7468015	9.9993223		8,747,4792	11-2525208	1	10.0006777	11.2531585	48
	9: =400443	0.000140		8.7497400	11.2502600	1.	10.0006848	11-2500445	
13 14	8.7490553 8.7512973	9 .9993 152 9 .9993 081		8.7519892	1.2480108		10.0006919	11-2509447 11-2487027	147
15	8.7535278	9.9993009	!	8.7542269	1.2457731	:	10 0006991	11.2464728	45
16	8.7557469	9.9992938		8.7564531	1.2435460	i.	10.0007060	11.244253	44
17	8.7579546	9-9992865	\$ 1	8.7586681 8.7608719	1.3413310		10.0007135	11.2420454	43
18	8.7601512	9.9992793	1	-1006/1A	1.2391,282		19.0007207	11.2398488	: 42
19	8.7623366	9 9992720	:	8,7630647	1.5367323		10.0007280	11.2376634	41
20	8.7845111	9.9992646	,	8.7652465	112347535		10.0007354	11.2354889	40
. 21	8.7666747	9-9992572	;	8.7674175 8.7695777	1.2325825		10,0007428		39
22	&.7688275 8 ,7709697	9.999 24 98 9.999 24 24	i	8.7717274	1.2304222	;	10.0007502	11.2311723 14.2290303	2 3
24	8,7731014	9.9992349	1	8.7738665	1.2361335		10-0007651	11.2268536	· 37
				, - 3					
25	8.7752216	9-9992274	,	8.7759952 8.7781136	11.2242048		10.0007726	11.2247774	2 3 9
26 ; 27	8.7773334 8-7794340	9.9992198 9.9992122		8,7,402218	1.2197782	i	10.0007878	11.2226566 11.220566	: 3
28	8,7815244	9.9992046		8-7823199	1.2176801		10 0007954	11,2184796	31
29.	8.7836048	9.9991969		8.7844079	1.2155921		10.0008031	14.2163952	. 3
30	8.7856753	9.9991892		8.7864861	1.2135139	;	10.0008108	11.2143247	39
-	8.7877359	9.9991815	!	8.7885544	11.2114456	:	10-0008185	11.2122641	-
31	8.7897867	9.999.1737		8.7906130	1.2093870		10.0008262	11.2102173	2
33	8.7918278	9.9991659	•	8.7926620	1.2073380		10.0008341	11.2081722	2
. 34	8.7938594	9.9991580		8.7947014	11.2052986 11.2032687		10.0008420	11.2061496	2
35	8 7958814 8.7978941	9.9991501	i	8.7987519	1.2012481		10.0008499 10.0008578	11.2044186 11.20210-9	2 2
36		9.9991422				•	75.6555,7		
-37	8,7998974	9.9991342		8.8007632	11.1992368	í •	10.000855	11.2001016	2
.38	8.8018915	9.9991262	lí l	8-8027 6 58 8-804 7 583	11.1972347		12000373	11.1981085	23 24
39 40	8.8038764 8.8058523	9.9991182	i i	86067422	11.1952417		10.0008818	11-1961236	. 7
41	8.8078192	9.9991020		8.8087172	11.1912828		10.0008984	11.1921818	
42	88097772	9,9999938		\$*8 10683 4	#1-1892166		10.000906	11.1902228	# 3
	9 8 17 2264			8.8126407	11:1873593		10.000014	11.1882786	
43	8.8 117264 8.8136668	9.9990856 9.9990774		8.8145894	11.1854106		10.0009144	11.1863332	*
44	8.8155985	9.9990601		8.8165294	11.1834706		10.0009309	11.1844015	
46	8.8175217	9.9990608		8.8184608	1-1815392	i i	100000939	11-1824783	1
47	8-8104363	9.9999525		8.8203838 8.8222984	111-1790162 111-1777016		10,0009478	11.1805637	3 2
. 48	8.8213425	9.9990441		0.0222904	11.1///010		10.0009559	11.1786575	12
49	8.8232404	9.9999357		8.8242046	11-17-57954		10.0009648	11.1767596	1
50	8-8251299	9.9997273		8.8261026	11.1738974		10,0009727	11.1748701	0
51	8-8270112 8-8288844	9-9990188		8.8279924 8.8298741	11-1720076	}	10,000,812	14.1729888	9 8
52	8.8307495	9.9990103 9.9990017	,	8.8317478	11.1682522		10,0009895 10,0009933	11.1711156	
53	8.8326066	9.9989931	1	8.8336134	11.1663866		10.0010060	11,1673934	7 8
	-		i		,	1			<u>L</u> L
2 55	88344557	9-99-898-45		8.8354712 8.837 3211	11.1645288		10.00101	11.1645413	5
56	8.83 6296 9 8.83 8 1304	9.9989671 9.9989671		8.8391633	11.1 626 789 11.1608367		10.0010242		4
57 58	8.8309561	9.9989571		8.8409977	11.1590023		10:0010320		3 2
59	8-8417741	9.9989496		3.8428245	11-1571755	1 !	10.0010504	11.1582359	
60	8.8435845	919989408		8.8446437	11:1553563	l i	10.0010592	11.1564155	
	L. Co Sine.	L. Sine	<u> </u>	L- Co. Tang.		1	L Co-Secant.	L. Secant.	M
1				86 DE	GREES.				
					Nana		** **********		

	-fi-		. 21	- D.E	0 0 5 5 6				
M	N bine.	N. Co-Sine.		N. Tangent.	N. Co-Tang.	· · · ·	N. Secant.	N. Co- Secont	
_0	697565	9975640		699268	14300666		10024419	14335587	6 0
1 2	700466 703368	9975437 9975233		702191 705115	14241134		10024623	14276200 14277304	59 58
-3	706270	9975029		708038	14123536		10025034	14158894	57
4	709171	9974822		710961	14065459		10025241	14100962	56
5	712073	9974615		713885	14007856		10025449	14043504	55
6	714974	9974407		716809	13950719		10025658	13986514	54
	717876	9974199		719733	13894045		10025868	13929985	53
7	720777	9973990		722657	13837827		10026078	13873913	.52
9	723678	9973780		725581	13782060		10026289	13818291	51
10	726580	9973569		728505	13726738		10026501	13763115	50
11	7294 ⁸ £ 732382	9973357		731430	13671856		10026714	13708379	48
12	/32302	9973144		734354	13617409		10026928	13654077	48
13	735283	9972931		737279	13563391		10027143	13600205	47
14	738184	9972717		740203	13509799		10027358	13546758	46
15	741085	9972502		743128	13456625		10027574	13493731	45
16	743986 746887	9972286	•	746053	13403867		10027791	13441118 13388914	44
17	749787	997 2069 9971851	-	748979 751904	13351518 13299574		10028228	13337116	43
10		-							42
19	752688	9971632		754829	13248031		10028448	13285719	41
20	755589	9971413	•	757755	13196883		10028663	13234710	40
21	758489 761390	9971193		760680 763606	13146127		10028889	13184106 131338 8 2	39 38
22	764190	9970972 9970750		766532	13095757 13045769		10029111	13084040	38 137
23 24	767190	9970527		769458	12996160		10029558	13034576	36
-									
25	770091	9970303	•	772384	12946924		10029783	12985486	35
26	772991 775891	9970079		775311 778237	12898058 12849557		10030009	12936765 1 12888410	34
27 28	778791	9969854 9969628		781164	12801417		10030236	1284-415	33
29	781691	9969401		784090	12753634		10030693	12792779	31
30	78459F	9969173		787017	12706205		10030922	114745495	130
-							10015140	10600,60	-
31	787491 790391	9968944	-	789944 792 8 71	12659125 12612390		10031152	. 12698560 . 12651971	29
32	793290	9968715 9968485		795798	12565997		10031014	12605784	27
33 34	796190	9968254		798726	12519942		10031848	12559815	26
35	799090	9968022		801653	12474221		10032081	12514240	25
36	801089	9967789		804581	12428831		10032315	12468995	24
1-	804889	0067666		807509	12383768		10032550	12424078	22
37 38	807788	9907555		810437	12339028	1	10032786	12379484	23
39	\$10687	9967085		813365	12294608	1	10033023	12335210	21
40	813587	9966849		816293	12250:05	1	10033161	12291252	20
41	816486	9966612		822150	12206716	ł	10033500	12247608	19
42	819385	9966374			12103230	•	10033740	12204274	. 18
43	822284	9966135		825078	12120062	I	10033980	12161246	17
44	825183	9965895		828007	12077192		10034221	12118521	46
45	828082	9965655		830936	12034622	•	10034463	12076098	15
46	833880 830081	9965414		833865 836794	11992349 11950370	_	10034706	12033970	14
47 48	836778	9965172	l	839723	11908682	l	10034956	11950595	13 12
40	.		l			•			
49	839677	9964685	1	842653	11867282	Ì	10035441	11909340	11
50	842570	9964440	1	845583 848512	11826167 11785333		10035687	11868370	10
51	845474 848373	9964194	l	851442	11744777	ł	10035934	11827633 11787274	. 9
52 52	0	9963948 9953701	l	854372	11704500		10036431	11747141	7
53 54		9963453	l	857302	11664495		10035681	11707282	6
1				8600-0	1.601-6-		*000*===	. 1669600	
55	857067	9963204		860233 863163	11624761		10035932	11667693 11 6 28372	5
56		9962954	1	866094	11546093		10037184	11589316	4
57 58		9962452	l	869025	11507154		10037689	11550523	2
5º	803000	9962200	ŀ	87.1056	11468474		10037943	11511990	1
65	871557	9961947		874887	11430052		10038198	11473713	<u>c</u>
	N. Co-Sine.	N. Sine.		N. Co-Tang.			N. Co-Secant.	N. Secant.	M
				85 DE	GREES.				

	'			4 D F	GREES			****	1
M	L. Sine.	L. Co. Sine.	1/	L. Tangent	L. Co.Tang.		L. Secant.	L'Co-Secant.	_
-0	8.8435845	9.9989408		8.8446437	11.1553563		10.0010592	11.1564155	1 60
	8.8453874	9.9989319	1	8.8464554	11.1535446		10-0010681	11.1546126	. 59
2	8.8471827	9.9989230	18	8.8482597	11-1517403		10.0010770	11.1528173	58
3	8.8489707	9.9989141	- 13	8.8500566	11.1499434		100010859	11.1510203	57
4	8.8507512	9,9989052	- 13	8·8518461 8.8536283	11.1481539 11.1463717		10.0011038	11.1492488	50
5	8.8525245	9.9988962 9.9988871		8.8554034	11.1445966		10.0011120	11.1474755	55 54
			•					-31.457095	74
7 8	8.8560493	9.9988780	- 13	8.8571713	11.1428237		10.0011220	11.1439507	53
	8.8578010 8.8595457	9.99 88639 9. 9988598		8.8589321 8.8606859	11.1410679		10.0011311	11.1421990	52
9 IO	8.8612833	9.9988506		8 8624327	11.1375673		10.0011494	11.1404543	51
11	8.8630139	9.9988414	18	8.8641725	11-1358275		10.0011586	11.1369861	49
12	8.8647376	9.9988321	1	8.8659055	11.1340915		100011679	11.1352624	48
	8.8664545	9.9938228		8.8676317	11.1323683		10.0011772	12 1004444	
13	8.8681646	9.9988135		8.8603511	11-1306489		10.0011865	11.1335455	47
14 15	8.8698680	9.9988041	1	8.871c638	11.1289362		10-0011959	11.1301320	46
16	8.8715646	9.9987947		8.8727699	11.1272301		10.0012053	11.1284354	44
17	8.8732546	9.9987853		8.8744694 8.87 6 1623	11.1255306		10.0012147	11.1267454	43
18	8.8749381	9.9987758			11.1238377		100012242	11-12:0019	42
19	8.8766150	9.9987663		8.8778487	11,1221513		10,0012337	11-1233850	41
20	8.8782854	9.9987567	1 1	8.8705286	11.1204714		10.0012433	11.1217146	40
21	8.8799493	9.9987471		8.8812022 8.8828694	11.1187978	:	10,0012529	11,1200507	39
22	8.8816069	9.9987375		8.8845303	11.1171306 11-1154697		10.0012625	11.1183931	38
23 24	8.8849031	9.9937278	1	8.8861850	11-1138150	i i	10.0012810	11.1150969	37 36
			1						
25	8.8865418	9.9987084		8.8878334 8.8894 7 57	11.1121666	, ;	10.0012916	11.1134582	35
26	8.8881743 8.8898007	9.9986986		8.8911119	11.1105243		10.0013014	11.1118257	34
27 28	8.8914209	9.9986790	1	8.8927420	11.1072580		10.0013112	11.1085791	33 32
29	8.8930351	9,9986691	ł	8.8943660	11.1056340		10.0013309	11.1069649	31
30	8.8946433	9.9986591	1	8.8959842	11.1040158		10.0013409	11.1053567	30
	8.8962455	0.00%100		8.8975963	11:1001005		10-001 3508	11 1005414	
31	8.8978418	9.9986492	1	8.8992026	11-1024037 11-1007974		10.0013508	11.1037545	29
32 33	8.8994322	9.9986292		8.9008030	11.0991970		10-0013708	11.1005678	27
34	8.9010168	9.9986191		8.9023955	11.0976023		10.0013809	11.0989832	26
35	8.9025955	9.9986090		8 9039866 8.9055697	11.0960134		10.0013910	11.0974045	25
36	8.9041685	9.9985988			11.0944303		10.0014012	11.0958315	24
27	8.9057358	9.9985886		8.9071472	11.0928528		10.0014014	11.0942642	23
37 38	8.9072975	9.9985784		8.9087190	11.0512810		10.0014216	11.0927025	22
39	8.9088535	9.9985682		8.9102853 8.9118465	11.0897147		10.0014318	11.0911465	21
40	8.9104039 8.9119487	9.9985579 9.99854 75		8 9134012	11.0865988		10.0014421	11.0895961	20
41 42	8.9134881	9.9985372		8.9149509	11.0850491		10.0014628	11.0865119	18
<u> </u>									
43	8.9150219	9.9985268		8.9164952 8.9180340	11.0835048		10.0014732	11.0849781	17
44	8.9165504	9.9985163 9.9985058		8.9195675	11.0804325		10.0014837	11.0834496 11.0819266	16
45 46	8.9195911	9.9984953		8.9210957	11.0789043		10.0015047	11.0804089	15 14
47	8.9211034	9.9984848	1	8.9226186	11.0773814		10.0015152	11.0788966	13
48	8.9226105	9.9984742		8.9241363	11.0758637		10,0015258	11.0773895	12
	8.9241123	9.9984636		8.9256487	11.0743513		10.0015364	11.0758877	
49 50	8.9256089	9.9984529		8.9.271560	11.0728440		10,0015471	11.0743911	10
5I	8.9271003	9.9984422	1	8.9286581	11.0713419		12,0015578	11.0728997	9
52	8.9285866	9.9984315		8.9301552	11,0698448		10.0015685	11,0714134	8
53	8.9300678 8.9315439	9.9984207	1	8.9316471 8.9331340	11,0683529		10.0015793	11.0699522	7 6
54		y-yyo4-yyy		- 733-540					0
55	8.9330150	9.9983990		8.9346160	11.0653840		10.0016010	11.0669850	5
56	8.9344811	9.4983881		8.9360929	11.0639071		10.0016119	11.0655189	4
57 58	8-9359422	9.9983772		8.9375650 8.9390321	11.0624350		10.0016228	11.0640578 11-0626017	3
58 59	8.9373983	9.9983553		8.9404944	11.0009579		10.0016337	11.0611504	2 1
65	8.9402960	9.9983442		8.9419518	11.058-482		10,0016558	11.0597040	o
	L. Co-Sine.	L. Sine.		L.Co Tang.	L. Tangent		L.Co-Secant	L. Secant.	M
		·		85 D	EGREE	S.			

5 DEGREES										
M	N. Sine	N. Co-Sine	· i	N. Tangent.	N. Co-Lang.		IV. Secant.	N. Co-Secant	-	
-	871557	9961947		874887	11430052		10038195	11473713	6	
-	874455	9961693		877818	11391885		10038454	11435592	 59	
2	877353	9961438	;	830749	11353970		10038711	11397922	58	
3	880251	9961182		883681	11316304		10038969	11360402	5	
4	883148 886046	9960926		886612	11278885		10039228	11323129	56	
5	888943	. 9960669 9960411		88 9 544 8 9 2476	11241712 11204780		10039487 10039747	11236101 11249316	55 54	
7	891840	9960152	, 1	895408	11168089		10040008	18 212770	53	
8	89473 8 897635	9 959892 9 959631		898341	11131635 11095416		10040270 10040533	11176462 1114 0 389	52	
9 10	900532	9959369		9012 7 3 904206	11059431		10040797	11104549	51 50	
11,	903429	9959107		907138	E1023676		10041051	11068940	49	
. 12	906326	9958844	;	910071	13988150		10041326	.11033560	48	
13	909223	9958580	,	913004	10952850		10041592	10998406	17	
14	912119	9958315		915938	10917775		10041859	10963476	47 46	
15	915016	9958049		918871	10882921		10042127	10929763	45	
16.	917913	9957782	1	921804	10848288		10042396	10894281	44	
17 18	920809 923706	9957515 9957247		924738 927672	10813872		10042666	10860011 10825957	43	
	923/00	993/24/		92/0/2	10//90/3			10027977	42	
19	926602	9956978		930606	10745687		10043208	10792117	4	
20	929499	9956708		933540	10711913 10678348		10043480 10043753	10788488	40	
21 22	932395 935291	9956437 995 6 165	,	936474 939409	10644992		10044027	10725070	39	
23	938187	9955892		942344	10611841		10044302	10658854	37	
24	941083	9955619		945278	10578895		10044578	10626054	36	
705	943979	9955345		948213	10546151		10044855	T0502455		
25 26	945875	9955070		940213	10513607		10045133	10593455 10561057	3 5	
27	949771	9954794	-	954084	10481261		10045411	E0528857	33	
28	952666	9954517		957019	10449112		10045690	10496854	32	
29	955562	9954247		959955	10417158		10045970 10046251	10465056	1:	
30	958458	9953962		962890	10307397		10040251	10433430	30	
<u> 31</u>	961353	9953683		965826	10353827		10046533	10402007	29	
32	964248	9953403		968763	10322447		10046816	10370772	28	
33	957144	9953122 9952840	, 1	971699	10291255 10260249		10047099 10047383	10339 726 10308866	27	
34 35	972934	9952557	1	974635 977572	10229428		10047668	10278190	26 25	
36	975829	9952274		980509	10198789		10047690	10247954	24	
	978724	6041000			10168332	,	13049241		-	
37 38	981619	9951990 9951705		9834 46 986383	10138054		10048529	E0217385 10187254	23	
39	984514	9951419	:	989320	10107954		10048818	10157300	22 21	
40	987408	9951132	. :	992257	10078031		. 10049108	10127522	2 C	
41	990303	9950844	·	995195	10048283		10049399	10097920	19	
42	993197	9950555		998133	10018708		10049690	10068491	18	
. 43	996092	9950266		1001071	99893050		10049982	10039234	17	
44	998986	9949976		1004009	99500724		10050275	10010147	16	
45	1001881	9949685		1006947	99310088		10050569	99812291	15	
4 6 47	1004775	9949393 9949100		1009885 1012824	99021125 98733823		10054864 10051160	99524787 99238943	14	
48	1010563	9948806		1015763	98448166		10051457	98954744	13	
					00.4		******			
49 50	1013457	9948512		1018702 1021641	98154 1 40 97881 7 32		10051754 10052052	98672176	11	
50 51	1019245	9948217		1021041	97600927		10052351	98391227 9811188	10	
52	1022138	9947624		1027520	97321713		17052651	97834124	8	
53	1025032	9947326	1	1030460	97044075		10052952	97557944	7	
54	1027925	9917037	1	1033400	96768000		10053254	97283327	6	
55	1030819	9946728	ł	1036340	96493475		10053557	97010260	5	
56	1033712	9946428		1039280	96220486	1	10053860	96738730	4	
57	1036605	9946127	1	1042220	95949022		10054164	96468724	3	
58 59	10394 99 104239 2	9945825 9945522]	1045160 1048101	95679068 95410 61 3	· ·	10054469 10054775	96200229 9593 32 33	2	
65	1045285	99457218		1045101	95143645		10055082	95667722	0	
	N. Co. Sine.		1		N. Tangent.		N.Co-Secant		<u>,</u>	
			<u> </u>		GREES					
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10.9820406

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L. Tangent

DEGREES.

9.0179594 9.0191831

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9.0216202

L.Co Tang.

9.0156135

9-0168239

9.218**0**329

9.0192346

L. Co-Sine.

58

59 65 9.9976540

9.9976408

9.9976276

9.9976143

L. Sine.

10.9843865

10.9831761

10-9819691

10.9807654

L. Secant.

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M

10.0023460

10.0023592

10.0023724

10.0023857

L. Co-Secant

<u> </u>		,		6 D I	EGREE	<u>. </u>			
<u>~</u>	N. Sine	N. Co-Sine		N. Tangent.	N.Co-Tang.	3	N Secret	N. Co-Secant	
M									
	1045285	9945218		1051042	95143645		10055052	95667722	- 6 ∵
1	1048178	9944914		1053983	94878149		1 005 5 390	95403686	59
2	1051070	9;44609		1056924	94614116		10055699	95141110	59 58
3	1053963	99443.23		1059866	94351531		10056009	94879984	57
4	1056856	9943996		1062808	94090384		17056320	91620296	56
5	1059748	9943688		1065750	93830663	1	10056631	94362033	55
6	1062641	9943379	\	1068692	93572355		10056943	94195184	54
	1064422	0040060		1071604			10057056	228 425	
7 8	1065533	9943069 9942759	. 1	1071634 1074576	93315450		10057256	93849735	53
	1071318	9942/19		1077519	93059936 92805802		10057885	93595682	52
9 10	1074210	9942446		1080462	92553035		10058201	93343006 93091699	51
11	1077102	9941823		1083405	92301627		10058518	92841749	50
12	1079994	9941509		1086348	92051564		10058835	92593145	4 9 48
								7 77 7-47	40
13	1082885	9941194		1089291	91802838		10059153	92345877	47
14	1085777	9940879		1092234	91556486	.	10059472	92099934	46
15	1088669	9940563		1095178	91309348		10059792	91855305	45
16	1091560	9940246		1098122	91064564		10060113	91611980	44
17	1094452	9939928		1101066	90821074		10060435	91369949	43
18	1097343	9939609		1104010	90578867	•	10063758	91129200	42
<u> </u>	400000					ł .	1006.0		
19	1100234	9939289		1106954	90337933	!	10061081	90889725	41
20	1103126	9938969		1109899	90098261	ł	10061405	90651512	40
21	1106017	9938648		1112844	89859843	1	10061730 10062056	90414553	38 39
22	1108908	9938326 9938003		1115789 1118 7 34	896226 6 8 89386726		10062383	90178937	38
23 24	1111799	9937679		1110/34	89152008	•	10062711	89944354	37
24	1114009	9737077		11210/9	09152000	1	10001/11	89711095	36
25	1117580	9937354		1124625	88918505		10063040	89479051	
26	1120471	9937028		1127571	88686206		10063370	89248211	35
27	1123361	9936702		1137517	88455103		10063701	89018567	34 33
28	1126252	9936375		1133463	88225186		10064032	88790109	32
29	1129142	9936047		1136409	87996446	1	10064364	\$8562828	31
30	1132032	9935718		1139356	87768874		10054697	88336715	30
31	1134922	9935388		1142303	87542461		10065031	88111761	29
32	1137812	9935058		1145250	87317198		10065366	87887957	28
33	1140702	9934727		1148197	87093077		10065702	87665295	27
34	1143592	9934395		1151344	86870088		10066039	87443766	26
35	1146482	9934062	l	1154091	86648223	·	. 1006 6 377 10066715	87223361	25
36	1149371	9933728	!	1157039	86427475		10000715	87004071	24
27	1152261	9933393		1159987	86207833		10067054	8678,830	-
37 38	1155151	9933057	•	1162935	85989290		10067394	86568805	23
39	1158040	9932720		1165883	85771838	l i	10067735	86352812	22 21
40	1160929	9932383		1168831	85555468		10068077	86137901	20
41	1163818	9932045	·	1171780	85340172		10068420	85924065	19
42	1166707	9931706		1174729	85125943		10068764	85711295	18
<u> </u>			1						
43	1169596	9931366	1	1177678	84912772		10069108	85499584	17
44	1172485	9931025	ŀ	1180628	84700651		Ico (9453	85288923	16
45	1175374	9930684	ł	1183578	84489573		10069799	85079304	15
46	1178263	9930342		1186528	84279531		10070146	84870721	14
47	1181151	9929999		1189478	84070515	•	10070494	84663165	13
48	1184040	9929655	ŀ	1192428	83862519		10070843	84456629	12
1	1186928	9929310	1	1195378	83655536		10071193	84251105	
49	1189816	9928964	l	1198328	83449557		10071544	84046586	10
50 51	1192704	9928617	1	1201279	83244577		10071896	83843065	
52	1195593	9928270	١.	1204230	83040586	l .	10072248	83640534	9
53	1198481	9927922	[1207181	82837579		10072601	83438986	7
54	1201368	9927573	1	1210132	82635547	l	10072955	83238415	· 6
<u> </u>			1			I			
55	1204256	9927223	l	1213084	82434485	l	10073310	83038812	5
56	1207144	9926872	f	1216036	82234384	ſ	10073666	82840171	4
57 58	1210031	9926521	1	1218988	82035239	l	10074023	82642485	3.
58	1212919	9926169	Ī	1221940	81837041	ł	10074381	82445748	2
59	1215806	9925816		1224893	81639786	ł	10074740	82249952	1
60	1218693	9925462		1227846	81443464	l	10075099	82055090	
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	12427AA	00000110		1255075	73799909		1.2000000	744720-	—
\43	1342744	9909442		#355015 #357977	73638916		10001383	744743-25	17
44	1348509	9 90 9051 9908659	1	#37797 7 #360940	73478610		10003183	74344803	7.16
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: 46	1354274	9907872		1366866 ×	73160047		10092084	73840318	#4
47 48	1357156	9907478	1	µ 369829	73001780		10003385	73663612	" 13 12
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49	13600381	× 9907083		1372793	72844184		10003782	73527377	IK
50	1352919	9906587		1 375 7 57 ·	72687255		10094792	73371909	.10
: 51	1365801	9906290		1378721 .	72530087	i i	10094506	73717102	9
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53	1371564	99054931		1384650	72220422		10099407	72909460	27
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55	1377327	9904694		1390480	71912456		10000555	72604 417	5
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¥ 57	1383080	9903891		1396510	171607056		10097041	72301940	3
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1 69	1388850	9903084	l	1402442	71304190	}	10097864	72001996	, 1 I
63	1391731	9902680		1405408	171153097		10008636	71852905	. `0
	N. Co-Sine.	N. Sine.		N. Co-Tung.	N. Tangent.	1	N. Co-Secant.	N. Sesant.	M
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M	L. Sine.	L. Co-Sine		L. Tangent	L. Co. Lang.	<u> </u>	L. Secant.	L. Co-Secant	
0	9.0858945	9.9967597		9.0891438	10-9108562	,	10-0032493	10.9141055	
				9-0901869			10.0032648		
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	0.1000000	9-9958411	·	9.1431959	10.8568041		10,0041589	10.86004=	
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59 60	3.1435553	9:9957528		91478025	10.8521975		10.0042472	13.8564447	0
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1 1394612 9902275 1408374 71093826 14099689 71794556 2 1397492 9901869 1411341 70854573 10099103 71576764 1409012 9901664 1414275 70557905 10099934 71293615 1409132 9900045 1422243 70410482 10100769 70971700 7 1411892 9900236 1423211 70263662 10100769 70971700 7 1411892 9899826 1426179 70117441 10101188 70820941 7017441 7017441 7017441 7017441 7017441 7017441 7017441 7017441 7017441 7017441 7017441 7017451 70582777 7	598 57 56 555 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 398 37
2 1307492 9901869 1441341 70854573 10099103 7155764 3 1400372 9901862 1441308 70705934 10099934 71263019 5 1406132 9500645 1447275 70557905 10099934 71263019 5 1406132 9500645 1422243 70410482 10100351 7117058 6 1409012 9900236 1423211 7026562 10100769 70971700 7 1411892 9899826 1426179 70117441 1010188 70826941 7 1417651 989903 1432115 60826781 1010227 7093205 10 142031 9808160 1435016 6068235 10102027 7053280 11 1423410 9808176 1438043 6058235 1010227 7043380 12 142689 9897762 1441022 69399192 10103293 70112001 13 1429168 9897762 1444022 69399192 10103293 70112001 14 143240 980614 1449931 68968799 10101568 69589994 16 1437805 9806096 1452901 68827807 10104994 69580464 17 1440684 9895777 1455871 6886799 10101568 69589994 18 1443562 9895277 1458842 68547508 10106230 695135239 19 1446440 9894837 1461813 68408196 10106230 695135239 10 1446440 9894837 1461813 68408196 10106230 68927942 11 142197 9893994 1467755 68131227 10107413 68363195 22 1457975 9893147 1470727 67992365 10107573 68724995 21 1457973 9893147 1470727 67992365 10107573 68724995 21 1457973 9893147 1470727 67992365 10107573 68734995 21 1457973 9893147 1470727 67992365 10107573 68734995 21 1457973 9893147 1470727 67992365 10107573 68731904 22 1457973 9893147 1470727 67992365 10107573 68731904 22 1457973 9893147 1470727 67992365 10107573 68731904 22 1457963 9891475 1470747 67719867 10108440 6885135 10107573 68731904 29 1475117 9890888 1494510 69117562 10106428 67786632 67786632 67786632 67786632 67786632 67786632 67786632 67786632 67786632 67786633 67944966 10113715 6883190 6664307 10113715 6883192 1146606 66617568 1149530 6885738 10113715 6687382 11492477 988795 1590383 66952382 10113715 6687382 1190933 1909338 1938655 1592285 6573382 1011593 664640 1011593 664640 1011593 664640 1011593 664640 1011593 664640 1011593 664640 1011593 664640 1011593 664640 1011593 66646307 10114606 66617568 1149606 66617568 1149606 66617568 115906 66617568 115906 66617568 115906 66617568 115906 6663679 115906 6663679 115909 6663679 115909 6663679 115909 6663679 115909 666	58 57 56 55 54 53 52 51 50 48 47 46 45 44 43 42 41 40 38 37
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6 1409012 9900236 1423211 70263662 10100769 70971700 7 1411892 9899826 1426179 70117441 10101188 70826941 8 14414772 9899415 1429147 69826781 10101607 70682777 9 1417651 9899003 1435084 69682335 1010227 7053202 10 1420531 9898176 1435083 69582335 10102448 70396220 12 1426189 9897762 1441022 69395192 10103293 7012201 13 1429168 9897747 1443991 69352489 10103293 7012201 14 1422647 9806931 1446961 6910249 1010329 1010429 69370760 14 143265 9806931 1446961 6910249 1010442 6989009 10104668 69589904 10104684 6983009 10104668 69589904 10104668 69589904 101046684 69849146 1449361 6887378	54 53° 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37
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8 1414772 9899415 1429147 69971806 10101607 70682777 9 1417651 9899003 1432115 69826781 10102027 70632920 10 1420531 9898190 1435084 6982335 10102448 70396220 11 1420531 9898196 1438053 69538473 10102487 70539202 12 1426289 9897762 1441022 69395192 10103203 7012201 13 1429168 9897347 1443991 69352489 10103717 69970760 14 1432407 9896931 14440601 09110359 10104142 69830092 15 1434926 9896514 1449931 68968799 1010458 69689994 16 1437805 9896096 1452901 68827807 10104994 69550464 17 1440684 9895677 145581 68687378 10105423 6941496 18 1443562 9896371 1458842 68547908 1010581 69473089 19 1446440 989487 1461813 68408196 10106280 69135239 20 1449319 9894416 1464784 68269437 10106710 689397942 21 1452197 9893994 14667755 68131227 10107141 68861195 22 1457975 9893571 1470727 67993565 10107573 68724995 23 1457953 9893147 1473699 67856446 10103006 68389338 24 1460830 9892723 1476671 67719367 10108440 68454222 25 1463708 989296 1479644 6788326 10103006 68389338 24 1460830 9892723 1476671 67719367 10108440 68454222 25 1463708 9891457 14385990 67313241 10109131 68185997 28 1472340 9891017 1438590 67313241 10109131 68185997 29 1475217 9809588 1491536 67044966 10103006 68454222 21 148061 98891017 1438663 66748691 1016032 67786631 1016033 6674446 1016062 67786632 67786631 10160433 67786631 10160433 67786631 10160433 67786631 10160433 67786631 10160433 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786631 1016043 67786647 1016046 67786446 1016066 67746446 1016066 1016066 1016067 1016067 10	52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37
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N Co Sine. N. Sine. N Co Tang. N. Tangent. W. Co-Secant: N. Secanti.	\overline{M}
81 DEGREES.	4.7

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		L. Co-Sine				. 1		L. Co-Secant	
	9.1435553	9.9957528		9.1478025	10-8521975		10.0042472	10.8564447	
,1	9.1444532	9.9957350		9.1487182	10.8512818	1	10.0042650	10.8555468	59
2	9.1453493	9.9957172		9.1496321	10.8503679	1	10-0042828	10.8546507	58
3	9'1462435	9 9956993	l	9.1505441	10.8494559		10.0043007	10.8537565	
4	9.1471358	9.9956815	l	9.1514543		1	10.0043185	10.8528642	
. 8	9.1480262	9.9956635	ł	9.1523627			10-0043365	10.8519738	
	9.1489148	9.9956456		9-1532692	10-540/305		10.7043544	10.8510852	54
7	9.1498015	9.9956276		9.1541739	10.8458261		10.0043724	10.8501985	
7 8	9.1506864	9.9956095		9.1550769	11.8449231		10.0043905	10.8493136	, , ,
9	9.1515694	9.9955915		9.1559780	10.8440220		10.0044085	10.8484306	
10	9.1 524507	9.9955734	,	9.1568773	10.8431227		10.0044266	10.8475492	60
71	9.1533301	9.9955552		9.1577748	10.8422252		10,0044448	10.8466699	10
12	9.1542076	9.9955370		9.1586 706	10.8413294		10.0044630	13.8457924	48
13	9.1550834	9.9955188		9.1595646	10.8404354		10.0044812	10.8449166	47
14	9.1559574	9.4955005		9.1604569	10.8395431	1	10.0044995	10.8440426	1 46
15	9.1568296	9.9954822		9.1613473	1018386527	1	10 0045178	10.8431704	лс
16	9.1577000	9.9954639		9.1622361	10.8377639		10.0045361	10.8423000	1 44
17	9.1585686	9.9954455		9.1631231	10.8368769		10.0045545	10.8414314	43
18	9.1594354	9.9954272		9.1640083	10.8359917	l i	10.0045729	10.8405646	42
	0.1602001	0.001400=		9-1648919	10.8351081	[10-0045050	10.8206	
19	9.1603005 9.1611639	9 99 \$4087		9-1657737	10.8342263	1 1	10.0045913	10.8396995 10.8388361	41
20	9.1620254	9.9953902		9.1666538	10.8333462		10.0046283	10.8379745	40
22	9.1628853	9 . 9953717 9.9953531		9.1675322	10.8324678		10.0046469	10.8371147	39
23	9.1637434	9.9953345		9.1684089	10.8315911	1	10.0046655	10.8362566	38
24	9.1645998	9.9953159		9.1692839	10.8307161	1 1	10-0046841	10.8354002	1 2, 1
		7.7913-17							36
25	9.1654544	9.9952972		9.1701572	10.8298428	1 1	10.0047028	10.8345456	25
26	9.1663074	9.9952785		9-1710289	10.8289711	l I	10.0047215	10.8336026	35 34
27	9.1671586	9.9952597		9,1718989	10.8281011		10.0047403	10.8328414	33
28	9.1680081	9.9952409		9.1727672	10.8272328		10.0047591	10.8319919	32
29	9.1688559	9.9952221		9.1736338	10.8263662	1	10-0047779	10.8311441	31
30	9-1697021	9.9952033		9.1744988	10.8255012	1	10.0047967	10.8302979	30
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31	9.1705465	9.9951844		9.1753622	10.8246378	1 1	10-3048156	10.8294534	29
32	9.1713893	9 9951654		9.1762239 9.1770840	10.8237761		10.0048346	10.8286107	28
33	9.1722305	9.9951464		9.1779425	19.8220575	1 1	10.0048536	10-8277695	27
34	9.1730699	9.9951274		9.1787993	10.8212007		10-0048726 10-0048916	10-8269301	26
35 36	9 173 9 077 9·1 7474 39	9.9951084		9.1796546	10.8203454		10.0049107	10.8252561	25
30	21.747437	9 9 9 5 6 8 9 3						20.02,72,01	24
27	9.1755784	9.9950702		9.1805082	10.8194918	, i	10.0049298	10.8244216	99
37 38	9.1764112	9.9950510		9.1813502	10.8186398	1	10,0049490	10.8235888	23
39	9.1772425	9.9950318		9-1822106	10.8177894		10.0049682	10.8227575	21 21
40	9.1780721	9.9950126	.]	9.1830595	10.8169405		10.0049874	10.8219279	20
41	9.1789001	9.9949933		9-1839068	10.8160932		10.0050067	10.8210990	19
42	9-1797265	9.9949740		9.1847525	108152475	i	10.0050260	10.8202735	18
43	9.1805512	9-9949546		9.1855966	10.8144034	·	10.0050454	10.8194888	17
44	9-1813744	9-9949352		9-1864392	10-8135608		10.0090648	10.8186256	16
45	9.1821960	9.99491581		9.1872802	10.8127198		10.0050842	10.8178040	15
46	9.1830160	9.9948964		9.1889575	10.8118804		100051036	10.8160840	14
47	9-1838344	9.9948769		9.1897939	10.8102061		10.0051231	10-8161656	13
48	9.1846512	9.9948573		30. 37/939	40.0102001		20.005142/	10-8153488	12
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49	9.1862802	9.9948377 9.9948181		9.1914621	10.3085379		10,0051819	10.8137199	.11
50	9.1870923	9.9948181		9.1922939	10.8077061		10,0052015	10.8129077	10
52	9.1879029	9.9947988		9 1931241	10.8058759		10,0052212	10.8120971	8
53	9.1887120	9.9947791		9.1939529	10.8060471		10.0052409	10,8112887	
54	9.1895195	9.9947393		9.1947802	13.8052198		10.0052607	10.8104805	7 6
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55	9.1903254	9-9947195		9.1956059	10.8043941	i	10.0052805	10.8096746	5
56	9.1911299	9.9946997		9,1964302	10.8035698	1	10.0053003	10.8088201	4
57	9.1919328	9.9946798	,	9.1972530	10.8027470		10.0053202	10.8080672	3
58	9.1927342	9.9946599		9.1980743	10.8019257	1	10.0053401	10.8072658	2
59	9.1935341	9.9946399		9.1988941	10-8011059		10.0053601	10.8064659	1
60	9.1943324	9:9946199		9.1997125	10.8002875		10.2053801	10.8056676	0
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47 1699226 9854574 1727300 57893825 10148081 58751128 12 49 1704961 9853583 1733296 57793588 10148591 58652356 11 50 1707828 9853087 1733292 57693688 10149102 58553920 10 51 1710694 9852590 1736288 57594122 10149614 58455820 9 52 1713560 9852092 1739285 57494889 10150127 58358053 8 53 1716425 9851593 1742282 57395988 10150641 58260617 7 53 1716425 9851093 1745279 57297416 10151156 58163510 6 55 1722156 9850592 1748277 57109173 10151672 58066732 5 56 1725022 9850091 17512754 57131256 10152189 57970283 4 57 1727887 9849589 1754273 57003663 10152797 57874153 3 58 1730752 9849086 1757272 56906394 10153746 57682867 1 59 1736482 9848077 N. Sine N. Co Tang. N. Tangent. N. Co-Secant M. Secant M.	46	1696362		ł			ŀ		\$8850228	
48 1702095 9854579 1727300 779305	47			t		1780282	1		58751128	
49 1704961 9853583 1733296 57793588 10148591 58652356 11 1707828 9853087 1736288 57594122 10149614 58455820 9 1736288 57594122 10149614 58455820 9 1736288 57594122 10149614 58455820 9 1739285 57494889 10150127 58358053 8 1716425 9851593 1742282 57395988 10150641 58260617 7 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10152189 57970282 4 1745273 57109173 10152189 57970282 4 17512754 57101256 10152707 57874153 3 1730752 9849589 1754273 57003663 10152707 57874153 3 1750271 9848582 1760271 56809446 10153746 57682867 1 1763270 7787705 0 1736482 9848077 N. Sine N. Co Tang. N. Tangent. N. Co-Secant M. Secant M.	48	1702095	9854079		1/27300	7/~93025	.l	10140001		.]
49 174901 933303 50 1707828 9853087 51 1710694 9852590 1736288 57594122 10149614 58455820 9 52 1713560 9852092 1739285 57494889 10150127 58358053 8 53 1716425 9851593 1745279 57297416 10151156 58163510 6 55 1722156 9850592 1748277 57109173 10151672 58066732 5 56 1725022 9850091 17512754 57131256 10152189 57970283 4 57 1727887 9849589 1754273 57003663 10152797 57874153 3 58 1730752 9849086 1757272 56906394 10153226 57778350 2 59 1733617 9848582 1760271 56809446 10153746 57682867 1 59 1736482 9848077 N. Sine N. Co Tang. N. Tangent. N. Co-Secant M. Secant M.	}	-	0011101	1	1723206	57702688	1	10148501	58652356	1
50 1707828 9853087 1736288 57594122 10149614 58455820 9 1736288 57594122 10149614 58455820 9 1736288 575941889 10150127 58358053 8 1716425 9851593 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57101256 10152189 57970282 4 17512754 57101256 10152189 57970282 4 17512754 57101256 10152797 57874153 3 1750272 56906394 10153226 57778350 2 173617 9848582 1760271 56809446 10153746 57682867 1 1736482 9848077 N. Sine N. Co Tang. N. Tangent. N. Co-Secant M. Secant M.	49			l		57602688	ł			
51 1710694 9852592 1739285 57494889 10150127 58358053 8 17106425 9851593 1742282 57395988 10150641 58260617 7 17106425 9851093 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57297416 10151156 58163510 6 1745279 57109173 10151156 58163510 6 1725022 9850091 17512754 57101256 10152189 57970280 4 17512754 57109173 10152189 57970280 4 17512754 57109173 10152189 57970280 4 17512754 57109173 10152707 57874153 3 17527887 9849589 1757272 56906394 10153226 57778350 2 1733617 9848582 1760271 56809446 10153746 57682867 1 1760271 56809446 10153746 57682867 1 1763270 5712818 10154267 57587705 0 1736482 9848077 N. Sine N. Co Tang. N. Tangent. N. Co-Secant M. Secant M.				ł	1735292	57504122	1		58455820	
1745282 1716425 5351593 1742282 57395988 10150641 58260617 7 7 7 7 7 7 7 7 7			9572790	1	1720286	57494880	1		58358053	8
53 171042) 9851093 1745279 57297416 10151156 58163510 6 55 1722156 9850592 1748277 57109173 10151672 58066732 5 56 1725022 9850091 1751275 57101256 10152189 57970280 4 57 1727887 9849589 1754273 57003663 10152707 57874153 3 58 1730752 9849086 1757272 56906394 10153226 57778350 2 59 1733617 9848582 1760271 56809446 10153746 57682867 1 59 1736482 9848077 1763270 56712818 10154267 57587705 0 N.C. Sine. N. Sine N. Co Tang. N. Tangent. N. Co-Secant M.		1 6 . 6 .		l	1742282	57395988	1		58260617	
1722156 9850592 1748277 57109173 10151672 58066732 57070280 47512754 57109173 10152189 57970280 47512754 57109173 10152189 57970280 47512754 57109173 10152189 57970280 47512754 57109173 57003663 10152707 57874153 37003663 10153226 57778350 2778350 27783			0861003	1		57297416	1		28193210	6
172150 9850592 1751276 57131256 10152189 57970283 4 1725022 9850091 1751276 57131256 10152797 57874153 3 1730752 9849086 1757272 56906394 10153226 57778350 2 1733617 9848582 1760271 56809446 10153746 57682867 1 1763270 56712818 10154267 57587705 0 N. Co. Sine. N. Sine N. Co. Tang. N. Tangent. N. Co. Secant M. Secant M.	. 54	1/19291	9971093		1 - 1 - 1 - 1 - 1 - 1	.	-1			
1725022 9850091 1751276 57131256 10152189 57970283 4		1722156	0850502	1	1748277	57109173	1		58066732	5
1727887 9849589 1754273 57003663 10152707 57874153 3 3 3 3 3 3 3 3 3	55			1 .			i .			4
1730752 6849086 1757272 56906394 10153226 57778350 2 2 2 2 2 2 2 2 2			0840580	l		57003663		10152777		3
1733617 9848582 1760271 56809446 10153746 57682867 1736482 9848077 1763270 N. Sine N. Co Tang. N. Tangent. N. Co-Secant N. Secant M.	27		6840086	1		56906394	. 1			· 2
60 1736482 9848077 1763270 56712818 16154207 5750705 N. Sine N. Co Tang. N. Tangent. N. Co-Secant N. Secant M				1		56809446	1.		57052807	
N. C. Sine. N. Sine N. Co Tang. N. Tangent. N. Co-Secant N. Seton M.		1736182		1		56712818	1			
	<u> </u>	N Ca Sim		1		N. Tangent.	.7	N Co-Secant	N. Secant	M
OD DEGREES	1 -	17 0,7-01/1	11, 0,,,,							
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MI	L. Sine.	L. Co. Sine.		L. Tangent	L. Co-Tang.		L. Secant.	1. Co-Secant.	
0	9.1943324	9.9946199		9.1997125	10.8002875		10.0053801	10.8056676	60
1	9.1951243	9.6945999		9.2005294	10-7994706		10-0054001	10.8048707	59
2	9.1959247	9.9945798		9.2013449	10.7986551		10.0054202	10.8040753	5 8
3	9.1967186	9-9945597		9.2021588	10.7978411		10.0054403	10.8032814	57
4	9.19751 1 0 9.198301 9	9.9945395 9.994 5 194		92029714 92037825	10-797 286		10.0054806	10.8024890 10.8016981	50
5	9.1990913	9.9941992		912045922	10-7954078		rc+2055008	10.5009387	55 54
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7	9.1998793	9.9944789		912054004	13.7945995		10.0055211	10.8001207	53
8	9.2006658	9.9944587 9.9944383		9.2062072 9.2070126	10.7937928		10.0055413 10.005561 7	10.7993342	52
9 10	9,2014509 9,2022345	9.9944380		9.2078165	10 7921835		10.0055820	10,7985491	51
11	9.2030167	9.9943975		9-2086191	10.7913859	Ì	10.0056025	10.796,833	49
12	9.2037974	9.9943771		9,2094203	19.7905797		10.0056229	10.7962026	48
	2 2045266	0.0043566		9.2102200	10.7897800		10.03(6434	10.535.405.4	
13	9.2045766 9 ² 053545	9.9943566 9.9943361		9,2110184	10.7889816		10.0056434	10.7954234 10. 7 946455	47
14 15	9.2061309	9.9943156		9:2118153	10.7881847		10.0056844	10.7538691	46
16	9.2069059	9.9942950		9.2126109	10.7873891		10.0057050	10.7930941	44
17	9.2076795	9.9942743		9.2134051	10.7865919		10.0057227	13.7923205	43
18	9.2084516	9.9942537		9.2141980	10.7858020		10.0057463	177915484	42
19	9.2092224	9.9942330		9.2149394	10.7950.06		10.0057670	10.7907776	41
20	9.2099917	9.9912122		9.2157795	19.7842205		0.0057578	10.7901083	40
21	9.2107597	9.9941914		9.2165683	10.7834317		10.0058086	10.7892403	39
22	9.2115263	9.9941706		9.2173556 9.2181417	10.7826444		10.0058294	10.7884737	38
23	9.2122914	9.9941498	•	9.2189264	10-7818583		10.0058502	10.7877586	37
24	9.2130772	9.9941209						7309446	36
25	9-2138176	9.9941279	l '	9`2197097	10.7802903		10.0058921	10.7861824	35.
26	9.2145787	9.9940870		9.2204917	19.7795083		10.0059130	10.7854213	34
27	9.2153384	9.9940659	١.	9,2212724 9,2220518	10.7787276		10.0059341	10.7846616	33.
28	9.2160967 9.2168536	9.9940449		912228298	10.7771702		10.0059551	10.7839033	32
2 9 30	9.2176092	9.9940027		9,2236005	10.7763935		10.0059973	10-7823908	30
31	9.2183635	9.9939815		9•2243819 9•2251561	19.7756181	ł i	10.0060185	10.7816365	29
32	9.2191164	9.9939391 9.9939603		9,2259289	10.7748439		10.0060397 10.0060609	10.7808836 10.7801320	28
33 34	9.2.06182	9.9939178	1	9-2267004	10.7732996		10.0060822	10.7793818	27 26
35	9.2213671	9.9938965		9.2274706	10 7725294		10.0061035	10.7786329	25
36	9.2221147	9.9938752		9.2282395	10,7717602		10.0061248	10.7778853	24
	9.2228609	9.9938538	ŀ	9.2290071	10.7709929		10.0051452	10 7771201	_
37 g S	9.2236059	9.9938324		9.2297735	10.7702265		10.0061676	10.7771391 10.7763941	23
39	9-22+3495	9.9938109		9.2305386	10.7694614		10.0061891	10.7750505	21
40	9.2250918	9.9937894		9.2313024	10.7686976		10.0062106	17.7749052	20
41	9.2258328	9.9937679		9·2320650 9·2328262	10.7679350 10.7671738		10.0062321 10.0062537	10.7741672	19
42	9.226;725	9.9937463	<u> </u>					10.7734275	18
43	9.2273110	9-9937247		9.2335863	10.7664137		10.0062753	10.7726890	17
44	9.2280481	9.9937030		9-2343451	10.7656549		10.0062970	10.7719519	16
45	9.2287839	9.9936813	'	9-2351026 9-2358589	10.7648974		10,0063187 10.0063404	10.7712161	15
46	9.2295185	9 .9936596 9 .99 36378		9-2350589	10.7633861		10.0003404	10-7704815 10-7697482	14
47 48	9.2309838	9.9936169		9-2373678	10.7626322		10.0063840	10.7690162	13.
40									
49	9.2317145	9-9935944	۱ ا	9,2381203	10.7618797		10.0064758	10.7682855	11
50	9.2324440	9.9935723		9.2388717 9.2396218	10.7611283 10.7603782		10.0064277	10.7675560	10
51 52	9.2331722	9.9935 5 04 9.9935285		y.2403708	10.7596292		10.0064715	10.7661008	8
53	9.2346249	'9.9 93506 5		9-2411185	10,7588815		10-0064935	10.7653751	7
54	9.2353494	9.9934844		9 2418650	10.7581350		10.0065156	10 764650 6	6
	0.2163114	0.0024624		9.2426103	10.7573897		10.0065376	10.7639274	
55 50	9.2;63726 9.2367946	9.9934624 9.9934403		9.2420103	10.7566457		10.0065597	10.7632054	5 4
57	9.2375153	9.9934181		9.2440972	10.7559028		10.0065819	10.762484 <u>7</u>	3
58	9.2382349	9.9933959		448389	10.7551611		10.0066041	10.7617651	3.51
59	9.2389532	9-9933737		9-2455794	10.7544206		10,0065263	10.7610468	` 1
<u>6</u> 5	9.2396702	9.9933515		9.2463188	10.7536812		10 00 66485	10.7603298	C
	L. Co.Sine.	L. Sine.	1	L.Co Tang.	L. Tangent	-	L. Co Secant	L. Secant	M
				δο D	EGREE	5.			

1				10 DE	GREES.				
M	N dine.	N. Co-Sine		N. Tangent.	N. Co- Sang.		N. Secant.	N. Co- Secant	
0	1736482	9848077		1763270	56712818		19154267	5758 7 705	6 0
1	1739346	9847571		1766269	50016579		10154788	57492861	59 58
2	17422:1	9847065		1769209	56520516		10155310	57398333	58
3	17450 95 174793 9	9846558 9846050		177 1 269 1775 269	56424838		10155833	57304121 572102 2 3	57 56
4 5	1750803	9845541		1778270	56329474 56234421		10156882	57116636	55
6	1753667	9845031		1781271	56139680		10157408	57023360	54
						1			— <u> </u>
7 8	1756531	9844521		1784272	56045247		10157935	56930393	53
° 9	1759395 1752258	9844010 9843198		1787274	55951121 55857302		10158463 10158992	56837734 56745380	52 51
10	1765121	9812945		1793278	55763786		10159521	56653331	50
11	1767984	9842471		1796281	55670574	i '	10160051	56561584	49
12	1770847	9841956		1799284	55577663	1	10160582	56470140	48
	1773710	9841440		1802287		l	10161114	56378995	-
13	1776573	9 ⁹ 40924		1805291	55485052 55392740	l	10161647	56288148	47 46
15	1779435	9840407		1808295	55300724		10162181	56197599	45
16	1782298	9839889		1811299	55209005		10162716	56107345	44
17	1785160	9 ⁸ 393 7 0		1814303	55117579		10163252	56017386	43
18	1788022	9838850		1817308	55026446	1	10163789	55927719	42
19	1790884	9838329		1820313	54935604		10164327	55838343	41
20	1793746	9837808		1823318	54845052		10164866	55749258	40
21	1794607	9837286		1826324	54754788		10165406	55660460	
22	1799469	9836763		1829330	54664812		10165946	55571950	38 39
23	1802330 1805191	9836239		1832336 1835343	54575121		10166487	554 8 3 7 26 55395786	37
24	1005191	9835714		1037343	54485715		1010/029	11391/00	36
25	1808052	9835189		1838350	54396592		10167572	55308129	35
26	1810013	9834663		1841357	54307750		10168116	55220754	34
27	1813774	9834136		1844365	54219188		10168661	55133659	33
28	1816635 1819495	9833608		1847373 1850381	54130906	•	10169237 10169754	55046843 54960305	32
29 30	1822355	9833079 983 254 9		1853390	54042901 53955172		10170302	54874043	30
-30		7-3-147					·		
31	1825215	9832018		1856390	53867718		10170851	54788055	29
32	1828075	9831487		1859408 1862418	53780538		10171401	54702342	28
33	1830935	9830955 9830422		1865428	53693630 53 6 069 9 3		101719 52 10172504	5461 69 01 54531731	27 26
34 35	1836654	9829888		1868438	53520626		10173056	54446831	25
36	1839513	9829353		1871449	\$3434527		10173609	54362199	24
	-9.12-22	0.00		-954460	400196-6		70.74.60		_
37 38	1842373 1845 2 32	9828817 9828281	i	1874460 1877471	53348696 53263131		10174163	54277 ⁸ 35 54193737	23 22
30 39	1848091	9827744		1880483	53177830		10175274	54109903	21
40	1850949	9827206		1883495	53092793	Ī	10175831	54026333	20
41	1853808	9826667		1886507	53008018		10176389	53943026	19
42	1856666	9826127		1889520	52923505		10176948	53859979	18
	1859524	9825587		1892533	52839251		10177508	53777192	17
43 44	1862382	9825046		1895546	52755255		10178069	53694664	16
45	1865240	9824504		1898559	52671517		10178631	53612393	15
45	1868098	9823961	•	1901573	52588035		10179194	53530379	14
47 48	1870956 1873813	9823417		190458 7 1907602	525 04809 5242 1836		10179758	53448 6 20 53367114	13 12
48		9822872			,_4			7777114	
49	1876670	9822327		1910617	52339116		10180887	53285861	11
50	1879527	9821781		1913632	52256647		10181453	5320486 0	10
51	1882384	9821234		1916648	52174428		10182020	53124109	9
52	1885241 1888098	9820686 9820137		1919 6 64 19 2 2680	52 092459 52 010738	I	10183157	53043608 52963354	7
53 54	1890954	9819587		1925696	51929264		10183727	52883347	6
			1						
55	1893811	9819036		1928713	51848035		10184298	52803587	5
56	1896667	9818485	l	1931730	51767051 51686311		10184870 10185443	5272407 0 52644798	4
57 58	1899523	981 7933 981 73 80		1934748 1937766	51605813		10185017	52565768	3 2
50 59	1905234	9816526	i	1940784	51525557		10186592	52486979	ī
60	1908090	9816271	l	1943803	59445540		10187168	52408431	0
	N. Co-Sine.	N. Sine.	<u> </u>	N .Co-Γang.	N. Tangent.		N. Co-Secant.	N. Secant.	M
1	· · · · · · · · · · · · · · · · · · ·	,		79 DE	GREES.				
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		-	10 D I	EGREES		-		
M	L. Sme.	L. Co. Sine.	L. Tangent	L. Co-Tang.		L. Secant.	4. Co-Secant.	
0	9.2396702	9-9933515	9.2463188	10:7536812		10.0066485	110.7603298	60
	9.2423861	9.9933292	9.2470569	10.7529431	- ,	10-0066708	10.7566139	- 59
2	9.2411007	9-9933068	9.2477939	10.7522061		10.0066532	10.7588993	58
3	9.2418141	9.9933845	9.2485297	10.7514703		10.0067155	10.7581859	57
4	9.2425264	9.9932621	9.2492643	10.7507357		10.0067379	10.7574736	56
5	9-2432374	9.9932396	9.2499978	10-7500022		10.0067604	10.7567626	
. 6	9.2439472	9.9932171	9,2507301	10.7492639		10.0067829	10.7560528	54
	9.2446558	9.9931946	9,2514612	10.7485388		10.0068054	10.7553442	
7	9.2440550	9.3931720	9,2521912	10.7478088		10.0068280	10.7546368	53 52
9	9.2460595	9.9931494	9.2529200	10.7470800		10.0068506	10,7539305	51
10	9.2467746	9,9931268	9,2536477	10.7463523		10.0068732	10.7532254	50
11	9.2474784	9-9931041	9,2543743	10,7456257		10.0068959	10.7525216	49
12	2.2481811	9.9930814	9,2550995	10,7449003		10.0069186	10.7518189	48
	2.0000	0.0000495	9,2558240			FD 0060440		
13	9.2488827 9*2495830	9•9930587 9•9930359	9.2565472	10-7441760		10.0069413	10.7511173	47
14	9.2502822	9.9930131	9:2572691	10.7427308		10.0069869	10.7497178	46
15	9.2509803	9.9929902	9.2579301	10.7420099	1	10.0070098	10,7490197	45 44
16 17	9.2516772	9-9929673	9,2587099	10.7412901	1	10.0070327	10.7483228	43
18	9.2523729	9.9929444	9,2594285	19.7425715	ł	10.0070556	127476271	42
			- 04		ŀ			
19	9.2530675	9-9929214	9.2601461	10.7398539	•	10.0070786	10.7469325	. 41
20	9.2537679	9.9928984	9.2608625 9.2615779	10.7391375	1	10.0071016	10.7462391	40
21	9-3544532	9.9928753	9-2622921	10.7381221	Ì	10.0071247	10.7455468	39
22 1	9.2551444	9.9928522 9.9928291	9-2630053	10.7377079		10.0071478	10.7448556	38
23	9.2565233	9.9928059	9,2637173	10-7362827	1.	10.0071941	10.7434767	37 36
24					1	7.77.		30
25	9.2572110	9.9927827	9.2644283	19.7355717		10.0072173	10.7427890	35
26	9.2578977	9.9927595	9.2651382	14.7348618	li i	10.0072405	10.7421023	341
27	9.2585832	9.9927362	9-2658470	19.7341530		10.0072638	10.7414168	33
28	9.2592676	9.9927129	9-2665547 9-2672613	14.7834453		10.0072871	10.7407324	32
29	9.2599509	9-9926895	9 2679669	14.7327387		10.0073105	19-7400491	31
30	9.2606330	9-9926661	720/9009	10.7320331		10.0073339	10-7393670	30
	9.2613141	9.9926427	9-2686714	10.7313286	!	10.0073573	10.7386859	29
31	9.2619941	9.9926192	9.2693749	10.7306251		10,0073808	10.7380059	28
32	9.2626729	9.9925957	9.2700772	19.7299228	[·	\$0.0074043	10.7373271	27.
331	9.2633597	9.9925722	9.2707786	10,7292214	}	10.0074278	10.7366493	26
34 35	9,2640274	9.9925486	\$ 2714788	10 7285212	}	10-0074514	10.7359729	25
36	9.2647030	9.9925250	9.2721780	10.7278220	Ī	10.0074750	10.7352970	24
			9.17.18762	1	Į	20.000.00	10.704(0)	
37.	9.2653775	9.9925013	9.2735733	10.7271238	ł	10.0774987	10.7346225	23
38.	9.2660509	9.9924776	9.2742693	10.7264267	1	10.0075224	10.7339491	22
39	9-2667232	9.9924539	9.2749644	1b.7250355	1	10.0075461	10.7332768	21
4 0	9.2680 647	9.9924301 9.9924063	9.2756584	Ip.7243416	1	10.0075937	10.7319351	20
41.	9.2687338	9.9923824	9.2763514	10.7236486	1	10.0076176	10.7312662	18
42		777-50-4			1		'	
43	9.2694019	9-9923585	9.2770434	10.7229566	ſ	10.0076415	10.730598#	17
44	9.2700689	9-9923346	9.2777343	10.7222657	ł	10.0076654	10.7299311	15
45	9.2707348	9.9923106	9.2784242	10.7215758	1	10.0076894	10.7292652	1 15
46	9-2713997	9-9922866	9.2791131	0.7208869	ł	10.0077134	10.7286003	1. 14
47	9.2720635	9.9922626	9.2834878	10.7201991		10.0077374	10.7275365	18
48	9.2727263	9.9922385		0.7195122	1	10.00//013	100/2/2/3/	12
	9.2733880	9.9922144	9.2811736	10.7188264	1.	10.0077856	10.7266120	LI
49	9.2733880	9.9922144	9.2818585	0.7181415	1	10.0078098	10.7259513	H S
50 51	9.2747083	9.9921660	9.2825423	10.7174577	1	10.0078340	10.7252917	5
51 52	9.2753669	9.9921418	9.2832251	0.7167749	1	10.0078582	10.7246331	18
53	9.2760245	9.9921175	9.2839070	0,7160930	1	10.0078825	10.7239755	17
54.	9. 2766811	9,9920932	9 2845878	10.7154122	1	10.0079068	10.7233139.	6
-			9.2852677	1 70 22 42 22 22	1	10.0070311	10.700664	F-1,
55	9.2773366	9.9920689	9-2859466	10.7147323	i	10.0079311	10.7226634	15
56	9.2779911	9.9920145	9-2866245	10.7140534	1	10.0079555	19.7,213555	4
57	9.2786445	9.9920201	9.2873014	10.7133755	Į	10.0080044	10.7307030	ו פי ו
58	9.2792970	9.9919956	9.2879773	10.7120227	f	10.0080289.	10,7200516	
59 60	9.2799484	9.991 97 11 9.9919466	9.2886523	10.7113477	1	10.0080534	10.7194012	.0
	L. Co-Sine	L. Sine.	L. Co Cang.	L. Tangent	1	L. Co-Secant	L. Secant.	M
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]	M .	N bine.	N. Co-Sine.	1	N. Tangent.	N. Co-Lang.	- 1	N. Secant.	N. Co- Secant	-
_	0	1908090	9816271		1943803	51445540		10187168	. 52408431	60
I —	_ -		9815716			51365763	,	10187744		
		1910945	9815160	- 1	1946822			10188321	1 52330121	sy
		1913800	9814603	- 1	1949841	51286224		10188899	52252050	58
1	- 1	1916655	9014003		1952861	51206921	1		52174216	57
i	, ,	1919513	9814045		1955881	51127855		10189478	52096618	56
		1922365	9813486		1958901	51049024		10190358	52019254	55
ł	6	1925220	9812926	Ī	1961922	50970426		10192639	51942125	54
1	_ ^	****		1		100.0060			1106120	-
1		1928074	9812366		1964943	50892061		10191221	51865228	53
i		1930928	9811805	- 1	1967964	50813928		10191804	51788563	52
}		1933782	9811243		1970986	50736025		10192383	51712128	51
		1936636	9810680		1974008	50658352		10122973	51635924	50
•		1939493	9810116		1977030	50580907		10193559	51559948	49
1 1	12	1942344	9809551		1980053	50503690		10194146	51484199	48
 	- -		- C 0 04						b.	_
1		1945197	9808986		1983076	50426700	1	10194734	51408677	47
1		1948050	9808420		1986100	50349935		10195323	51333381	46
1		1950903	9807853	3	1989124	5027 3395	1	10195912	51258309	45
1	6	1953756	9807285		1992148	50197078		10196502	51183461	44
1	17	1956609	9806716		1995172	5012 0984.		10197093	51108835	43
	8	1959461	9806146		1993197	50045111		10197685	51034431	42
1-	<u> </u>									<u> </u>
1 .		1962314	9805576		2001222	49969459		10198278	50960248	. 41
		1965166	9805005		2004248	49894027		10198872	50886284	40
		1958018	9804433	-	2007274	49818813		10199467	50812539	
		1970870	9803869		2010300	49743817		10200063	50739012	39 38
		1973722	9803286		2013327	49669037		10200660	50665701	37
		1976573	9802711		2016354	49594474		10201258	50592606	36
						1777.17		~		
	25	1979425	9802136		2019381	49520125		10201857.	50519726	35
	26	1982276	9801560		2022409	49445590		10202457	50447060	34
-		1985127	9800983		2025437	49372068		10203058	50374607	
	27 28	1987978			2028465	49298358		10203660	50302367	33
		1990829	9800405					10204263	.50230337	32
	29		9799826		2031494	49224859	•		50168617	31
1 3	30	1993679	9799247		2034523	49151570		10204867	50158517	30
1	-1		-044-		000000			1000445	£008600=	-
	31	1996530	9798667		2037552	49078491		10205471	50086907	29
	32	1999380	9798086		2040582	49005620		10206076	50015505	28
	33	2002230	9797504		2043612	48932956		10206682	49944311	27
	34	2005080	9796921		2046643	48860499		10207289	49873323	26
	35	2007930	9796337		2049674	48788248		10207897	49802541	25
1	36	2010779	9795752		2052705	48716201		10208506	49731964	24
1-	<u>ا</u> ــــــــــــــــــــــــــــــــــــ	-					j '			
1	37 38	2013629	9795167		2055737	48644359	1	10209116	49661591	23
1	28 L	2016478	9791581		2058769	48572719	1	10209727	49591421	22
٠.	39	2019327	9793994		2061801	48501282		10210339	49521453	21
	40	2022176	9793406		2064834	48430045	1	10210952	49451687	20.
	41	2025024	9792817		2067867	48359010		10211566	49382120	19
1	42	2027873	9792228	l .	2070900	48288174	l	10212181	49312754	18
+=					<u> </u>		I			
1	43	2030721	9791638	l	2073934	48217536		10212797	49243586	17
1	44	2033569	9791047	1	2076968	48147696	1	10213414	49174616	16
1:	45	2036417	9790455		2080003	48076854	į.	10214032	49105844	15
1		2039265	9789862		2083038	48006808	ł	10214650	49037267	14
1	46	2042113	9789268	l	2086073	47936957	1	10215209	48968886	13
. 17	47 48	2044961	9788674	1	2089109	47867300	l	10215889	48900700	12
1-	+"		1	l		4,21,300	I	I———		1
! :	40	2047808	9788079		2092145	47797837	ł	10216510	48372707	111
Į.	49	2050655	9787483	ŀ	2095181	47728567	ł	10217132		10
Ţ	50	2053502	9786886	1	2098218	47659490	I	10217755	48697299	
1	51	2056349	9786288	1	2101255	47590603	l	10218379	48629883	
4	52			1 .	2104293	47521907	1	10219004	48562657	·° l
1	53	2059195		t		47453401	ł	10219630	48495621	9 8 7 6
4.	54	2062042	9785090		2107331	4/473401	I	10219030	1 70497021	
1-	_	2061888	0284400	1	2110369	47385083		10220257	48428774	
ı	55	2064888	9784498	f			1			5
1	56	2067734		1	2113407	47316954	1	10220885	48362114	4
ı	57 58	2070580	9783287	1	2116446	147249012	1	10221514	48295643	3
ľ	58	2073426		1	2119485	47181256	1	10222144	48229357	2
	49	2076271			2122525	47113686	1	10222775	48163258	1
1	60	2079117		1	2125565	47046301	1	10223407	48097343	
1		N. Co-Sine	N. Sine.	1	N .Co-Tang.	N. Tangent.	ı	N. Co-Secant.	N. Secant.	M
1-					78 DE	GREES.		: <u>-</u>		-
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M	L. Sine.	L. Casine	L. Tangent	L. Co-Tang.	1	1 L. Secant.	L. Co-Secant	
-0	9.2805988	9.9919466	9.2886523	10.7113477	1	10,0080534	10.7194012	- 6 a
	9.2812483	9.9919220	9.2893263	10.7106737	ı	10-0080780	10.7187517	
2	9.2818967	9-9918974	9,2899993	10.7100007	İ	10.0081026	10.7181033	59 58
3	9.2825441	9.9918737	9.2906713	10.7093287	ł	10,0081273	10.7174559	57
4	9.2831905	9.9918480	9.2913424	10.7086576		10.0081526	10.7168099	56
5	9.2838359	9-9918233	9.2920126	10.7079874		10:0081767	10.7161641	55
6	9-2844803	9.9917986	9.2926817	10.7073183	1	10.0082014	10.7155197	54
	9.2851237	9.9917737	9.2933500	10.7066500	I	10.0082263	10.7148763	
7 8	9.2857661	9.3917489	0.2940172	10.7059828	1.	10.0082511	10.7142339	53
9	9.2864076	9.9917240	9.2945836	10.7053164		10.0082760	10,7135024	5 4
10,	9.2870480	9.9916991	9.2953489	10.7046511.	į	10.0083009	10.7129520	50
11	9.2876875	9.9916741	9.2960134	10.7039866	İ	10.0083259	10.7123125	49 48
12	9-2883260	9.9916492	9.2966769	10.7033231	1	10.0083208	10.7116840	48
	9.2889636	9.9916241	9-2973395	10-7026,605		10.0083759	10.7110364	47
13	9.5806001	9.9915990	9.2980311	10.7019589		10.0084010	10.7103999	46
15	9.2902357	9-9915739	9.2986618	10.7013382	1. 1	10.0084261	10.7097643	45
16	9.2908704	9.9915488	9.2993216	10.7006784		10.0084512	10.7091296	44
17	9.2914040	9-9915236	9.2999874 9.3006383	10.7000196	1	10-0084764	10.7084960	43
18	9.2921367	9.9914984	9.3000303	10.6993617	1	100085016	10.4048638	42
19	9.2927685	9.9914731	9.3012954	19.6987046	1	10.0085269	10.7072315	
20ì	9-7933903	9-9914478	9.3019514	10.6980486	1	10:0085522	10.7066007	44
21	9-2940291	9-9914225	9.3026365	10.6973934	1	10.0085775	10.7059709	- 39
22	9.2946980	9-9913974		10.6967391	1	10.0086029	10.7053420	. 38
23	9.2952859	9.9913717	9-3039143	10-6960857	1	10.0086283	10.7047141	37
24	9.2949129	9.9913462	9.3045007	10.0954333	l	10.0086538	10.7040871	. 30
25	9-2965390	9.9913207	9.3052183	10.6947817	1	10.0086793	10.7034610	" 3 \$
26	9-2971641	9.9912952	9.3058689	10.6941311	1	10.0087048	10.7028350	34
27	9 -297788 3	6-99 MB 696	9-3065187	.1b.6644813	•	10.0087304	107022117	33
28	9.2984116	9-9912440	9.3072074		1	10.0087560	10.7015884	32
29	9-2990339	9.9913184	9.3078155	10.6915374	1.	10.0087816	10-7009661	3
30	9-2996553	9.9911927	9-30-4020	10.0913374		10.0036073	10-7003447	30
2.	9.3002758	9.9911670	9.3091088	10.6908912		10.0088330	10.6997241	29
31 32	9.3008953	9.9911412	9.3097541	10.6902459	1	10,0088588	10.6991047	28
33	9-3015140	9.9911154	9.3103985	10.6896315		10.0088846	10.6984860	27
34	9.3021317	9.9910986	9.3116421	10.6889579 10.6883152	l	10.0089104	10.697868	20
35	9-3027485	9.9910637 9.9910378	9 3123256	10.6876734	1	10.0089363	10.697251	24
-36	9.3033644	99910370	7,5,5,5		1	120,000,0022	1010900350	24
37	9.3039794	9.9910119	9.3129675	19.6870325		100789881	10.6960206	21
37 38	9.3045934	9.990 9859	9.3136076	10.6863924	l	10.0090141	10.6954066	22
39,	9-3042006	9-9909598	9.314246	10.6857532	l	10.0090402	10.6947934	2
40	9-3058189	5 55 15 33 8	9.3148951	10.6844774	l	10.0090662	10,6941811 10.6935 69 7	20
41	9-3064303	9.9909077 9.9908815	9.201592	10.6838408		10.0091185	10.6929593	1 I
42	7,5757				t .		-	
43	9-3076503	9-9908553	9.3167990	10.6832050		10.0091447	10.692349	: 1
44	9-3082590	9-9908291	19.3174299 19.3180640	10.6825701 10.6819360		10.0091709	10:6917416	10
45	9.3088668	9.9908029	9.3186972	10.6813028		10,0091971 10,0092234	10.6911332	- 1
46	9.3094737	9.9907766 9.9907507	9.3193295	10.6806704		10.0092234	10,000,320	- I
47	9.3106849	9-990727	9.3199611	10.6800389		10.0092761	10.6893151	1
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49	9.3112892	9.990674	9-3205918	10.6794082	•	10.0093026	10.6887108	5 I
50	9.3118926	9.990710 9.993445	9-3212216	10.6787784 10.6781494		10.0003290	10:6881074 10:6875040	7 1
51	9,3124951	9.999445	93224788	ID.6775212		10:0093555	10.6869732	1
52	9.3130968	3.105914	9.3231061	10,6768939		10-0094086	10-6863024	. []
53 · 54	9.3142975	9905648	9-3237327	1b.6762673		10.0094352	10-6857025	. 1
1		2002082	0.0010191	in Artesia			1 40 1	
55	9.3148965	.9905382	9-3243584	10.6756416 10.6750168	1	10.0094618	10.6851035	? { {
56	9.3154947	29904848	93249832	10.0750108		10.0094885 10.0095152	ro.6845053	1
57	9.3160921	9.9904580	913262305	10.0737695	ŀ	10.0095152	10.6833115	3
58	9.317284	9.9904312	9 3268 929	10.6731471	•	10.0095688	10.6827159	1
77	9.317878	9-9904044	9 3274745	10.0725255	į	10.0095956	10.6821211	- 6
1-	L. Co-Sir	L. Sine.	L. Collang.	1. Tangent	, ,	L. Co-Secont	L. Secant.	M;
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M. N. Sine. N. Co-Sine. N. Tangent. N. Co-Tang. N. Secant. N. Co-Secant	1—			22		···· / ·	tur a	anu		4 -
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52 2226830 9748909 2284183 43779317 1027555 44906889 8 53 2229666 9748261 2287244 43720731 1025837 44849775 7 54 2232501 9747612 2290305 43662293 1025820 44792810 6 55 2235337 9746962 2293367 43604003 1025964 44735993 5 56 2238172 9746311 2296429 43545861 1026028 44679324 4 57 2241007 9745660 2299492 43487866 1026028 44679324 4 58 2243841 9745008 2302555 43430018 10261661 44566428 2 59 2246676 9744355 2305618 43372316 10262350 44510198 1 60 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Sine. N. Co-Tang. N. Taugent. N. Co-Secant. N. Secant. M.	, 41				2281123	43838054		1026874		
53 2229000 9748201 2290305 43720731 1025837 44849775 6 55 223537 9746962 2293367 43604003 1025964 44735993 5 56 2238172 9746311 2290429 43545861 1026028 44679324 4 57 2241007 9745660 2299492 43487866 2243841 9745008 2302555 43430018 10261661 44566428 2 59 2246676 9744355 2305618 43372316 10263350 44510198 1 60 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Sine. N. Co-Tang. N. Tangent. N. Co-Secant. N. Secant. M.		2 2226830 :	9748909	l :	2284183	43779317		1027555		ğ
55 2235337 9746962 2293367 43604003 1025964 44735993 5 56 2238172 9746311 2296429 43545861 1026028 44679324 4 57 2241007 9745660 2299492 43487866 2243841 9745008 2302555 43430018 10261663 44566428 2 59 2246676 9744355 2305618 43372316 102612350 44510198 1 60 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Sine. N. Co-Tang. N. Taugent. N. Co-Secant. N. Secant. M.	5	2229666	9748261	1				1025 37	44849775	
55 2235337 9746962 2293367 43604003 1025964 44735993 5 56 2238172 9746311 2296429 43545861 1026028 44679324 4 57 2241007 9745660 2299492 43487866 2026097 44622802 3 58 2243841 9745008 2302555 43430018 10261661 44566428 2 59 2246676 9744355 2305618 43372316 10263350 44510198 1 60 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Sine. N. Co-Tang. N. Tangent. N. Co-Secant. N. Secant. M.	54	223250E	9747512	١,	2290305	43002293		1025820	44792810	
2238172 9746311 2296429 43545861 1026028. 44679324 4 4 4 4 4 4 4 4 4		222522	07/5060	1.	2202267	A2604002		102506		
57 2241007 9745660 2299492 43487866 2026097; 44622802 3 58 2243841 9745008 2302555 43430018 10261663 44566428 2 59 2246676 9744355 2305618 43372316 10262350 44510198 1 60 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Co-Tang. N. Tangent. N. Co-Secant. N. Secant. M.	5			!					44735993	
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2246676 9744355 2305618 43372316 10262350 44510198 1 1 1 1 1 1 1 1 1	5	2243841	9745008	١,	2302555	43430018		10261661	44566428	
6c 2249511 9743701 2308682 43314759 10263039 44454115 0 N. Co-Sine. N. Sine. N. Co-Tang. N. Tangent. N. Co-Secant. N. Secant. M	3	2246676		į	2305618	43372316		10262350		
	_6	2249511		ľ					44454115	
77 D E G R E E S.	l	N. Co-Sine.	N. Sine.	1				IV. Co-Secant.	N. Secant.	M
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- M	L. Sine.	L. Co. Sine.		L. Tangent	L, Co-Tang.	ì	L. Secant.	L. Co-Secant.	
0	9.3178789	9-9904044		9-3274745	10-6725255		10.0095956	10.6821211	60
1	9.3184728	9.9903775		9-3280953	10.6719047	1.	10-0096225	10.6815272	59
2	9.3190659	9.9903506		9-3287153	10.6712847		10.0096494	19.6809341	58
3	9.3196;81	9-9908237	}	9-3293345 9-3299528	10.6706655 10.6700472	1.	10'0096763	10.6803419	57,
4. 5	9.3202495	9.9902967 9.9902697		9-3305704	10.6694296	1	10.0097033	10-6797505	50
6.	9-3814297	9.9902426		9.3311872	IC.6688128	i	12-0097574	10.6785703	55
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. 7	9.3220186 9.3 32696 6	9.9902155	i	9-3318031 9-3324183	10.6681969	1	10.0097845	10.6779814	53
8	9-3231938	9 .99018 83 9.9901612	٠	9-333-7327	10.6659673		10.0098288	10.6773934	52
10	9.3337802	9.9901339	1	9-3336463	10.6663537		10.0098661	10.6762198	51 50
11,	9-3243657	9-9901067	1	9-3343591	10.6657409	1.	10.0098933	10.6756383	49
:12	9-3249505	9.9900794		9,3348711	10.6651259		10.0099206	10.6750499	48
13	9-3255344	9-9900531		9-3354822	10 6645177	1	10.0099479	10.6744656	47
14	9.3261174	9-9900247		9,3360927	10.6639073	ł	10.0009753	13.6738826	46
15	9.3266997	9-9899973	'	9,3367024	10-6632976	1	10.0100027	10.6733003	45
16 17	9.3272811	9.9899698 9.9899423	1	9,3373413 9,3379194	10-6526887 10-6520806	1	10.0100302	10.6727189	44
18	9.3284416	9.9899148		913385267	10 6614733	1	10.0100852	10.6715584	43
			}	-	·	ł			42
19	9.3290206	9.9898873		9,3391333	10.5605667	1	10.0101127	10.6709794	41
20 21	9.3295988	9.989859 7 9.9898 320		9.3397391	10.6602679	1	10-0101403	10.6704012	40
22	9.3307527	c.9898043		2.3409484	10,0590516	1	10.0101957	10.6692473	. 38
23	9.3313285	9.9897766		9.3415519	19 65 84481	ł	10.0102234	10.6686715	37
24	9.3319035	9.9897489	1	9,3421546	19.6578454	į	10.0105211	10.6680965	36
25	9.3324777	9.9897211		9.3427566	10.6572434	İ	10.0102789	10.6675223	•
26	9.3330511	9.9896932	'	9.3433578	19.6566422	1	10.0103068	10.5669480	35 34
27	9.3336237	9-9896654	•	9,3439583	19.6560417	ł	10-0103346	10.6667762	33
28	9-3341955	9-9896374	:	9.3445580	10.6554420	ŧ	10.0103626	10.6658045	32
29 30	9.3347665 9.33533 6 8	9.9896095 9.9895815		9,3451570	19,6548430 19.6542448		40-0103905 40-0104185	10.6652335 10.6646632	31
			;						30
31	9.3359062	9-9895535	,	9-3463527	10.6536473	i	10,0104465	10.6640938	29
32	9.3364749	9.9895254	:	913469494 913475454	10,6530506	l	10.0104746	10.6635251	28
33 34	9.3370428 9.33 7 6799	9.9894973	ţ	9-3481407	10.6524546	•	10.0105027 10.0105308	10.6623901	27
35	9.3381762	9.9894410	•	943487352	10.6512618		10.0105590	10.6618274	26. > 25
36	9.3387418	9 9 8 9 4 1 2 8		9•3493 2 90	106506717		10.0105872	10.6612582	24
7.7	9-3393065	9.9893845		9-3499220	19.6500780		10.0106159	. 10.6606935	
37 38	9.3398706	9-9893562		9-3505143	10.6494857		10.0106438	10.6601293	23
39	9.3404338	9-9893279		9-3511050	10-6485941		10.0106721	10.6595662	21
40	9-3409963	9-9892995		9-3516968	10.6483032		10.0107004	10.6590037	20
41 42	9-3415587	9.9892711 9.9892427		9.3528763	10.6471237		10.0107289	10,6584420; 10-6578810	19
	9034-21-7-	3,903,4-7					100207775		18,
43	9-3426792	9.9892142		9.3534610	10.6465350		10-0107858	10.6573208	17
44	9'3432386	9.9891856		9.3540530 9.3546402	10.6449470	'	10.0108144	10.6567614	16,
45	9·3437973 9·3443552	9.9891571	•	9.3552267	10.6453598		10.0108429 10.0108716	10-6562027 10-6556448	15.
47	9.3449124	9.9890398		9.3558126	10,6441874		10-0109002	10.6550876	14
48	9.3454688	9.9890711	•	9.356397.7	10,6436023		10.0109289	10.6545312	12
	9.3460245	0800434		9-3569821	106420120		10.01.00554	10.6539755	
49 50	9.3465794	9.9890424		9.3575658	10,6430,179 10,6424342		10.0179576 10.0109363	10.6534206	11
-51	9.3471336	9.9889849		9.3581487	136418513		10.0110151	.10,6528664	9
52	9.3476879	9.9889560		9.3587310	10.6412693		10-0110440	10.6523130	•
53 54	9.34823 9 7 9°3487917	9.9889271 9.9888982	•	9.359512 6 9.3598935	10.6406874 10.6401065		10.0110723	10.6517603	7
74	y 340/91/	y,y000y01	. ;	((6,4(6,4			101011010	12003	6.
55	9.3493429	9-9888693		9 3624736	10,6395264	: , !	10.0111307	10.6506561	5
56	9.3498934	9.9888403		9.8610531	106389469	·	10.0111597	12.6501066	4
57	9.3504432	9.9888113 9.98 87822	1	9-3616319 9-3622100	10-638 368 2 10-6377900		10.0111887 10.0112178	10.6495568	3 2
58 59	9-3509622 9-3515405	9.9887531		9,3627874	19.6372126		10:0112170	10.6484595	1
. 65	9.3520580	9.9887239		3.3633611	10,6366359		10.0112761	126479120	0
-7	L. Co-Siue.	L. Sine	<u> </u>	L. Co Cang.	L. Tangent		L.Co-Secant.	L. Secant.	M
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1.			N (1 11 1			GREES.		' Of Vacant 1	N Co- Secant	
1.	M	N Sine.	N. Co-Sine.		N. Langent.		.			401
	0	2249511	9743701	,	,2308682	43314759	`	10263039	44454115	60
1	1	2252345	9743046		2311746	43257347		10263729	44398176	: 58
ı	2	2255179	9742390	.	2314811	43200079	- 1	10264420	44342382	- 58 - 57
1	3	2258013 2260846	9741734	. 1	2317876	43142955		10265865	44231224	56
	4	2263680 2263680	9741077		23 2 0941 23 24 00 7	43085974 43029136	- 1	10266499	44175859	55
ı	5	2266513	9747419 9 7 39760		2327073	42972440	1	10267194	44120637	54
1.	_		7/39/00			1777-110	1			
I	7	2269346	9739100		2330140	42915885		10267890	44065556	53
. 1	7 8	2272179	9738439		.2333207	42859472		10268587	44010616	52
	9	2275012	9737778		2336274	42803199		10269284	43955817	51
ł	10	2277844	9737116		2339342	42747066		10269982 102706 8 1	43 9 01158 43 8 46638	50 49
1	11	2280677 2283509	.9736453		2342410	42691072 42635218		10271381	43792257	48
1	12	22037.9	9735789	1	2345479	4505)510				
t	7.	2286341	9735124	+	2348548	42579501		10272082	43738015	47
I	13	2289172	9734458		2351617	42523923	١.	10272784	43683910	46
ı	15	2292004	9733792		2354687	42468482 .	`	10273487	43619943	45
1	16	2294835	9733125		2357758	42413177		10274191	43576113	44
	17	2297666	9732457		2360829	42358009		10274896	43522419	43
	, 1 8	2300497	9731788	,	2363900	42302977		10275602	43468861	42
ŀ		2202228	07011.0	1	22660=2	42248080	•	10276309	43415438	41
	.19	2303328 2300159 r	9731118		2366972 2370044	42193318		10277017	43362150	40
	20	2308989	9730448		2373116	42138690		10277726	43308996	39
·t	21	2311819	9729777 9729105		2376189	42084196		10278436	43255977	38
ł	22	2314649	9728432	•	2379262	42029835		10279147	43203090	37
1	23 24	2317479	9727758		2382336	41975606		I: 27 9859	43150336	36 1
٠L				•						-
.1	25	2320309	9727084		2385410	41921510		10280572	43097715	35
1	26	2323136 .	9726409	:	2388485	41867546		102812001	42992867	34
1	27	2325967	9725733		2391560	41813713	l	10282717	42940640	33 32
1	28:	2328796	9725056		2394635	41760011		10283434	42888543	.31
1	29	2331625	9724378	1	2397711	41706440 41652998	·	10284152	42836576	30
	30	2334454	9723699	:	2400787	41072990				
t		2337282	9723019	:	2403864	41599685		10234871	42784738	29
- 1	31	2340110	9722339	'	2406941	41546501		10285591	42733029	. 28
	32	2342938	9721658	. 1	2410019	41493446	l	10286312	42681449	27
	34	2345766	9720976		2413097	41440519	1	10287034	42629996	26
	35	: 2348594	9720293		2416176	41387719	•	10287757 10288484	42578671	25
1	36	2351421	9719609		2419255	41335046	ĺ	13203469	42527474	24 !
ŀ			2218224		2400204	41282499		10289206	42476402	23
ı	37	2354248	9718925	ļ	2422334 2425414	41230079	, ·	10289932	42425457	22
ł	37 38;	2357075	9718240		2428494	41177784	ļ	10290658	42374637	21
	39	2359902 .2362729	9716867		2431575	41125614	ŀ	10291385	42323943	20
-]	40	2365555	9716179		2434656	41073569	ŀ	10292113	42273373	19
- ;	41	2368381	9715491	١.	2437737	41021649	ł	10292842	42222928	18
	42		 			1000000	1	102024	10170606	7.7
· `	'43	2371297	9714802	1	2440819	40969852	1	10293572	42172606	17
,	44	12374033	9714112	:	2443901	40918178 40 866627	1	10294303	42072333	15
•	45	:2376859	9713421	f	2446984	40800027	1.	10295768	42022380	.14
•	÷ 46;	2379684	9712729		2450057	40763892	1	102965.02	41972549	13
*	47	2382510 2385335	9712036		2453151	40712707	[10297237	41922845	-12
	48	-2307337	9/24343				4		•	1-
	'49	2388159	9710649	1 5	2459320	40661643		10297973	41873252	711
1	150		9709954		2462405	40610700		10298710		10
í	. 51	2393808	9709258		2465491	40559877	1	10299448	41774438	. 9 8
	52	2396633	9708561	l i	2468577	40509174	1	10300187 10300927	41676102	7
	5 3	2399457	9707863	1	2471663	40458590	1	10301668		6
•	. 54		9707165		2474750	40408125	.[1	-	-
į		a since	1 0706466	1	2477837	49857779	1	10302410	41578243	.5
1	1 55		9706466		2480925	40807550	1	10303153	41529491	4
	. 56 . 27		9705700	1	2484013	40257440	1	10303897	41480856	3
	· 57 - 58		9704363		2487102	40207446	1	10304542	41432339	
	- 50 1 - 59	2416396	9703660	1	2490191	40157570	1	10305388		
	60	1	9702957		2493280	40107809	. I	10306135		- - 9
	1	N Co-Sine		1	N .Co-Tang		1	N. Co-Secant.	N. Secant.	M
	1-				. 76 DE	GREES.		. 4.		
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1		_		13 D I	GREE	S _*			
M	L. Sine.	L. Co-Sine	L	Tangent	L. Co. Sang.	1	L. Secant.	L Co-Sec.ant	
0	9.3520880	9.9887239	9.	3633641	10.6366359		10.0112761	10.6479120	50
	9.3526349	9.9886947	0.	3639401	10.6360599		10,0113053	12.6473651	
I 2	9.3531810	9.9886655	ó.	3645155	10.6354845		10.0113345	10.6468190	59
1 1	9.3537264	9.9886363		3650901	10.6349099	1	10.0113637	10.6462636	58
3	9.3542710	9.9886070		3656641	10.6343359		10.0113030	10.6457293	57
4	9.3548150	9.9885776	6.	3662374	10.6337626		10.0114224	10.6451850	56
5	9.3553582	9.9885482	9.	3668100	10.6337900	:	10,7114518	10.6416418	55
	7.5775700		-				444 2004 7 2 4		74
7	9.3559149	9.9885188	9.	3673819	10.6326181		10.0114812	10.6440993	53
7 8	9-3564426	9 9884894		3679532	10.6320468		10:0115106	10.6435574	52
9	9.3569336	9.9884599		3585238	136314762		10-0115401	10.6430164	ŚI
10	9.3575240	9.9884303		3690937	10.6309063		10.0115697	10.6424760	50
71	9.3580637	9.9884008		3696629	10.6303371		10.0115992	10.6419363	49
12	9.3586027	9.9883712	9.	3742315	10:6297685	·	10-0116288	10.6413973	48
		- 00			10 (000)		10000	(10)	
13	9.3591409	9.9883415		3707994	10.6292006	i	10.0116585	10.6408591	47
14	9.3596785	9.9883118		3713657	10.6286333	•	10.0116882	10.6403215	46
15	9.3602154	9.9882821		3719333	10.6280667		10.0117179	10.6397846	45
16	9.3607515	9.9882523		3724992	10.6275008		10.0117477	10.6392485	44
17	9.3612870	9.9882225		3730645	10.6269355	'	10.0117775	10.6387130	43
18	9.3618217	9.9881527		3736291	10.6263709		10.0118073	10.5381783	42
	9.3623558	9.9881628	0.	3741930	10.6258070		10.0118372	10.6376442	<u> </u>
19	9.3628892	9.9381026		3747563	10.6252437		10.0118671	10.6370442	41
20	9.3634219	9.9881029		3753190	10.6246810		10.0118071	10.6365781	40
21	9.3639539	9.9880729		3758810	13.6241190		10.0119271	10.6360461	39
22	9.3644852	9.9880429		3764423	10.6235577		10.0119571	10.6355148	38
23	9.3650158	9.9880128		3770030	10.6229970		10.0119872	10.6349842	37 36
24	\								30
25	9.3655458	9.9879826	9.	377 5631	10.6224369		10.0120173	10.6341542	25
26	9.3660750	9.9879525		3781225	10.6218775		10.0120475	10.6339250	35 34
27	y.3666036	9.9879223		3786813	10.6213187		10,0120777	10.6333954	33
28	9.3671315	9.9878921		3792394	10.6207606		10,0121079	10.6328635	32
29	9.3676587	9.9878618		3797969	10.6232031	1	10,0121382	10.6323413	31
30	9.3681853	9.9878315	9	3803537	10.6196463	Į	10-0121685	10.6318147	30
1	- 460	0-0-0		20222	10 (4)	ł	70.000.00		
31	9.3687111	9.9878012		3800100	13.6190900	ł	10-0121988	10.6312889	29
32	9.3692363	9.9877708		3814655 38 2020 5	10.6185345		10.0122292	10.6307637	28
33	9-3697608	9.9877404	1 9	3825748	10.6179795		10.0122596	10.6302392	27
34	9.3702847	9.9 ⁸ 77099 9.9 ³ 76794		3831285	10.6168715	١.	10.0122901 10.0123706	10.6297153	26
. 35 . 36	9.3713304	99376794		3836816	10-6163184		10.0123512	10.6286696	25
30	7.37-33-4	990/0400				:		10.0230050	24.
1	9.3718523	9.9876183	.وا	3842340	10.6157660	l	10.0123817	10.6281477	•
37	9-3723735	9.9875876	ِوَ ا نوا	3847858	10.6152142		10.0124124	10.6276265	23 22
38 39	9.3728940	9.9875570	9.	38533 7 0	10.6146630		10.0124430	10.6271060	21
40	9-3734139			38588 76	10.6141124	l	10.0124737	10.6265861	20
41	9-3739331	9.9874955	9.	3864376	10.6135624	1	10.0125045	10.6267669	19
42	9.3744517	9.9874648	9.	3869869	10.6130131		10.0125352	10-6255483	18
 		1	-	00-4	1060000	I			
43	9.3749696		š.	3875356	10.6124644	l ·	12.0125661	10.6250304	17
44	9.3754868			3880837	10.6119163		10.0125969	10.6245132	16
45	9.3760034			38 86312 38 91781	10.6113688	ŀ .	10.0126278	10.6239956	15
46	9.3765194			3897244	10.6108219	J .	10.0126587	10.6234806	14
47	9.3770347			3997244	10.0102750	•	10.0126897	10.6229653	13
48	9.3775493	9.9872793		77-2700	10 009/300	i	10:012/20/	10.6224507	12
	9.3780633	9.9872482	0.	3908151	10.6091849	Į.	10-0127518	10.6219367	
49	9.3785767			3913595	10.6086405	l	10.0127829	10.6214233	11
50	9:3790894			3919034	10.6080966	l	10.0128140	10.6209106	10
51	9.3796015	9.9871549		3924466	10.6075534	į .	10.0128451	10.6203985	8
52 53	9.3501129			3929893	10.6070167	1	10.0128764	10.6198871	
54	9.3806237			3935313	10.6064687		10.0129076	10.6193763	7 6
1.7			-			1.		-	
55	9.3811339	9.9870611		3940727	10.6059273	1	10.0129389	10.6188661	.5
56	9.3815434	9.9870298		3946136	10.6053864	1	10,0129702	10.6185366	4
57	9.3821523	9.9869984		3951538	10.6048462	I	10,0130016	10.6178477	3 1
58	9.3826605	9.9869670		•3956935	10.6043065	1	10,0130330	10.6173395	12.
59	9.3831682	9.9869356		.3962326	10.6037674	1	10.0130644	10.6168318	1
60	9.3836752			3967711	10.6032289	1	10-0130959	10.6163248	-
	L. Co. Sine	L. Sine		. Co-Tang.	L.Tangens.		L.Co-Secant.	L. Secant.	M
			. 79	6 DE	GREES.				
1									

A TABLE of Natural and		A	T	Ą	₿	L	E	of	Natural	and
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<u> ۲</u>	30 - A TABLE of Natural and											
, <u> </u>					GREE			• • • • • • • • • • • • • • • • • • • •				
M	N. dine	N. Co-Sine			N. Co-lang.	1	N. Secant	IV Co-Secans.	, 			
-0	2419219	9702957		2493280	40107809		10306135	41335655	60			
-	2422041	9702253		2495370	40058165		10306583	41287487	59			
2	2424863	9701548		2499460	40008636	}	10307632	41239435	58			
3	2427685	9700842		2502551	399592	<u> </u>	17308382	41191498	57			
4 5	2433507 2433329	9700135 9699428		2505642 2508734	39909924 39860739	l	10309885 10309133	41143675	56			
6	2436150	9698720		2511826	39811669	ł	10310638	41048374	55 54			
						Ì						
7 8	2438971	9698011		2514919	39762712	ŀ	10311392	41000893	53			
9	2441792 2444613	9597301 9696590	:	2518012 2521106	39713868 39665137	}	10312147	40953526	52			
10	2447433	9695879		2524200	39616518	1	10313665	40859130	51 50			
11	2450254	9695167		2527294	30568011		10314418	40812100	49			
12	2453074	9694454		2530589	39519615	1	10315177	40765281	48			
13	2455894	9693740		2533484	39471331	Ì	10315936	40718374	47			
14	2458713	9693025		2536580	39423157		10316697	40671677	46			
15	2461533	9692309		2 539676	39375084	1	10317459	40578615	45			
16	2464352 2467171	969159 2 9690875		· 3542733 354587 0	39327141 39279297	l	10318282	40578015	44			
18	2469990	9690157	,	2548968	39281563	ł	10319750	40485992	43 42			
	2.72800	40.40		2412.46		•			<u> </u>			
19	2 172809 2475627	9689438 9688 7 18		4552066 4555165	39183937 39136420	•	10320516	40439844 40393804	4:			
21	2478445	9687998		2558264	30080011	ł	10322050	40347872	40 39			
22	2481263	9687277		2 561363	39041710	†	10322818	40302048	38			
23	.2484087 2487 8 99	9686555	,	2564463	38994516		10323588	40256332	37			
24	2407099	9685832		2567563	38947429	•	10324359	40210722	36			
25	2489716	9685108		2570564	38900448		10325130	40165219	35			
26	2492533	9684383		2573766	38853574		10325903	40119823	34			
27 28	2495350 2498167	9683657 968 2931		3 57 6 868 3 5799 7 0	38806805 38760142	į į	10326676	40074532	33			
20	2500984	9682204		2583073	38713584	ł .	10328227	39984267	32 31			
30	2503800	9681476		2586176	38667131		10329003	39939292	30			
	2506616	9680747		2589280	38620782		10329781	39894421	-			
31 32	2509432	9680018		2592384	38574537		10330559	39849654	· 29			
33	2512248	9679288		2595488	38528396		10331339	39804991	27			
34	2515063° 2517879	9678557		\$598593	38482358		10332119	39760431	26			
35 36	2520694	9677825 9677 0 92		2601699 260480 5	384364 24 38390591		10332901 103336 ⁹ 3	39671621	25 24			
				-								
37 38	2523508	9676358	1	2607911	3834486z		10334467	39627369	23			
38 39	2526323 2529137	9675623 9674888		4611018 4614126	38299233 38253707		10335251	3958 3219 39539171	22 21			
40	2531952	9674152		2617234	38208281		10336823	39495224	20			
41	2534766	9673415		2620342	38162957		10337611	39451379	19			
42	25 37579	9672677	}	2623451	38127733	}	10338399	39407633	18			
43	2540393	9671938		2626567	38072609		10339188	39363938	.17			
44	2543206	9671199)	4 629670	38027585		10339979	39320443	16			
45	2545019 2548832	9670459 9669718		2632780 2635891	37982661 37937835		10340770	39276997	15			
46 47	2551645	9568976		2639002	37937935 37893109		€0342356	39190403	14			
48	2554458	9668233		2642114	37848481		10343151	39147254	12			
	2557270	0667400		2645226	37803951	ł	10343946	39104203	F			
49 50	2557270 2560082	9667 490 9666746		4648339	37759 5 19	ŀ	10344743	39061250	10			
51	2562894	966600 L		2651452	37715185	ļ ·	10345540	39018395	9			
52	2565705	9665255		2654566	37670947		10346338	38975 ⁶ 37 3893 29 76				
53 54	2568517 2571328	9664508 96637 6 0		2657680 2660794	37626807 37582763	ŀ	10347138	38390411	7 6			
74		7505/05	. 1	*	,—— ,	Ī						
55	2574139	9663012		2663909	37538815	1	10348740	38847943 38805570	5			
56	2576950	9662263 9661513		2667025 2670141	37494963 37451207	İ	10349542	38763293	4 3			
57 5 8	2579760 25825 7 0	9660762		2673257	37407546	1	10351150	38721112	2			
59	2585381	9660010		2676374	`37363980	ł	10351955	38679025	1			
65	2588190	9659258	ł	2679492	37320508	•	10152762	38637033	-0			
	N Co-Sine.	N. Sine.	ا 	N Co Tang.	N. Tangent.		N. Co-Secant	N. Secant	M			
<u> </u>	, , , , ,			75 DE	GREES),						

) —			14 D	EGREE	S.			
M	L. Sine.	L. Co-Sine	L. Tangent	L. Co. Tang.	1	L. Secant.	L. Co-Secant	
0	9.3836752	9.9869041	9.3957711	10.6032289				·
					i i	10.0130959	10.6163248	
I	9.3841815	9.9868726	9.3973089	10.6026911		10.0131274	10.6158185	59
2	9.3846872	9.9868410	9.3978463 9.3983830	10.6021537		10.0131590	10.6153127	59 58
3	9.3851924 9.3856969	9.9868094	2 3 3 8 9 1 9 1	10.6010170		10.0131906	10.6148076	
4	9-3862008	9.9867778 9.9867461	9.3991517	10.6005453	Ĭ	10.0132222	10.6143031	,
5	9.3867040	9.9867144	9.3999895	10.6007104		10.0132539	10.61 37992	
	913007040	9.900/144	75777-90	10.005 7104		10.7132650	10.6132960	54
7	9.3872067	9.9866827	9-4005240	16.5994760		10.0133173	10.6127933	10
7 8	9.3877087	9:9866509	9.4010578	10.5989422		10.0133491	10.6122913	53 52
9	9.3882101	9.9866191	9.4015910	13.5984090		10-0133879	10.6117898	51
10	9.3887109	9.9865872	9.4021237	10.5978763	1	1.00134128	10.6112891	50
71	9-3892111	9.9865553	9.4026558	10.5973442		10.0134447	10.6107880	49
12	9.3897106	9.9865233	9-4031873	10.2968127		10-0134767	10.0103804	48
		- 01	- 1-0- 00	100.0		-	-	
13	9-3902096	9.9864913	9.4037182	10.5962818		10.0135087	10.6097904	47
14	9.3907079	9.9864593	9.4042486	10.5957514		10.0135407	10.6092921	46
15	9'3912057	9.9864273	9.1047784	10.5952216		10.0135727	10.6087943	45
16	9-3917028	9.9863952	9.4053076 9.4058363	10.5946924		10.0136048	10.6082972	44
17	9-3921993 9-3926952	9.9863630 9.9 86 3308	9.4063644	10.5941637		10.0136370 10.0136692	10.6078007	43
12	9.5920972	2.7003300	3-7-03041	101930370		20.0130092	10.6073048	42
	9.3931975	9-9862986	9.4068919	10.5931081		10.0137014	10.6068005	
19	9.3936852	9.9862663	9.4074189	10.5925811		10.0137337	10.6063148	41
20 21	9.3941794	9.9862347	9.4079453	10,5920547		10 0137660	10 6058206	40
22	9.3946729	9.9862017	9.4084712	125915288		10.0137983	10.6053271	39
23	9.3951658	9.9861693	9.4089965	10.5910035	!!	10.0138307	10.6048342	38
24	9.3956581	9.9861365	9.4095212	10.5914788	l 1	15.0138631	10.6043419	37 36
		,			1 1		134.7	30
25	9.3961499	9.9861045	9.4100054	10.5899546		10.0138955	10.6038501	35
26	9.3966410	9.9860720	9.4105693	10.5894310		10.0139280	10.6033500	34
27	9.3971315	9.9860394	9.4110921	10.5889079	1	10.0139606	10-6028685	33
28	9.3976215	9.9862069	9 41 16146	10.5883854	1	10.0139931	10-6023785	32
29	5'3081100	9.9359742	9.4121366	10.5878634	1	10.0140258	10.6018891	31
30	9.3985996	9.9859416	9-4126581	10.5873419	1	10-0140584	10-6014004	30
		2 2842080	0-4171790	10.5868211		50.0110011		
31	9.3990878	9.9859089	9-4131789 9-4136993	10.5863007		10.0140911 10.0141238	10 6009122	29
32	9.3995754 9.4000625	9.9858434	9.4142191	10.5857809		10.0141566	10.6004246	28
33	9.4005489	9.9858106	9.4147383	10.5852617		10 0141894	10.5999375	27
34	9.4010348	9.9857777	9.4152570	10.5847430		10-0142223	10,5989652	26
35 36	9.4015201	9-9857449	9.4157752	10-5842248		10.0142551	10.5984799	25
30							77,4777	24
37	9.4020048	9.9857119	9.4162928	10.5837072		10-0142881	10.5979952	23
38	9.4024889	9.9856790	9.4168099	10.5831901		10.0143210	10.5975111	22
39	9.4029734	9.9856460	9,4173265	10.5826735		10-0143540	10.5970276	
40	D.4034554	9.9856129	9.4178425	10.2821222		10-0143871	10.5965446	20
41	9.4039378	9.9855798	9.4183580	10.5816420		10.0144202	10.5960622	19
42	9.4044196	9.9855467	9.4188729	10.5811271		10.0144533	10.5955804	18
 -	45.555	0000000	9.4193874	10.5806126		12014494	10.45	
43	9.4049009	9.9855135 9.9854803	9.41930/4	10.5300120		10.0144865	10.5950991	17
44	9.4053816	9.9854471	9.4204146	10.5795854		10.0145197	10.5946184	16
45	9.4058617		9.4209275	19.5790725		10.0145329	10.5941383	15
46	9.4063413 9 4068 2 03	9.9853805	9.4213398	10.5785602		10.0146195	10.5936587	14
47 48	9.4072987	9.9853471	9.4219515			10.0146529	10.5931797	13
40	7-40/-90/	177777	•	1				12
49	9-4077766	9.9853138	9.4224528	10.5775372		10-0146862	10.5922234	·
50	9.4082539	9.9852803	9.4229735	10.5770265		10.0147196	10.5917461	11
, 5 I	9.4087306	9.9852468	9.4234838	10.5765162		10.0147532	10.5912694	
52	9.4092068	9.9852133	9.4239935	10.5760065		10.0147867	10.5907932	8
*53	9.4096824	9.9851798	9.4245026	10.5754974	[. i	10.7148202	10.5903176	7
54	9 4101575	9.9851462	9.4250113	105749887		10.0148538	10.5898425	6
			4644	20.5711016				
55	9.4106320	9-9851125	9.4255194	10.5744806		10.0148875	10.2893680	5
56	9.4111059	9.9850789	9.4260271	10.5739719		10,0149211	10.5888941	4
57	9.4115793	9.9850452	9.4265342	10.5734658	1 1	10.0149548	10.5884207	3
58	9.4120522	9.9850114	9.4270408 9.4275469	10.5729592) [10,0149886	10.587,478	2
59	9.4125245	9.9849776	9.4280525	10.5724531	1 1	10.0150224	10.5874755 10.5870038	I
60	9.4129962	9:9849438	L. Co-Tang.		! I	L.Co-Secant.		·-
I	L. Co-Sine	L. Sine				Co-Secant.	L. Secant.	M
			75 DE (GREES.				

A TABLE of Natural and

32	-		A	CABLE	of Nat	ural	and	•	
					EGREE	S			
177	N. Sine	N. Co-Sine	1		N. Co-Tang.	-	N. Secant.	UV Co-Secans.	
. 0	2588190	9659258	1	2679492	37320580	_	10352762	38637023	6 0
4 1	2591000	9658505	١.	2682610	37277131	1	10353569	38595135	. 59
2	2593810	9557751	l	2685728 2688847	37233847		10354378	38553332	' 5 8
3 4	2596619 2599428	9656996 9656240		2691967	37190658 37147561	١,	10355998	38511622	57
. 5	2502237	9655483	1.	2695087	37104558	į '	10356809	38428482	56
6	2605045	9654726	i	2698207	37061648	1	10357621	38387051	54
1		(1)	ŀ			1			
7 8	2607853 2610661	9653968 9653209	l	2701328	37018830	Į.	10358435	38345713	. 53
9	2613469	9652449	'	2704449 2707571	36976103 36933469	ł	10359249 10360065	38304467 38263313	52
10	2616277	9651688	l	2710693	. 36890927	l	10360831	38222251	5I 50
11	2619085	9650927	i	2713816	36848475	ł	10361699	38181280	49
12	2621892	9650165		2716940	36806115	l	10362517	38140399	49 48
	2624699	2642422		2720064	26262044	1	10363337	38099610	
13	2024099	964940 2 9643 6 38		2723188	36763845 36721665	İ	10303337	38058911	47
15	2630312	9647873		2726313.	36679575	1	10364979	38018301	46
16	2633118	9617107	:	2729438	36637575	i	10365801	37977782	44
17	2635924	9646341	1	2732564	36595565	l I	10366525	37937352	43
18	2638730	9645574		2735690	36553844	I .	10367449	37897017	42
	2641536	9644806		2738817	36512111	1	10368275	37856760	1
19 20	2544342	9644037	:	2741944	36470467	1	10369101	37816596	41
21	2647147	9643257	:	27450 72	36428911	1	10369929	37776522	40 39
22	2649952	9642497	:	2748201	36387444	1	10370757	37730535	38
23	2652757	9641726	•	2751330	36346064	l .	10371587	37696536	37
24	2655561	9640954		2754459	36304771		10372457	37656824	36
25	2658365	9640181		2757589	36263566	1:	10373249	37617100	
26	2661160	9639407	,	2760719	36222447		10374082	37577462	35 34
27	2663973	9638633		2763850	36181415	1	10374915	37537911	33
28	2666777	9637858	ì	2766981	36140469		10375750	37498447	32
29	2669581	9637082		2770.113	36099609	1	10376585	37459068	.31
30	2672384	9636305		2773245	36058835	,	10377422	37419775	30
31	2675187	9635527		2776378	36018146		10378200	37380568	29
32	2677989	9634748		2779512	35977543	ŀ	10379098	37341446	28
33	2680792	9633969		2782646	35937024		10379938	37302409	27
34	2683594	9633189		2785780	35896590		10380779	37263457	26
35	2686396 2689198	9632408		2788915	35856241		10381621	37224589	25
36	2009190	9631626		2792050	35815975		10382463	37185805	24
37	2692000	9630843		2795186	35775794		10383307	37147105	23
38	26 94801	9637059		2798322	35735696	l i	10384152	37108489	22
39	2697602	9629275		2501459	35695681		10384998	37069956	21
40	2700403	9628490		2804597	35655749		10385844	37031506	20
41	2703204 2706004	9627704 9626 9 17		28 27735 2810873	35615900 35576133		10386692	3699313 9 36 9 54854	19
42	2700004	yuzuyi/			3,3,70133		34/741	3°974°74	18
43	2708805	9626130		2814012	35536449		10388391	36916652	17
44	2711605	9625342		2817152	35496846		10389242	36878572	16
45	2714404	9624553		2820292	35457325		10390094	36847493	15
46	2717204	9623763		2823432 2826573	35417886		10390947	36802536	14
47 48	2720003 2722802	9622972 9622180		2829715	35378528 35339251	1	10391800 10392655	3676466 c	13
40									
49	2725601	9621387		2832857	35300054		10393511	36689151	11
50	2728400	9620594		2835999	35260938		10394368	36651518	10
51	2731198	9619800		2839142 284228 5	35221902		10395226	36613964	98
52	2733996 2736794	9618209		2845430	3518 2 946 35144070		10396085 10396945	36576491 36539097	
53 54	2730/94	9613209		2848575	35105273		10397806	36501783	6
				·					
55	2742390	9616616	,	2851720	35066555		10398669	36464548	5
56	2745187	9615818	'	2854866	35027916		10399532	36417392	4
57	2747984	9615019		2858012 2861159	34989 3 56 34950874		10400396 10401261	36353316	3
58	2752781 2753578	9614219 9613418		2864306	34910674		10402127	30316395	2 1
59 65	2756374	9612617		2867454	34874144		10402994	36279553	Ö
	N Co-Sine.	N. Sine.		N Co Tang.	N. Tangent.	i i	N. Co-Secant	N. Secant	M
			<u>'</u>		GREES				1
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					EGREE	S			77
M	L. Sine.	L. Co-Sine		L. Tangent	L. Co. Tang.		L. Secant.	L Co-Sec.ans	
0	9-4129962	9.9849438		9.4280525	10-5719475	Í	10.0150562	10.587003	
1	9-4134674	9.9849099		9.4285575	10.5714425	i	10.0150901	10.5865326	59
2	9.4139381	9.9848760		9.4290621 9.4295661		Ì	10.0151240	10.5300010	
3	9°4144082 9°4148778	9.9848420 9.9848081		9.4295001	10.5704339 10.5699303	1 .	10.0151580	10.5855918	
4	9-4153468	9.9847740		9 4305727	10:5694273		10.0151919	10.5845532	56
5	9.4158152	9.9847400		9.4310753	10.5689247	9	10.2152600		, ,,,
	-							7.4.0.40	54,
7	9.4162832	9.9847059		9.4315773	10.5684227		10.0152941	10.5837168	53:
7 8	94167506	9 9846717		9.4320789	10.5679211		10-0153283	10.5832494	52,
9	9-4172174	9.9846375		9-4325799	10.5674201	,	10.0153625	10.5827826	źΙ
10	9-4176837	9.9846033		9.4330804	10.5669196	:	10.0153967	10.5823163	50
11	9.4181495	9.9845690		9.2335805	10.5664195	·	10.0154310	10.581850	49
12	9.4186148	9 9 8 4 5 3 4 7		9-4340800	10.2629200		10-0154653	10.581385	48.
	9.4190795	9.9845004		9.4345791	10.5654209		10.0154996	10.5809205	
13	9.4195436	9.9844660		9.4350776	10.5649224		10.0155340	10.5804564	47
14	9-4200073	9.9844316		9.4355757	10.5644243		10.0155684	10.5799927	46
16	9.4204704	99843971	٠,	9.4360733	10.5639267		10.0156029	10.5795296	45
17	9.4209330	9.9843626		9.4365704	10-5634296		10.0156374	10.5790670	44
18	9.4213950	9.9843281		9.4370670	10.5629330		10.0156719	10.5786050	
[
19	9.4218566	9.9842935		9.4375631	10.5634369		10.0157065	10.5781434	41
20	9.4223176	9.9842589		9.4380587	10.5619413		10.0157411	10.5776824	40:
21	9.4227780 9.4232380	9.9842242		9.4385538	10.5614462 10.5609515		10 0157758	10.5772220	39
22	9.4232360	9.9841895 9.9841548		9 ·4390485 9· 4395426	10.5604574		10.0158105	10.5767620 10.5763026	38
23	9.4241563	9.9841200	,	9-4400363	10.5599637		10.0158800	10.5758437	37
24	J.4040,05	9.9041200		7.7700303	2017779037			10.5750437	36
25	9.4246147	9.9840852		9.4405295	10.5594705		10.0159148	10.5753851	
26	9.4250726	9.9840503		9.4410222	10.5589778		10.0159497	10-5749274	35 34
27	9-4255299	9.9840154		9.4415145	10.5584855		10.0159846	10-5744704	33
28	9.4259867	9.9839805		9.4420062	10.5579938		10.0160195	10.240133	32
29	9.4264430	9.9839455		9.44 24975	10.5575025	l	10.0160545	10.5735570	31
. 30	9-4268988	9.9839105		9-4429883	10.5570117	:	10-0160895	10.5731012	30;
	9*4273541	9.9838755		9-4434786	10.5565214	(.	10-0161245	10.5726459	
31 32	9-4278085	9.9838404		9.4439685	10.5560315	ł	10.0161596	10.5721911	29 28
33	9-4282631	9.9838052		9.4444579	10.5555421	1.	10.0161948	10.5717369	
34	9-4287169	9.9837701		9.4449468	10.5557532		10-0162299	10.5712834	26
35	9.4291701	9.9337348		9.4454352	10.5545648	l	10.0162652	10,5708299	25
. 36	9.4296228	9.9836996		9-4459232	105540768	ļ.	10,0163004	10.5703772	24
	9.4300750	2006612		9.4464107	10 5625802	1	100160045	10.5600055	-
37 38	9-4305267	9 9836643 9.9836290		9.4468578	10.5535893		10.0163357	10.5699250 10.5694733	2 1
	94309779	9.9835936		9.4473843	10.5526157		10.0164064	10.5690221	}
1 39	9.4314286	9.9835582		9.4478704	10-5521296		10 0164418	10.5685714	21
41	9.4318788	9.9835227		9.4483561	10.5516439		10-0164773	10.5681212	
42	9.4323285	9.9834872		9.4488413	10.5511587		10.0164128	10.5676715	19
									نتسا
43	9-4327777	9.9834517		9.4493260	10.5506740		120165483	10.5672223	17
44	9.4332264	9.9834161		9.4498102	10.5501898	٠	10.0165839	10.5667736	1 168
45	9.4336746	9.9833805	; ·	9.4502940 9.4507774	10.5497060	\ :	10:0166195 10:0166551	10.5663254	/ [
46	9.4341223 9.4345694	9.9833449 9.9833092	i"	9.4512602	10,5492220		10.0166908	10.5658777	14
· 47	9.4350161	9.9832735		9.4517427	10-5482573		10.0167265	10.5654306	> 1
40		122211			- 22 200			XC24503X	12
49	9.4354623	9.9832377		94522246	10.5477754		10.0167623	10-5645377	11
. 50	9.4359980	9.9832019	,	94527061	195472939	·	10-0167981	10.5640020	10
: 51	94363532	9.9831661		94531872	10.5468128	•	10-0168339		0
, 52	9.4367980	9.9831302	.	94536678 94541479	10.5463322	[]	100168698	10-5632020	8
53	9.437242 2 9.4376850	9.9830942 9.9830583	i	914546276	10.5458521	۱ ۰	10.0169058	10-5627578	• • •
54	9,45/0050	3.3.3.3.3		7,7,404/0	105453724		10.0160417	10.5623141	6
55	9.4381292	9.9830223		914551069	10.5448931	ŀ	10.0169777	10.5618705	
. 56	9.4385719	9.9829862	!	914555857	105444143	Į :	10.0170138	17.5614281	- 5
57	9.8390142	9.9829501	;	314560641	105439359	i .	10.0170499	10.5609858	4
- 58	9.4394560	9.9829140	: 1	914565420	105434580	1	10.0170860		2
59	9.4398973	9.9828778	,	914570194	10,5429805	ì	10.0171222	10.5601027	. 1
60	9-4403381	9.9828416	•	9'4574964	195425036	l ;	10.0171586	10.5596619	ō
	LCo Sine	L. Sine		L. Co-Tang.	L. Tangent.		L.Co-Secant.	L. Secant.	M
L				74 -D.E	GREES				

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1-	N O'-	M.C. C.			REES.		At December	N.C. Passel	
M	N Sine.	N. Co-Sine.	1 1	N. Tangent.	N. Co-Tang.		N. Secant.	N Co- Secant	<u> </u>
0	2756374	9612617		2867454	34874144		19402994	36279553	60
	2759170	9611815		2870602	34335896		10403863	36242788	59
2	2761965	9611012		2873751	34797726		10404732	362 6101	58
3	27647¢1	9610208		2876900	34759632		10405602	36169490	57
4	2767556	9609403		2880050	34721616		10406473	36132957	56
5	2770352	9608598		2883201	346§367 6		10407346	36096501	55
6	2773147	9607792		2886352	34645813		1040/340	3606012	
	2//3-4/	700//92		2000572	34047013		10400219	3000012	54
1 ,	2771941	9606985		2889503	34608026		10409.94	36023818	
7 8	2778736	9676177		2892655	34570315	Ï	10409969	35987590	53 52
	2781530	9605368		2895808	34532679		10410845	35951439	
9	2784324	9674558		2898961			10411723		51
10 11	2787118	9603748		2902114	34495120		10412601	35915363	50
12	2789911	9602937		2905268	3445 7 63 5 344 202 26		10413481	35879362 35843437	43
	-7/-99-2	9-4-757			34420220		10415411	37043437	48
	2792704	9602125		2908423	34382891		10414362	35807586	
13	2795497	9601312	•	2911578				35771810	47
14	2798290	9600498		2914734	3 4345631 34308446		10415243	35736108	46
15 16	2801083	9599684		2917890			10416126	35700481	45
	2803875	9598869		2921047	34271334		10417894		44
17 18	2806667	9598053		2924205	34234297		10418780	35664928	43
1_'		2190073		-7-7-07	34197333		-5410/00	35629448	42
	2809459	9597236		2927363	24160442		IOAIOAA-	200000	
19	2812251	9597230		292/303	34160443		10419667	35594042	41
20	2815042	9595600		2933680	34123626	1	10420554	35558710	40
21	2817833	9595000		2936839	34086882		10421443	35523450	38 39
. 22	2820624	9594781			34050210		10422333	35488263	
23	2523415	9593961		2939999 2943160	34013612		10423224	35453149	37
24	2323417	9593140		2943100	33977085	,	10424116	35418107	36
	2826205	2400018		2046221	20040604		1040404.0	2400	
25	2826205	9592318		2946321	33940631		10425009	35383138	35
26	2828995	9591495		2949483	33904249		10425903	35348240	34
27	2831785	9590672		2952645	33867938		10426798	35313414	33
28	2834575	9589848		2955808	33831699		10427694	35278660	32
29	2837364	9589023		2958971	33795531		10428591	35243977	31
30	2840153	9588197		2962135	33759434		10429489	35209765	30
31	2842942	9587370		2965299	33723403		10430388	35174824	29
32	2945731	9586543		2968464	33687453		10431289	35140354	28
33	2848520	9585715		2971630	33651568		10432190	35105954	27
34	2851308	9584886		2974796	33615753		10433092	33071625	26
35	2854096	9584056		2977962	33580008		10433995	35037365	25
36	2856884	9583225		2981129	33544333		10434900	35003175	24
-									
37	2859671	9582394		2984297	33508728		10435805	34969055	23
38	2862458	9581562		2987465	33473191		10436712	34935004	22
39	2865245	958c 729		2990634	33437724]	10437619	34901023	21
40	2868032	9579895		2993803	33402326		10438528	34867110	20
41	2870819	9579060		2996973	33366997		10439437	34833267	19
42	2873605	9578225		3000144	33331736		10440346	34799392	18
1			l l						
43	2876391	9577389		3003315	33296543		10441259	34765785	17
44	2879177	9576552	i i	3006486	33261419		10442172	34732146	16
45	2881963	9575714		3009658	33226362		10443086	34698576	15
46	2884748	9574875		3012831	33191373		19444001	34665037	14
47	2887533	9574035		3016004	33156452		10444917	34631673	13
48	2890318	9573195		3019178	33121598		10445833	3459826,	12
									1
49	2 893103	9572354		3022352	33085811		10446751	34564969	11
50	2895887	9571512		3025527	33052091	.	10447670	34531735	10
51	2898671	9570669		3028703	33017438	1	10448590	34498568	9
52	2901455	9569825		3031879	32982851		10449511	34465467	: 8
53	2974239	9568981		3035055	32948330		10450433	34432433	7
54	2907022	9568136		3038232	32913876		10451257	34399465	6
			Ť						
55	2909805	9567290		3041410	32879487		10452281	34366563	5
56	2912588	9566443		3044588	32845164		10453206	34333727	4
57	2915371	9555595	l,	3047767	32810907		10454132	34300956	3
58	2918153	9564747	ĺ	3050946	32776715	I	10455060	34268251	2
60	2927935	9563898	1	3054126	32742588	Ī	10455988	34235611	1
69	2923717	9563048	· ·	3057307	32708526	l	10456918	34203036	0
1	N. Co. Sine.	N. Sine.		N.Co-Tang.	N. Tangent	. .	N. Co-Secant.	N. Secant.	M
 	121.00 3	1 211 01/161	<u> </u>			<u> </u>			
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M L. Sine. L. Co. Sine. L. Tangent L. Co-Tang. L. Seeant. L. Co-Secant 9.4407184 9.9828416 9.4579730 10.5425036 10.0171584 10.5596619 10.94407184 9.9827691 9.458491 10.5415509 10.0172309 10.5587818 3.94416576 9.9827328 9.4589243 10.5415509 10.0172672 10.5587818 4.94429965 9.9826606 9.4594001 10.5405999 10.0173036 10.5587818 5.94425728 9.9826606 9.4598409 10.5405999 10.0173036 10.55770272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.017364 10.5570272 10.5387033 10.0174494 10.5557163 10.94447197 9.9824774 9.4617697 10.5382303 10.0174860 10.5557163 10.94447197 9.9824774 9.4622423 10.5377557 10.0175226 10.5552803 10.017599 10.5544096 10.9446491 9.9823306 9.4627145 10.5363424 10.0176926 10.5534096 10.9446491 9.9823306 9.4658690 10.5389310 10.017694 10.5536741 10.9447586 9.9823306 9.4658690 10.53849310 10.0177629 10.5534091 10.977799 10.5526741 10.9447586 9.9822938 9.4658690 10.5349310 10.0177621 10.5526741 10.9447586 9.9822938 9.4658690 10.5349310 10.0177931 10.5526741 10.5526741 10.9447586 9.9822938 9.4658690 10.5349310 10.0177692 10.5536091 10.9177431 10.55224414 10.0177999 10.5526741 10.5526741 10.9449540 9.9821831 9.4664765 10.5335235 10.0178508 10.5513773 10.9178908 10.5513773 10.9449540 9.9821092 9.4669488 10.5335552 10.0178908 10.5513773 10.55509460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460 10.55309460	59 58 57 56 55 54 53 52 51 50 49 48
O 9.440381 9.9828416 9.4571964 10.5425036 10.0171584 10.5596619 1 9.4407784 9.9828054 9.4579730 10.5425270 10.0171946 10.5592216 2 9.4412182 9.9827691 9.458491 10.5415509 10.0172309 10.5587818 3 9.4416576 9.9827328 9.4589248 10.5410752 10.0172672 10.5583424 4 9.4420965 9.9826664 9.4598749 10.5405999 10.0173036 10.5779035 5 9.4429728 9.9826600 9.4598749 10.5401251 10.0173400 10.5579035 6 9.4429728 9.9826236 9.4603492 10.5391768 10.0174129 10.5565897 7 9.4434103 9.9825506 9.4612967 10.5387033 10.0174129 10.5565897 8 9.4442837 9.9825140 9.4617697 10.5387033 10.0174494 10.5561528 9 9.4447197 9.9824408 9.4627145 10.5372855 10.0175592 10.5552803	59 58 57 56 55 54 53 52 51 50 49 48
1 9.4407784 9.9828054 9.4579730 10.5420270 10.0171946 10.5592216 2 9.4412182 9.9827691 9.4589248 10.5410752 10.0172309 10.5587818 3 9.4420965 9.9826664 9.4594001 10.5405999 10.0173036 10.5579035 5 9.4425349 9.9826600 9.4598749 10.5401251 10.0173400 10.5574651 10.0173400 10.5570272 7 9.4434103 9.9825871 9.4603492 10.5391768 10.0173764 10.55070272 7 9.4438472 9.9825506 9.4612967 10.5387033 10.0174129 10.5561528 9.4447197 9.9824774 9.4621637 10.5382303 10.0174494 10.5561528 10.94447197 9.9824478 9.4621423 10.5377557 10.0175226 10.5552803 10.94455904 9.9824408 9.4621436 10.5372855 10.0175929 10.5548447 12 9.4455904 9.9824041 9.4631863 10.5368137 10.0176326 10.5534096 11 9.4464591 9.9823306 9.4631863 10.5368137 10.0176326 10.5534096 11 9.4464591 9.9823306 9.4645990 10.5363424 10.0176326 10.5534096 11 9.4464591 9.9823306 9.4645990 10.5354010 10.017694 10.5531073 10.94477586 9.9822201 9.4655386 10.5349310 10.0177622 10.5531073 10.94477586 9.9822201 9.4655386 10.5349310 10.0177621 10.5526741 10.94477586 9.9822201 9.4655386 10.5339922 10.0178593 10.5518091 10.94486227 9.9821831 9.4660708 10.5335235 10.0178538 10.5518773 10.9177599 10.5518091 10.94486227 9.9821462 9.4654765 10.5335235 10.0178538 10.5513773	59 58 57 56 55 54 53 52 51 50 49 48
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I	2926499	9562197		3060488	32674529		104;7848	34170526	59	
. 2	2929280	9561345		3063669	32640596		10123780	34138080	59 58	
3	2932061	9560492		3066851	32606728		10459712	34105699	57	
4	2934842	9559639 9558785		3070034 30 7 3 218	32572924 32539184		10461581	34973352 34041130	56	
5 6	2937623 2940403	9557930		3076402	32505508		10462516	34008941	55 54	
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7 8	2943183	9557074		3079586	32471895		10463453	33976816	53	
	2945563	9556217		3082771	32438346	'	10454391	33944754	52	
9	2948743	9555360		308 5957 308 9143	324048 60 32371438		10465330 1046 627 0	33912755 33880820	51	
10 I 1	2951522 2954301	9554502 9553643		3092330	32338078		10467211	33848948	50 40	
12	2957080	9552783		3095517	32304780		10468153	33817138	49	
13	2959859	9551922		3098705	32271546		10469096	33785391	47	
14	2962638	9551061		3105082	32238373		10473040	33753707 33722084	46	
15 16	2965416 2968194	9550159 9549336		3105082	32205263 32172215		10472936	3,690921	45 44	
17	2970971	9548472		3111462	32139228		10472879	33659026	44	
18	297 3749	9547607		3114653	32106304	1	10473828	33627589	42	
19	2976526	9546742		3117844	32073440		10474777	33596214	41	
20	2979303	9545876	•	3121036	32040638 32007897	1	10475728	33564900 33533647	40	
21 22	2082079	9545009 9544141		3124229 31274 22	31975217	l	10477612	. 33502455	39 38	
23	2984856 29 87 632	9543272		3130616	31942598		10478585	33471324	37	
24	2990408	9542403		3133810	31910039	•	10479540	33440254	36	
						l			-	
25	2993184	9541533		\$137005	31877540	İ	10480496	33409244	35	
26	2995959	9540662		3140 200 3143396	31845102 31812724	l	10481453	33379294 33347405	34 33	
27 28	2998734	9539 79 0 9538 917		3146593	31780426		10483370	33316475	33	
29	3001509 3004284	9538043		3149790	31748147		10484330	33285805	31	
30	3007058	9537169		3152988	31715948		10489291	33255095	30	
	-								 	
31	3009832	9536294		3156186	31683808		10486253 10487217	33224444 33193853	29 28	
32	3012606	9535418		3159385 3162585	31651728 31619706		10489217	33163330	27	
33	3015380 3018 1 53	9534541 9533664		3165785	31587744		10480146	33132847	26	
34 35	3020926	9532786		3168986	31555840		10400113	33102432	25	
36	3023699	9531907		3172187	31523994	l l	1049 1080	33072076	24	
					خندت، صحادت					
37	3026471	9531027		3175389	31492207		10492049	33041778	. 23	
38	3029244	9530146 9529264		3173591 3181794	31400478 31428807		10493019 10493989	32981357	22 21	
39 40	303 2 016 3034 788	9528382		1184998	31397194		10494961	32951234	20	
41	3034/00	9527499		3188202	31365639		10495934	32921168	19	
42	304033E	9526615		3191407	31334141		10496908	32891160	18	
				4 = 4 = =	d		*D40500-	32861209	 -	
43	3043172	9525730 9524844		3194613 3197 8 19	31302701		10497883 10498859	32831316	17 16	
. 44	3045872	9524044		3197019	31271317 31239991		10499836	32801479	15	
45	3048643	9523071		3204232	31239991		10500815	32771700	14	
46	3051413 3054183	9522183		3207440	31177509	ŀ	10501794	32741977	13	
48	3056953	9521294		3210649	31146353	i '	10502774	32712311	12	
				4 2 2 2 4 4			VOCOCTO	32682702		
49	3059723	9520404		3213858	31115254 31084210		10503756	32653149	10	
50	3062492	9 519 514 9518623		3217067 3220277	31064210		10505722	32623652		
51	3065261 3068029	9517731		3223488	31022291		10506706	32594211	8	
. 52 53	3070798	9516838		3220700	30991416	ł	10507692	32564825	7	
54	3073566	9515944		3229912	30960596	l	10508679	32535496	6	
					20-200-	Ī	10509667	32506222		
55	307.6334	9515049		3233125	30929831	l	10510656	32477003	5 4	
56	3079102	9514154	,	3236338 3239552	308991 22 30868468	l	10511646	32447840	3	
57	3081869 3084636	9513258		3239772	30837869		10512637	32418732	2	
5 8	3087463	9511463		3245981	30807325	ł	10513629	323896 8	1	
65	3090170	9510565		3249197	30776835	i	10514622	32360680		
	N Co - Sine.	N. Sine.		N Co Taug.	N. Tangent.		N. Co-Secant.	N. Secant	M	
					GREES					
1				72 DE	GKEES					

_			17 D	EGREE:).		`	<u> </u>
M	L. Sine.	L. Co. Sine.	L. Tangent	L. Co Tang.	,	L. Sesant.	V. C. S.	
	-				l ·		L. Co-Secant	
	9.4659353	9.9805963	9.4853395	10.5146610		10.0194037	10.5340647	60
1	9.4663483	9.9805577	9.4357307 9.4862419	10.5142093		10,0194423	10-5336517	59
. 2	\$.4667609	9.9805190	9.4856928	10.5137581		10.0194810	10.5332391	58.
3	9-4671730	9.9804415	9.4871433	10,5128567]	10.0195197	10.5328270	57
4 5	9.4679960	9.9804027	9.4 75933	10.5124067	1	16.0195973	10-5320040	56°
6	9.4684069	9.9803639	9.4330430	10-5219570	ł	10.0196361	10.5315931	54
			- 00		l			
7	9.4638173	9.9803250	9.4884924	13.5115076	1	10.0195750	10.5311827	53
8	9.4692273	9.3802860	9.4889413 9.4893898	10.5110587	1	10.0197140	10.5307727	52
9	9.4696369 9.4700461	9.9 ⁸ 02471 9.9802081	9.4898330	10.5101620	1	10.0197529	10.5303631	51
10 11	9.4704548	9.9801690	9.4902858	17.5097142	1	10.0198313	10.5299539	50
12	9.4708631	9.9801299	9.4907332	10.5092668	ŀ	10.0198701	10.5291369	49 48
					l			40
13	9.4712710	9.9800908	9.4911802	10 5088198	1	10.0199792	10.5237290	47
14	9.4716785	9.9800516	9.4916269	13.5083731		10.0199484	10,5283215	46
15	9.4720356	9.9800124	9.4920731	10.5079269	1	10.0199876	10.5279144	45
16	9.4724922	9.9799732	9,4925193	10.5074810	l	10-0200268	10.5275078	44
17	9.4728985	9.9799339	9:4929646 9:4938097	10,5070354	l	10,0200661	10.5271015	43
18	9'4733043	9.9798946	7 493009/	10.9065903	1	10.0201054	10.5266957	42
10	9-4737097	9.9798552	9,4938545	10.5061455	l	10.0201448	10.5262903	
19 20	9.4741146	9.9798158	9,4912988	10.5057012	1	10.0201842	10,5258854	41
21	9.4745192	9.9797764	9.4917429	10.5052571	ŀ	10.0202236	10.5254808	40
22	9.4749234	9.9797369	9.4951865	10,5048135	1	10.0202631	10.5250766	39 38
23	9.4753271	9.9796973	9.4956298	10 5043702	1	10.0203027	13.5246729	37
24	9.4757304	9.9796574	9.4960727	10.5039273	Ì	10.0203422	10.5242696	36
			2 4064445		ı			
25	9.4761334	9.9796182	9.4965152	10.5034848		10-0203818	10.5238666	35
26	9.4765359	9.9795785	9.4969;74 9.4973991	10,5030426	١.	10.0204215	10.5234641	34
27	9.4769380	9-9795388	9.4978406	10.5026009	ł	10.0204612	10-5230620	33
28	9-4773396	0.0794991	9.4982316	10.5017184	1	10.0205709	10-5226604	32
29	9.4777409	9.97 94 593 9.9794195	9.4987223	10 5012777		10.0205805	10.5222591 10.5218582	31
30	9.4/01410	9.9/94195	777			20.020,005	1015210507	30
31	9.4785423	9.9793796	9.4991626	10,5008374		10.0206204	10.5214577	29
32	9.4789423	9.9793398	9.4996026	10,5003974		10.0206502	10.5210577	28
33	9.4793420	9.9792998	9-5000122	10,4999578		10.0207002	16.5206580	27
34	9.4797412	9.9792599	9.5004814	10.4995186		10.0207402	10.5202588	26
35	9.4801401	9.9792198	9.5009203	10.4990797		10.0207802	10.5198599	25
36	9.4805385	9.2791798	9.5013588	10.4986412		10.0208202	10.5194615	24
	0.4800266	9.6.701207	9.5017969	13,4982031		10.0208603	10.5100604	
37	9.4813342	9.9750395	9.5022347	10.4977653	. 1	10.0209004	10.5190634	23
38	9.4817315	9.9790594	9.5026721	10-4973279		10.0209.05	10.5182685	22
39 40	9.4821283	9.9790192	9.5031092	10.4968908		10.0209808	10.5178717	2 I 20
40	9.4825248	9.9789789	9.5 335459	10.4964541		10.0210211	10.5174752	19
42	9.4829208	9.9789386	9.5039322	10.4960178		10.0210614	10.5170792	18
43	9.4833165	9.9788983	9.5044182 9.5048538	10,4955818		10-0211017	10.5166835	17
44	9.4837117	9.9788579	9.5052891	10-4951462		10,0241421	10.5162883	16
45	9.4841066	9.9788175	9.5057249	10,4947109		10.0211824	10,5158934	15
46	9.4845010	9.978777	9.5061585	10.4942760		10.0212230.	10.5154990	14
47 48	9.4848951 9.4852888	9 97873 6 5 9.97869 6 0	9.5055928	10.4938414		10-0212635	10.5151049	13
48	9,4052000	9.9/00900				10.0213040	10.5147112	12
49	9.4856820	4.9786554	9-5070267	10.4929733		10.0213446	10.5143180	11
50	9.4860749	9.9786148	9.5074602	10.4925398		10.0213852	10.2139221	10
51	9.4854674	9.9785741	9.5078933	10-4921067	ŀ	10.0214259	10.5135326	9
52	9.4868595	9.9785334	9.5083261	10.4916739		10.0214666	10.5131405	8
53	9.4872512	9.9781927	9.5087586	10.4912414		10.0215073	10.5127488	7
54	9.4876426	9.9784519	9.5091907	10.4908093		10.0215481	10.5123574	Ó
	9.4880335	9.9784111	9 5096224	10.4903776		10.0215889	10.411066	
55	9.4884240	9.9783702	9.5100539	13:4899461		10.021589	10.91196 6 5 10.5115760	5
56	9.4888142	9.9783702 9.9783 2 93	9.5104849	10.4895151	ı	10.0216707	10.5111858	4 3
57 58	9.1892040	9.9782883	9.5100156	10.4890844	1	10.0217117	10,210,260	2
59	9.4895934	9.9782474	9.5113460	10 4486540	1	10.0217526	10.5104066	i
60	9.4899824	9.9782063	9.5117760	10.4882240		10.0217937	10.5100176	0
!	L. Co.Sine.	L. Sine	L. Co- Sang.	L. Tangent		L.Co-Secant.	L. Secant.	M
1—				EGREE	S.	,	- (
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18 DEGREES											
- N	1 N Vina	N. Co-Sine	 -		N. Co-Tang.	8	N. Secant	N Co-Secant.	,1		
M	N. Sine					j					
<u> </u>	3 20170	9510565		3249197	30776835	1	10514622	32360680	6 0		
1	3092936	9579666		3252413	30746400		10515627	32331736	5 9 58		
2	3095702	95°8766	1	3255630	30716020		10516612	32302845			
3	3098468	9507865		3258848	30685698	i :	10517608	32274011	57		
4	3101234	9506763		3262066	30655421	1	10518606	32245230	56		
5	3103999	9506060		3265285	30625203		10519605	32216503 32187830	55		
	3106764	9505157		3268504	30595038	i i	10520604	3210/030	54		
7	3109529	9504253		3271724	30564928	l.	10521605	32159210	- 63		
8	3112294	9503348		3274944	30534870		10522607	32130644	53 52		
9	3115058	9502442		3278165	30504866	l	10523610	32102132	5I		
10	3117822	9501536	1	3281387	30474915	ł	10524614	32073673	50		
11	3120586	9500629		3284610	30445018	•	10525619	32045266	49		
12	3123349	9499721		3287 833	30415173	1	10526625	32016913	49 48		
	2:062:0	21200	1					22000			
13	3126112	9498812		3291056	30385381	1	10527633	31988613	47		
14	3128875 3131638	9497902 9496991	. 1	3294280	30355641 30325954	[10528641	31960365 . 31932170	46		
15 16	3134400	9496080		3297505 3300731	38296320		10530661	31904028	45		
17.	3137163	9495168		3303957	30266737		10531673	31875937	44		
18	3139925	9494255		3307184	30237207		10532686	31847899	43 42		
19	3142586	9493341		3310411	30207728	l i	10533699	31819913	41		
20.	3145448	9492426		3313639	30178301		10534714	31791978	40		
21	3148209	9491511		3316868	30148926	1 1	10535730	31764095	39		
22	3150969	9490595		3320097	30119602]	10536747	31736264	38		
23	3153730	9489678		3323327	30090330	1	10537765	31708484	37		
24	3155490	9488760		3326557	30061109		10538785	31682756	36		
25	3159250	9487841		3329788	30031939	1	10539805	31653078	2		
26	3162010	9486922		3333020	30002820		10540826	31625452	35 3↓		
27	3164770	9485002		3336252	29973751		10541849	31597876	33		
28	3167529	9485081		3339485	29944734		10542873	31570351	32		
29	3170544	9484159		3342719	29915766		10543897	31542847	31		
30	3173047	9483236		3345953	29886850		10544923	31515453	30		
				2242.00	20045080		70444040	21100000			
31.	3175805	9482313		3349188	29857983	,	10545950	31488079	29		
32	3178563 3181321	9481389 9480464		3352424 3355660	29829166 29800400		10546978 10548077	31460756 31433483	28		
33	3184079	9479538		3358897	29771683		10549037	31406259	27 26		
34 35	3186836	9478611		3362134	29743016		10550068	31379086	25		
36	3189593	9477584		3365372	29714399		10551101	31351962	24		
37	3192350	9476756		33 6 8511	2968583I		10552134	31324887	23		
38	3195106	9475827		3371850	29657312		10553169	31297862	22		
39	3197863	9474897		3375090	29628842		10554204	31270886	21		
40	3200619	9473966		3378330 3381571	29500422 295 72 050		10555241 1055 6 279	31243959 31217081	20		
41	3203374 3205130	9473035 94 721 03		3384313	20543727		10557318	31190252	19 18		
42	3203130	94/2103		33047.3					10		
-43	3208885	9471170		3388056	29515453		10558358	31163472	17		
.44	3211640	9470236		3391299	29487227		10559399	31136740	16		
45		1 9469301		3394543	29459050		10560441	31110057	15		
46	3217149	9468356		3397787	29430921		10561485	31083422	14		
47	3219903	9467430		3401032	29402840		10562529	31056825	13		
48	3222657	9456493		3404278	29374807		10563575	31030296	12		
40	3225410	9465555		3407524	29346822		10564621	31003805	11		
49 50	3228164	9464616		3410771	29318885		10565669	30977363	10		
51	3230917	9463676		3414019	29290995		10566718	30950967			
52	3233670	9162730		3417267	29263152		10567768	30924620	. 9		
53	3236422	9461765		3420516	29235358		10568819	30898319	7		
54	3239174	5460853		3423765	29277610		10569871	30872066	6		
	2241004			2427011	20170000		10570924	30845860			
55	3241926	9459910	;	3427015	29179909		10570924	30845000	5 4		
56	3244678	9458967		3430266 3433518	29152256 29124649		10573034	30793590	3		
. 5 7 . 5 8	3247429 3250180	9457078		3436770	29097089		10574090	30767525	2		
. 5 0 . 5 9	3252931	9456132		3440023	29069576		10575148	30741507	1		
65	3255682	9455185		3443276	29042109	1 1	10576207	30715535	_ 0		
	N Co-Sine.	N. Sine.	;	N Co. Tang.	N. Tangent.		N. Co-Secant.	N. Secant	\overline{M}		
<u>-</u>	***	 			GREES	<u></u>					
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18 DEGREES.										
M	L. Sine.	L. Co-Sine		L. Tangent	L. Co. Jag.		L. Secant.	L Go-Sec.ant		
0	9.4899824	9.9782063		9.5117760	10.1882240		10-0217937	125100176	50	
1	9.4903710	9.9781653		9.5122057	10.4 . 7 7 9 4 3		10.0218347	10.5096290		
2	9.4907592	9.9781241		9:5126351	10.1873610		10.0218750	10.5092408	59 58	
3	9'4911471	9.9780830		9:5130641	10.4869359		10.0219170	10.5088529	57	
4	9.4915345	9.9780418		9.5134927	10,4865073		10-0219582	10.5084655	56	
5	9-4919216	9.9780006		9.5139210	10.4865790		10.0219994	10.5080784	55	
0	9.4923083	9-9779593	•	9:5143490	10.4856510		10.0220407	10-5076917	54	
	9.4926946	9.9779180		9.5147766	10.4852234		10.02.20820	10.5073054		
. 8	9-4930506	9 9778766		9.5152039	10.4847961		10-0221233	10.5069194	53	
9	9.4934661	9.9778353		9.5156309	10.4843691		10.0221647	10.5065339	52 51	
10	9.4938513	9.9777938		9.5160575	10.4839125		10.0222062	10.2061487	50	
; 11	9.4942361	9.9777523		9.5164838	10.483516:		10.0222477	10.5057639	49	
12	9.4946205	9.9777108		9.5169097	10.4830903		10.0222892	10.5053795	48	
	9.4950046	9.9776693	- 1	9.5173353	10.4826547		10.0223307	10.5049954		
13	9:4953883	9.9776277		9,5177606	10.4822394		10.0223723	\$0.5046117	47	
: 15	9.4957716	9.9775860		5.5181855	10.4818145		10.0224140	10.5042284	46	
16	9.4961545	9.9775444	1	9.5186101	10.4813899		10.0224556	10.5038455	45	
17	9.4965370	9.9775026	- 1	9.5190344	10.4809656		10.0224974	10.5034630	43	
: 18	9.4969192	9.9774609		9.5194583	10.4835417		10.0225391	40.5030858	42	
	9.4973010	9.9774191	. 1	9.5198819	10.4801181		10.0225802	in enrice		
19 20	9.49 6824	9.9773772	1	95203052	10.4796948		10.0225303	\$0.9026990 \$0.5023176	41	
20	9.4980635	9.9773354		9,5207282	10.4792718		10 0226646	10.5019365	40	
22	9.4984442	9-9772734		9.5211508	13.4788492		10.0227066	10.5015558	38	
, 23	9.4988245	9.9772515		9.5215733	10.4784270		10.0227485	10.5011755	37	
1 24	9.4992045	9.9772095		9.5219950	10.4780050		10.0227905	10.5007955	36	
	0.4005840	0.0771674	`	04204466	10.4276924		10.0008006	10.4504		
25	9.4995840	9.9771674 9.9771253		9-5224166 9-522 ³ 379	10.4775834		10.0228326	10.5004160	35	
26	9.5003421	9.9770832		945231589	10.4767411	, 1	10,0229168	10-5700367	34	
28	9.5007206	9.9770410	·	9 5236795	10.4763205		10.0229590	10'4992794	33	
, 29	9.5010987	9.9769968		9 5 240999	10.4759001		10,0230012	10.4989013	32 31	
30	9.5014764	9.9769566		9.5245199	10.4754801		10-0230434	10.4985236	. 30	
 	214218429				1 200		10.000=0+5			
31	9.2018238	9.9763143		9-5249395	10.4750605		10-0230857 10-0231280	10.4981462	29	
1 32	9.5022308	9.9763720 9.9768296		9.5253589	10.4742221		10.0231704	10.4977692	28	
33	9.5029838	9.9767872		9.5261966	10.4738034		10.0232128	10.4973925	27	
35	9.5033597	9 9767447	,	9.5266150	10.4733850		10.0232553	10,4966403	26	
36	9.5737353	9.4767022		9-5270331	10-4729669		10.0232978	10.4962647	. 27	
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37 38	9.5041105	9 9766597		9.5274508 9.5278682	10.4725492		10.0233403	10-4958895	23	
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. 39	9.5052339	9.9765318		9.5287021	10.4712979		10.0234255	10.4951402	21	
40 41	9.5056077	9.9764891		9.5291186	10.4708814		10-0235109	10.4947661 10.4943923	20	
42	9.5059811	9.9764464		9.5295347	10.4704653	•	10.0235536	10-4940189	19	
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49	9.5085850	9-9761461		9.5324399	10.4675611	ł	10.0238539	IC-4914190	11	
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51	9.5093258	9.9760599		9 \$336789	10.4667341	I	10.0239401	10-4906742		
52	9.5100651	9.9760167 9.9759736		9.4340916	10.4659084	1	10.0239833	10-490 3044		
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.56	9.5111716	9.9758437		9.5353278	10-4646722		10,0241563	10.4888284		
57	9.5115397	9.9758004	ŀ	9.5357393	10.4642607	ŀ	10,0241996	10.4884603	3	
58	9.5119074	9-9757570		9.5351505	10.4638495	ł	10.0242430	10.4880926	2	
159	9.5122749	9.9757135		9.5369719	10.4634387	1	10.0242865	10.4877251	1	
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16	3299652	9439931		3495420	28608863	l	10593298	30306221	44
17	3302398	9438971		3498685	28582168		10594376	30231023	43
18	3305144	9438010		3501940	28555517	1	10593454	30255868	42
	3307889	9437048		3505216	28528911	l	10596534	30230759	-
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23	3318867	9433192		3518287	28422926	1	10600805	30130760	37
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34	3349034	9422524		3554286	28135048	ł	10612867	29859352	26
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39 40	3365475	9416665		3573950	27980198	l	10619471	29713490	20
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50	3392583	9406835		3606795	27725448		10630568	29473725	10
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	9.5350915 9.5354375	9.9728477 9.9728016		9.5626360	10.4377561 10.4373640	j	10.0271984	10.4649085	
	9-5357832	9.9727554		9.5630278	17.4369722	l .	10.0272446		56
5	9.5361286	9.9727092		9.5634194	10.4365806		13.0272908	10.4038211	:54
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7 1	9.5364737	9.9726529		9.5638107	10.4361893		10.2273371	12.463;263	-53
8	9.5368184	9.9726166	;	9.5642018	10.4352982		100273834	10.4631816	52
9	9.5371628	9.9725703		9.5645925	10.4354075		10.0274297	10.4628272	51
	9.5375069	9.9725239		9.5649831	10.4350169		100274761		
	9.5378508	9.9724775		9-5053733	10-4346267	l	10.0275225	10.4521472	
12	9.5381943	9'9724310	- 1	9.5657633	10:4342367		10.0275690	10.4518057	48
	9.5385375	9.9723845	1	9.5661530	10.4338470		10-0276155	10.4614625	
, .	9.5388804	9.9723380	I	9.5665424	10.4334576		10.0276620	10.4611196	. ,,
	9.5392230	9.9722914	l	3.5659316	10.4330684		10.0277086	10.4607770	
	9.5395653	9.9722448	I	9.5673205	10.4326795		10.0277552	10.4604347	45 44
	9.5399073	9.9721981	l	9.5677091	10.4322909		10.0278019	10.4600927	43
	9.5402489	9.9721514	ı	9,5680275	10.4319025		10.0278486	10.4597511	42
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24	9. 1422920			7.770423				104777074	36
25	9.5426321	9.9718233	İ	9.5708088	10.4291912	1	10.0281767	10.4573679	35
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* 30	9.5443253	9.9715876		9.5727377	104272623		10.0284124	10.4556747	30
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	9.5466832	9.9712560	- 1	9.5754272	10.4245728	1	10-0287440	10.4533163	23
	9.5470189	9.9712084		9.5758104	10.4241896		10.0287916	10.4529811	22
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41	9.5480240 9.5483585	9.9710655 9.9710178		9-5773407	10.4230415		10-0289822	10.4516415	19
42	2.7433707	9.9710176	1	7,777,707					18
43	9.5486927	9.9709701	1	915777226	10.4222774	ľ	10.0290299	10.4513073	17
	9.5490266	9.9709223	1	9.5781043	10.4218957	1	10.0290777	10.4509734	16
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46	9.5496935	9.9708265		9.5788669	10.4211331	l	100291735	10.4503065	14
47	9.5500265	9.9707756		9.5792479	10.1207521		10,0292214	10.449973	13
48	9.5503592	9.9707306	1	9.5796286	10.4203714	ł	10.0292694	10.4496408	12
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56	9.5530105	9.9703454		9.5825651	10.4173349	į	10-0296546	10.4469895	4
57	9.5533406	9.9702970		9.5830435	10.4159565	1	10.0297030	10.4466594	3
	9.5536704	9.9702486		9.5 ⁸ 31217	10.4165783	i	10.0297514	10.4463290	2
''	9.5539999	9.9702002		9.5841774	10.416203	J	10.0298483	10.4455763	1
	L Co-Sine.				L. Tangent.	1	L.Co-Secant	L. Secant	M
	D CU31/16.	L. Sine					D.C.y. Webant		
				60 DE	GREES.				ı

44			A			· · · · · ·	. 4116	·	
-	N Sing	ALC: C			GREES.		XF 8	N Co- Secant	
M	N Sine.	N. Co-Sine.	ľ. 1	N. Langent.					
<u> </u>	3583679	9335804		3838640	26050891		10711450	27904281	_60
1	3586395	9334761		3841978	26028258		10712647	27883153 27862059	58 58
2 3	3591825	9333717 9332673		3845317 3848656	25005 <i>659</i> 25983095		10713844	27840999	57
4	3594540	9331628		3851996	25960564		10716244	27819973	56
5	3597254	9330582		3855337	25938068	1	10717445	27798982	55
6	3599968	9329535		3858679	25915606		10718647	27778024	54
	3602682	9328487		-960000	04800177		20710847	02747100	
7 8	3605395	9327439		3862 021 3865364	1 25893177 1 258 7 0782		10719851	27757100	53 52
9	3608108	9326390		3868708	25848421	1 1	10712262	27715355	5I
10	3610821	9325340		3872053	25826094	1	10723469	27694532	50
11	3613533	9324289		3875398	25803800	i i	10724678	27673743	49
12	3616246	9323238		3878744	25781539		10725887	27652988	48
13	3618958	9322186		3882091	25759312		10727098	27632266	47
14	3621669	9321133		3885439	25737118		10728310	27611578	46
25	3624380	9320079		3888787	25714957		10729523	27590923	45
16	3627091 3629802	9319024		3892136	25692830		10730737	27570301	44
17	3632512	9317968		3895486	25670735		10731953	27549712	43
10	30,2,12	9316912		3898837	25648674		10733170	27529157	42
19	3635222	9315855		3902189	25626645		10734388	27508634	41
20	3637932	9314797		3995541	25604649		10735607	27488144	40
21	3640641	9313738		3908894	25582686		10736827	27467687	39
22	3643350 3646059	9312679		3912248	25560756		10738048	27447263	38
23 24	3648768	9311619		3\$15602 3\$18957	25538858 25516992		10739271	27429871 27406512	37 36
		73.077		37. 377					
25	3651476	9309496	}	3922313	25495160		10741720	27386186	35
26	3654184	9308433		3925670	25473359		10742946	27365892	34
27	3656892	9307370		3929028	25451591		10744173	27345630	33
28	36595 99 36 6 2306	9306306 9305 24 1		3932386 3935745	25419855 25408151		10745402 . 10746631	27325400 27305203	32
29 30	3665013	9304175	,	3939105	25386479		10747862	27285038	31 30
			į						
31	3667719	9303109		3942466	25 364 ⁸ 39		10749095	27264905	29
32	36 70425 36 73131	9302742		394582 7 3949189	25343231 2532165 5		10750328	27244808 27224735	28
33	3675836	9300974 9299905	;	3952552	25300111		10751562	27204698	2 7
34 35	3678541	9298835	•	3955916	25278598		10754035	27184693	25
36	3681246	9297765	•	3959280	25257117		10755273	. 27164719	24
	2682050			2060614	2522665			00:44555	
37	3683950 3686654	9296694 9295622		3962545 396601 1	25235667 25214249		10756512	27144777 27124866	23
38 39	3689358	9294549		3969378	25192863	ļ.	10758995	27104987	22 21
40	3692062	9293475		3972746	25161507	l .	10760237	27085139	20
41	3694765	9292401		3976114	25250183	t	10761481	27065323	19
42	3697463	9291326		3979483	25128890		10762727	27 045538	18
	3700170	9290250	ł	3982853	25107629		10763973	27025784	
43 44	3702872	9289173		3986224	25086398	Ì	10765221	27006061	17 16
45	3705574	9288095	•	3989596	25065198		10766470	26 9 8 63 7 0	15
46	3708276	9287017		3992963	25044029	ł	10767720	26966709	14
47	3710977	9285938		3996341	25022891		10768971	26947079	13
48	3713678	9284858		3999715	25001784		10770224	26927480	12
49	3716379	9283777		4003089	24980707		10771477	26907912	11
50	3719080	9282696	ł	4007465	2495966E		10772732	26888374	10
51	3721780	9281614	l	4009841	24938645		10773988	26868867	9
52	3724480	9280531		4013218	24917660 24806706	l	10774246	26845391	8
53	3727179 3729878	9279447	l ·	4016596	24896706 24865781		10776504	26829945 26810530	7 6
54	3/270/0	9278362	Į	4019975		Ì	10777765		
. 55	3732577	9276277	l	4023354	24854887		10779025	26791145	5
56	3735275	9276191	I	4026734	24834023	}	10780287	26771790	4
57	3737973	9275104	1	4030115	24813190		10781550	26752465	3
58	3740671 3743369	9274016 9272928	l	4033497 4036879	24 7 92386 24 7 71612		10782815	26733170 26713906	2
59 60	3746066	9271939	•	4040262	24750869	1	10785347	26694672	o
ات	N. Co-Sine.	N. Sine.		N .Co Targ	N. Tangent		N. Co-Secant.	N. Secant.	\overline{M}
_			L		REES.				
1		<u> </u>							

21 DEGREES.											
M	L. Sine.	L. Ca-Sine		L. Tangent	L. Co. Tang.		L. Secant.	LC - vec.ant	- I		
0	9.5543292	9.9701517	i l	9.5841774	104158226	[10.0298483	10.4456708	50		
7	9.5546581	9.9701032		9.5845549	104154451	[10.0298968	10.4453419			
2	9.5549868	9.9700547		9.5849321	10-1150679		10.0200453	10.4450132			
- 3	9.5553152	9.9700061		9.5853091	10.4146909		10-0299989	10.4446848			
4	9.5556433	9.9699574	i	9,5856859	104143141		10.0300426	10,4443567			
5	9-5559711	9.9699087		9.5860624	10.4139376		10.0305013	10.4440289	55		
6	9.5562987	9.9698600	!	9-5854386	10,4135614		13,0301400	10.4432013	54		
	9.5566259	9.9698112	i	9.5868147	10.4131853	į į	10-0321888	10.4433741			
7	9.5569529	9.9697624		95871904	10.4128096	1	10.0302376	10.1430471	53		
ا و	9.5172796	9.9697136		9.5875665	134124340		10.0302864	104127204	52 51		
10	9.5576060	9.9696647		9-5879413	10.4120587		10.0303353	10'4423940	50		
31	9-5579321	9.9696158		9-5883163	104116837		10.0303842	10.4420679	49		
12	9.5582579	9,8682668		9.5886912	104113088		10,0304332	10.4417421	48		
	9.5585835	9.9695177		9.5890657	10.4100242	i l	10.0004820	10.4414164			
13	9.5489088	9.9694687		9.5894401	10,4109343		10,0304823	10.4414165	47		
14	9.5592338	9.9694196		9.5898142	10,4101850	1 1	10.0305804	10,4407662	7-		
15	9.5505585	9.9693704		9.5951881	10.4098119		10 0306296	10.4404415	45 44		
17	9.5598839	9.9693212	1	9.5905617	10.4794383	į (10.0306788	10,4401171	43		
18	9.5602071	9.9692720		9.2905321	10,40,0649		10.0307280	10.4397929	42		
		2062222		2.15: 0	12.42.95	,		-			
19	9.5605310	9.9692227	1	9.5913082	10,4036918		10.0307773	10-4394690	41		
20	9.5608 546 9.5611779	9,9691734 9,9691240		9'5916812	10,4083188 10,4079461		10.0308266	10,4391554	40		
21	9.5615010	9.9690746		9,5920539 9:5924263	10,4075737		10.0308759 10.0309254	10.4388221	39		
22	9.5618237	9.9990252	i	9.5927985	10.4072015		10.0309748	10.4381763	38		
23	9.5621462	9.9689757	.	9.5931705	10.4068295	1 1	10.0310243	10.4378538	37 36		
									30		
25	9.5624685	9.9689262	,	9.5935422	10.4064577		10.0310738	10.4375315	35		
26	9-5627904	9.9688766	1 1	9.5939138	10,4060862		10.0311234	10.4372096	34		
27	9.563112 f	9-9688270	i l	9.5942851	10.4057149		10.0311730	10.4368879	33		
28	9.5634335	9.9687773	i l	2 5946561	10.4053439	1	10.0312.227	10.4365665	32		
29	9,5637546 9.5640754	9.968727 6 9.9686779	Ĺ	9.5 95 0269 9 . 5953975	10.4049731 10.4046025		10.0312724	10.4362454	31		
30	7.7049/74	9.9000779		ר/ענועויע	104040023		.0.0313121	10-4359246	30		
31	9.5643960	9-9686281		9.5957679	10.4042321		10.0313719	10.4356040	30		
32	9.5647163	9.9685783	1	9.5961386	10.4038620	,	10.0314217	10.4352837	29 28		
23	9.5650363	9.9685284	,	9.5965279	10.4034921		10.0314716	10.4349637	27		
34	9.5653561	9.9684785		9.5958776	10,4031224		10.0315215	10.4346439	26		
35	9.5656756	9.9684286		9.5972470	10.4027530		10.0315714	10,4343244	25		
36	9.5659948	9.9683786		9.5976162	10.4023838		10.0316214	10.4340052	24		
	9.5663137	9.9683285	1	9.5979852	10,4020148		10.0316715	10,4336863			
37	9.5666324	9.9682784		9-5983540	10.4016460	·	10.0317216	10.4333676	23		
38 39	9.5669508	9.9652283		9.5987225	10.4012778		10.0317717	10,4330492	22		
40	9.5672689	9.9681781		9.5990908	10,4009092		10.0318219	10.4327311	21 30		
41	9.5675868	9.9681279		9.5994588	10,4005411		10.0318721	10.4324132	19		
42	9.5679044	9.9680777	i i	9-5995257	10.4001733		10.0319223	10.4320956	18		
	0.469	2.600000		0.600151	10.22202==		10.021-51	70 40===0			
43	9.568 2 217 9.5685387	9.9680274		9.6001943 9.6005617	10.3998057		10.0319726	10.4317783	17		
44	9.5005307	9.9679771 9.9679267		9.6009289	10,3994383		10.0320229	10,4314613	16		
4 5 4 6	9.5691721	-9.9678763		9.6012958	10.3987042		10.0321237	10.4308279	15		
47	9.5694883	9.9678258		9.6016625	10-3983375		10,0321742	10.4305117	14		
48	9.5698043	9.9677753		9-602 0290	10.3979710		10.0322247	104301957	13		
								-			
49	9'5701200	9.9677247		9-6023953	10-3976047		\$0.0322753	10-4298800	11		
50	9-5704355	9.9676741		9.6027613	10.3972387		10.0323259	10.4295645	10		
. 5I	9.5707506	9.9676235	_	9.6031271	103958729	į l	10 0323705	10-4292494	9		
52	9·5710656 9·5713802	9.9675 7 28 9.9675221	. 1	9.6034927 9.6038581	1 0 -39650 7 3.	,	10.0324272	10-4289344 10-4286198	8		
53	9.5716946	9.9674713		9.6042233	10.3957767		10.0324779	10.4283054	7		
54	7,75								6		
55	9.5720087	9.9674205		9.6045882	10.3954118		10.0325795	10.1279913	5		
56	9.5723226	9.9673697	1	9.6049529	10.3950471		10.0326303	10-1276774	4		
57	9.5726362	9.9673188		9.6053174	10.3916826		10.0326812	10.4273638	3		
58	9.5729495	9.9672679		9.6056817	10-3943183		10.0327321	10.4270505	2		
59	9.5732626	9.9672169	i	9.6360457	10.3939543		10.0327831	10.4267374	1		
<u>60</u>	9.5735754	9.9671659		9 6064096	10.3935904		10-0328341	10.4264246	0		
	LCo-Sine.	L. Sine		L.Co-Tang .	L. Tangent	. ,	L.Co-Secant	L. Secant.	M		
68 D L G R E E S.											

40			71	1 A D C		· · · · · · · · · · · · · · · · · · ·	4/100 		
I	M Cine	N C C'			GREES.		N. O	M.C. Named B	
M	N. Sine.	N. Co-Sine.	1	N. Tangent.	N. Co-Tang.	! !	N. Secant.	N Co-secont	
_ 0	3746066	9271839		4040262	24750869	1	10785347	26694672	60
1	3748763	9270749		4043646	24730155		10786616	26675467	59
2	3751459	9269658		4047031	24709470		10787885	26656292	58
3	3754156 3756852	9268566		4050417	24638816		10789156	26637148 26618033	57 56
4	3759547	9267473 9266380		4053804	24668191 24647596		10796427	26598947	55
5	3762243	9265286		4057191 4060579	24527030		10792975	26579891	54
				4000)//					
. 7	3764938	9264191		4063968	24606494	1 1	10794250	25560865	52
8	3767632	9263096		4067358	24585997	1 1	10795527	26541868	51
9	3770327	9262000		4070748	24565509	1 1	10796805	26522901	50
10	3773021	9260973		4074139	24545061		10798084	26503962	49
11 12	3775714 3778408	9259805 9258 7 06		4077531	24524642	1 1	10799364 10780646	26485054 26466174	53 48
	3//0400	9250700		4080924	24504252	· 1	-0/00040		
13	3781101	9257606		4084318	24483891	1 1	10801928	26447323	47
14	3783794	9256506		4087713	24463559	1 1	10803212	26428502	46
15	3786486	9255405		4091108	24443256	1	10804497	26409709	45
. 16	3789178	9254303		4094504	24422982	1	10805784	26390946	44
17	3791870	9253200		4097901	24402736	1 1	10807071	26372211	43
18	3794562	925209 7		4101299	24382519		10808360	26353505	42
	2707240	201020		4.046=1=	2126222		10809650	26334828	4:
19 20	3797253 3799944	9250993 9249888		4104697	24362331		10810942	26316180	41 40
21	3802634	9249686		4108097	243421 72		10812234	.26297560	39
22	3805324	9247675		4111497	24322041 24301938		10813528	26278969	38
23	3808014	9246568		4114393	24231864	. 1	10814823	26260406	37
24	3810704	9245460		4121703	24261819	1	10816119	26241872	36
25	3813393	9244351		4125106	24241801	1 1	10817417	26223366	35
26	3816082	9243241		4128510	24221812		10818715	26204888	34
27	3818770	9242131	'	4131915	24201851		10820015	20186439	33
2 8	3821459	9241020	•	4135321	24181918		10821316	26168018	32
29	3824147	9239908		4138728	24162013		10822618	26149624	31
30	3826834	9238795		4142136	24142136		10823922	26131259	30
31	3829522	9237681		ATASSAA	24122286		10825227	26112922	29
32	3832209	9236567		4145 5 44 4148953	24102465	1	10826533	26094613	28
33	3834895	9235452		4152363	24082672	1	10827840	26076332	27
34	3837582	. 9234336		4155774	24062906	1	10829149	26058078	26
35	3840268	9233219	1	4159186	24043168		10830458	26039852	`25
36	3842953	9232102	1	4162599	24023457		10831769	26021654	24
	2011		1			1		262228	
37 38	3845639	9237984	1	4166012	24002774		10833081 10834395	26003484	23
	3848324 3851008	9229865	l	4169426	23984118	1	10835709	25985341	22
39 40	3853693	9228745 9227624	ł	4172841	23964490		10837025	25949137	21 20
41	3856877	9226503	1	4176257 4179674	23944889 23925316		10838342	25931077	19
42	3859060	9225381	l	4183091	23905769	1	10839651	25913043	18
		7-2/30-	•	725,091	-390)/09	i			
43	3861744	9224258	1	4186509	23886250	ł	10840980	25895037	17
44	3864 427	9223134	1 i	4189928	23866758	} . ·	10842301	25877058	16
45	3867110	9222009	1	4193348	23847293	1	10843623	25859107	15
46	3869792	9220884	ŀ	4196769	23827855		10844947	25841182	14
47	3872474	9219758	[4200191	23808444	1	10846271	25823284	13
48	3875156	9218631	1	4203613	23789060	ì	10847597	25805414	- 12
49	3877837	0217602	1	4207026	23769703	1	10848224	25787 5 70	11
50	3880518	9217503		4207036 4210460	23750?72		10850252	25769753	10
51	3883199	9215246	l	4213885	23731068	1	10851582	25751963	
52	3885880	9214116	ı	4217311	23711791	ł	108<2013	25734199	9
53	3888560	9212985	1	4220738	23692540	l	16854245	25716162	7
54	3891239	9211854	i.	4224166	23673316	1	10855578	25698752	6
			1			1	100-1	25621562	
55	3893919	9210722	1	4227594	23654118	ı	10856912	27681060 25663412	5
56	389659 8	9209589	1	4231023	23634946	1	10858248 10859585	25063412	4
57 58	3899277	9208455	1	4234453	23615801 23596683	1	10850924	25628176	2
50	3901955 3904633	9207320	1	4237884 4241316	23577590	1	10862263	25610599	ī
60	3904033	9206185 9205049	1:	4244749	23558524	1	10863604	25593047	0
1	N. Co-Sine.	N. Sine.	1	N. Co-Tang.		1	N. Co-Secant.		31
-	THE.	- 11. 0176.	<u> </u>						
				67 DE (REES.				

1				22 D F	GREES	:	•		-7 /
	7 0					<i>,</i>		· ·	
M	L. Sine.	L. Co. Sine.	1	L. Cangent	L. Co Tang.	ł	L. Secant.	L. Co-Secant	<u></u>
	9-5735754	9.9571659		9.6064	10-3935904		10.0328341	10.4264245	60
I	9.5738885	9.96/1144.		9.605773	10.3932 :08	1	10.0328852	17.4261120	59
2	9-5742003	9.9670637		9.607136	10.3928634		10.0329363	10.4257997	58
3	9-5745123	9.9670125		9.6074997	10.3925003		10-0329875	10.4254877	57
4	9.5748240	9.9663614		9.6078627	10,3921373		10.0330386	10.4251760	56
5 6	9.5751355	9 9659101		9.6082251 9.6085830	10.3917746		10.0330899	10.4248644	55
	9-5754468	9.9668588		9.0555610	10-3914120	1	10-0331412	10-4245532	54
7	9-57-7578	9.9558.75		9.5089503	10.3910197	l	10.033192	10.4242422	(5)
8	9.5760685	9.2667562		9.6093124	10.3906876	I	10.033243	13.4239315	53 52
9	9.5763790	9.9667048		9.6096742	10.3903258	I	10.0332952	10.4236210	51
10	9.5766 92	9.9666533		9.6120359	10.3899641	}	10.0333467	10.4233108	50
11	9.5769991	9.9666518		9.6103973	10.38,5027	1	10.0333982	10.4230009	49
12	9-5773088	9 9665503	ŀ	9 6107536	10.3392414	ł	10.0334497	10.4226912	48
	0.5336.83			0.6111105		1		2.1.1.0	
13	9.5776183 9.5779275	9.9654987		9.6114854	10.3888804	ł	10.0335013	10'4223817	47
14	9 5782364	9.9664471 9.9563954		9.6118409	10.3881591	1	10.0335529	10.4220725	46
15	9-5785450	9.9663437		9.6122013	10.3877987	1	10.0336040	10-4217636 10-4214550	45
16 17	9.5788535	9.3662920		9 6125615	10.3874385	į	10.033708	10.4211465	44
18	9.5791616	9.9662402		9.0129214	10.3870786	I	10.0337598	10.1208384	43
						l			42
19	9.5794695	9.9661884		9.6132812	10.3867188	l	10.0338116	10.4205305	41
20	9.5797772	9.9561365		9.5136407	10.3863593	1	10.0338634	17.4202228	45
21	9.5800545	9.9663846	Ī	9.6140000	10.3850000	i	10.0339154	10.4199155	39
22	9.5803917	9.96503 26		9.6143591	10.3856409	i	10.0339674	10-4196083	38
23	9.5806986	9.9659806		9.6147145	10.3852820		10.0340194	10.4193014	37
24	9.5810052	9.9659285		9.6150765	10.3849234		10.0340715	10.4189948	36
2.	9.5813116	9 9658764		9.5154351	10.3845649.	j	10-0341236	10.4186884	
25 26	9.5816177	9.9658243		9.6157934	10.3842066	l	10.0341717	10.4183823	35 34
27	y.5819236	9.9657721		9.5161514	10.3838486		10'0342279	10.4180764	33
28	9.5822292	9.9657199		9.6165093	10.38349.37		10.0342801	10.4177708	32
29	9.5825345	9.9656577		9.5163669	13.3831331		10.0343323	10.4174655	31
30	9.5828397	9.9656153		9.6172243	10.3827757		10.0343847	10.4171603	30
	2 0 2 2 2 2			0 6175					
31	9.5 ⁸ 31445 9.5 ⁸ 34491	9 9655530		9.6175815 9.6176385	10.3824185		10.0344370	10.4168555	29
32	9.5837535	9.9655106		9.0170365	10.3820615		10.0344894	17.4165509	28
33	9.5740576	9.9654 5 52 9.9654 157		9.6186,19	10.3813481		10.0345418	10.4162465 10°4159424	27
34	9.2843612	9.9553532		9.5190033	10.3809917		10.0346468	10.4156385	26
35 36	9-5840651	9.9653006		9.6193615	10.3305355		10.0346991	10.4153349	25 24
-30						1			
37	9.5849635	9.96,2480	1	9.6197205	10.3802795		10.0347520	10.4150315	23
38	9.5852716	9.9651952		9.6200762	10.3795538		10.0348047	104147284	22
39	9.5855745	9.9651426		9.6204318	10.3795682		10.0348574	10.4144255	21
40	9.5358771	9.96.0339		9.6207872	10.3792128		10.0349101	10.4141229	20
41,	9.5861795	9.9650371		9.6211423 9.62149 7 3	17.3788577		10.0349629	10.4138205	19
42	9.5864816	9.9549843			13.3785027		10.0350157	10.4135188	18
	9.5857835	9.9649314		9.6218520	10.3781485		10.0350686	10.4132165	17
43 · 44	9.5875851	9.9648785		9.6222066	10.3777934	l i	10.0351215	10,4129149	16
45	9.5873865	9.9648256		9.6225639	10.3774391		10.0351744	10.4125135	15
46	9.5870876	9.9647726		9.6227150	10.3770850		10.0352274	10.4123134	14
47	9.5879885	9.4047195	H	9.6232690	10 3767 310		10.0352805	10,4120115	13
48	9.3882892	9.9646665		9:6236227	1013763773		10.0353335	10.4117108	-12
	0.00000	0:0646		0.633076:	13.5-6		100:100		
49	9.5885396	9.6646133		9.6239763 9.6243296	10.3760237		10.0353867	10-4114104	11
50	9.5858897 9.589 1 39 7	9 . 9645 6 02 9 . 96450 6 9		9.6246827	10:3756704		10.0354398	10.4111103	10
5 I	9.5894393	9.9644537		9.6250356	10-3753173	}	10.0354931 10.0355463	10.4105103	8
52 52	9.5897838	9.9644004		9.6253884	10.3749044		10.0355996	10-4102112	7
53 54	9.5970880	9.9643470		9.625740	10.3742591		10.0356530	10.4099120	6
55	9.59038 6 9	9.9642937		9 62609 32	10.3739068		10.0357063	10.4096131	5
56	9-5906856	9,9612402		9.6264454	10.3735546.		10.0357598	194093144	4
57	9.5909840	9.9641868		9.6267973	10.3732027		10.0358132	10.4090159	3
58	9.5912823	9.9641332		9.6271491	10-3728509		10.0358668	10.4087177	2
59	9.5915803 9.5918780	9.9640797		9.6275006	IC-3724994		10.0359203	10.4084197	1
65		9.9640261		L. Co- Cange	10 372 (48)		10.0359739 L.Co. Secant	L. Secant.	
<u> </u>	L. Co-Sine.	L. Sine	!		L. Tangent.	لــــــــٰ	L.Co. secant	L. Secant.	M
•		2		67 D.	EGREE	5.	•		[

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-	Ar Vina I	N. Co-Sin			N. Co-lang.	8	N N Strange	N. Co. Second	
M	N. Sine			N. Tongent.		1	N. Secant	N Co-Secant.	
_	3907311	9205049		4244749	23558524		10363604	25593047	_ 6 ე
I	3909989	9203912		4248152	23539483		10861016	25575521	59
2	3912666	9202774		4251616	23520469		10866289	25558022	58
3	3915343	9201635 9200496		4255051	23501481		10867634	25540548	57
4	3918019	9199356		4258487	23482519		10868979	25523101 25505680	56
5	39 2 0695 39233 71	9198215		4261924 4265362	23463582 23444672		10870326	25488284	55
	59-33/-	90,020,		420,302	234440/2		100/10/5	2,400204	54
7	3926047	9197073		-426880 a	23425787		10873024	25470915	53
7 8	3928722	9195531		4272239	2;406928		10874375	25453571	52
9	3931397	9194788		4275679	23388095		10875727	25436253	51
10	3934071	9193644		4279120	23369287		10877080	25418961	50
11	3936745	9192499		4282562	23350505		10878435	25401694	49
12	3939419	9191353		4286005	23331748		10879791	25384453	48
13	3942093	9190207		4289449	23313017		10881148	25367238	1
14	3944766	9189060		4292894	23294311		10882506	25350048	47 46
15	3947439	9187912		4296339	23275630		10883866	25332883	45
16	3950111	9186763		4299785	23256975		10885227	25315744	44
17	3952783	9185614		4303232	23238345		10886589	25298630	43
18	3955455	9184464		4306680	23219740		10887952	25281541	42
	20000	0.800.0		4010700	02027162		1000	04054.5=0	
19	3958127	9183313		4310129	23201160		10889317	25264478	41
20	3960798	9182161 9182008		4313579 4317030	23182606 23164076		10890683 108 9205 0	25247440 25230426	40
2 I 2 2	39 63469 396613 9	9179855		4326481	23145571	l	10892030	25213438	39 38
23	3968809	9178701		4323933	23127091		10894788	25196475	
24	3971479	9177546		4327386	23108636		10896159	25179537	37 3 6
]			,,
25	3974148	9176390		433084 0	23090206		10897531	25162624	35
26	3976817	9175234		4334295	23071801		10898904	25145735	3.1
27	3979486	9174077		4337751	23053420		10900279	25128372	33
28	3982155	9172919		4341208	23035064		10901655	25112032	32
29	3984823	9171760 91 7 0601		4344666	23016732		10903032	25095218	31
30	3287491	9.70001		4348124	22998425		10904411	2 50 7 8428	30
31	3990158	9169441		4351583	22980143		10905791	25061653	29
32	3992825	9168280		4355043	22961885		10907172	25044923	28
3 3	399549 2	9167118		4358504	22943651		10908554	25028207	27
34	3998158	9165955		4361965	22925442		10909938	25011515	26
35	4000824	9164791		4365429	22907257	1	10910323	24994847	25
36	4003490	9163627		4368893	22859096	l	10912709	24973204	24
	4006156	9162462		4372358	22870959		10914097	24961586	23
37 38	4008821	9161296		4375823	22852846	1	10915486	24944991	22
39	4011486	9160130		4379289	22834758		10916876	24928421	21
40	4014150	9158953		4382756	22816693		10918267	24911874	20
41	4016814	9157795		4386224	22798653		10919659	24895352	10
42	4019478	9156626		4389693	22780636		10921053	24878854	18
				4000060	2256664		700001.0	2496262	
43	4022141	9155456		4393163	22752643		10922448	24 8 62 380 24 845929	17
44	4024804	9154286		4396634 4400106	22744674		10923845	24829503	16
45 46	4027467 4030129	9153115		4400100	22726729 227 08807		10925243	24813100	-15 14
47	4032791	9150770		4407051	22690909	1	10928042	24796721	13
48	4035453	9149596		4410525	22673035		10929444	2478 0366	12
49	4038114	9148422		4414000	22655184		10930847	24764034	11
50	4040775	9147247		4117476	22637357		10932251	24747726	10
51	4043436	9146071		4420953	22619553		10933656	24731442	98
52	4046096	9144895		4424431	22501773 22584016		10935063 109364 7 1	24715181	
53	4048756 4051416	9143718 9142540		4427910 4431390	22566283		10937880	246 98943 246 82729	7 6
54	1-7-4.0	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		117.790					
55	4054075	9141361		4434871	22548572		10939291	24666538	5
56	4056734	9140181		4438353	22530885	ŀ	10940703	24650371	4
57	4059395	9139000		4441835	22513221	•	10942116	24634227	3
ś 8	4062051	9137819		4445318	22495580	i i	10943530	24618106	2
59	4064709	9136637		4448802	22477962]	10944946	246 02008 245 85933	1
60	N. Co-Sine	9135454 N. Sine.	}	4452287 N Co Tang.	22460368 N Tangant		10946363 N.Co-Secan.t	N. Secant	M
} — J	14. CO -3178	II. Sine.			N. Tangent.		14.C0-3 ccou.t	14. Sciant	147
نا				66 D E	GREES	•			

,		Artificia	l Sin	es, Tai	ngents and	d Sec	ants		4%
_					EGREE			and the second	
M	L. Sine.	L. Co-Sine		L. Tangen	L. Co. Tang.	1	L. Secant.	L Co-Sec.ant	
0	9.5918780	9.9540261	1	9.6278519	10 3721481	1	10,0359739	10.4581220	.50
1	9.5921755	9.9639724	:	9.6282031	10.3717969		10.0360276	10.4078243	-59
2	9-5924728	9.9639187		9.6285540	19.3714460		10.0360813	10.4079372	58
3	9.5927698	9.9638650	٠ ،	9.6289048]	10.0361350	10.4072302	+57
1 4	9.5930666	9.9638112		9.6292553		1 :	10.0361888	10.4069334	356
5	9·5933631 9·5936594	9-9637574 9 -96 3 703 6	i.	9.6296057	10.3703943	1	0.0362426	10.4066369	, ,,
1_	7 1750194	33037030	1	7 0 2 9 9 9 9	25,3700442	I i	0.0302904	104053476	-54-
7	9-5939555	9.9636496	l '	9.6303058	10,3696942	1	40.0363504	10-4060445	120
7	9.5942513	9 9635957	٠	9.6306556	10 3693444	[]	10.0364043	10.4057487	753 752
9	9-5945469	9.9635417		96310052	10 3689948		40.0364583	10.4054531	41
10	9.5948422	9.9634877		9.6313545	10,3686455		10-0365123	10.4051578	190
. 71	9-5951373	9.9634336		9,6317037			10.0365664	10.4048627	and the
12	9-5954322	9.9633795		9.6320527	1013679473	ľ	10.0366205	10.4045678	-48
13	9.5957268	9.9633253		9,6324015	10.3675985	'	10.0366747	0.40105-0	
14	9.5960212	9.9632711		9.6327501	10:3672499	!	10.0367280	10-4042732	47
15	9.5963154	9.9632168		9.6330985	10.3669015	:	10.0367832	0.4039788	46
16	9.5966093	9.9631625		9.5334468	10.3565522	:	10.0368375	0.4033907	45
17	9.5969030	9.9631082		9.6337948	10.3662052		10.0368918	10.4030970	44
18	9.5971965	9 •9630538		9.6341426	10.3658574		10.0369462	0-4028035	42
<u> </u>	0.507490-	D 060000		0.6044=	10.55.55	l .		<u> </u>	
19	9.5974897	9,9629994	·	9.6344903	10.3655097		10.0370006	10 4025103	47
20	9.5977827	9.9629449 9.9628904		9.6348378 9.6351850	10.3651622	. ;	10.0370551	0.4022175	40
21	9.5983679	9.9628358		9.6355321	10-3644679	•	10.0371096	0.4019246	39
23	9.5986602	9.9627812		9.6358790	103641210		10.0372188	10.4016321	38
. 24	9.5989523	9.9627266		9.6352257	10.3637743		ιψ.Ω372734	10.4013395	37
						;	1,37,34		36
25	. 9-5992441	9.9626719	:	9.6365722	10.3634278	!	19.0373281	10.4007559	35
26	9-5995357	9.9626172		9.6369185	10.3630815		14.0373828,	10.4004643	324
27	9.5998271	9.9625624		9.6372646	10.3627354		10.0374376	10.4001770	93
28	9.6001181	9.9625076	1	9 6376106	10.3623894	i	13.0374924	10.3998819	38
29	9.6006997	y 9624527 9 y623978		9.6379563	10.3620437		10.0375473	10.3995910	31
. 30	9.0000997	9 9043978		9.6383019	10-3010901		19.9376022	0.3003003	-30
31	9.6009901	9.9623428		9.6386473	10.3613527	•	10.0376572	0-3990099	1-1-
32	9.5012803	9.9622878		9.6389925		,	10-0377122	10.3997197	20
; 33	9.6015703	9.9622328		9.6393375	10.3606625		19.0377673	0.3984297	28
34	9.6018600	9.9621777		9.6396823	10.3603177	1	19.0378223	10.3981400	27
35	9 602 1495	9.9621226		9.6400259	10.3599731		19-0378774	40.3978505	25
36	9,6024388	9.9620674		9.6403714	10.3596286	!	19.0379325	10.3975512	24
	9.6027278	9.9620122		0.6407156	10.3592844		1000000-0		+
37	9.6030166	9.9619569		9.6407156 9.6410597	10.3589403		10.0379878 10.0380431	10.3972722	23
39	9.6033052	9.9619016		9.6414036	- / ^		19.0382984	10.3969834	22
40	9.6035936	9.9618463		9.6417473	10.3582527		10.0381537	10.3964964	21
41	9.6038817	9.9617909		9.6420908	10.3579092	į	10.0382091	10.3961183	20
. 42	9.6041696	9.9617355		9.6424342	10.3575658		10.0382645	10.3958304	19
			·]			•	-		1
43	9.6044573	9.9616800	•	9.6427773	10.3572228		10.0383200	10.3955427	117
44	9.6047448 9.6050320	9-9616245		9.6431203	10.35687.97		19.0383755	10.3922222	16
45	9.6053190	9-9615689		9.6434631 9.6438057	10.3565369		10.0384311	10.3949680	15
1 40	9.6056057	9.9614576		9.6441481	10.3558519	;	10-0384867	10.3946810	. 24
46 47 48	9.6058923	9.9614020		9.6444903	10.3555097		14.0385424 14.0385980	10.3943943	13
+								10.3941077	12
49	9.6261786	9.9613463		9-6448324	10.3551676	i	10.0386538	10.3938214	13
. 50	9.6064647	9.9612904		9.6451743	10.3548257	:	100387096	10.3935353	10
5 E	9.6067506	9.9612346		9.6455160	10.3544840	I	10,0387654	10-3932494	9
52	9.6070362	9.9611787		9.6458575	10.3541425		10,0388213	TO 3929638	8
53	9.6073216 9.6076068	9.9610668		9.6461988	10.3538012	i	1040388772	49-3926784	7
54	9.007,0000	2.2010000	į.	9.6465400	10.3534600		10.0389332	10.3923932	-6-
155	9.6078918	9.9610108].	9.6468810	10-3531190		10,0389892	10.202108	
: 56	9.6081765	9.9609548		9-6472217	10.3527783		10,0360452	1b.3921082 1b.3918235	: 9 1
57	9.6084611	9-9608987		9.6475624	10.3524376		10,0391013	10.3915389	1 4
57 58	9.6087454	9.9608426		9.6479028	10.3520972	ı	10,0391574	10-3912546	3
59	9.6090294	9.9607864		9.6482431	10.3517569		10,0392136	10.3909706	3
်ဂ	9.6093133	9.9607302		9.6485831	10.3514169	. 1	100392698	1b.3906867	0
	L Co-Sine.	L. Sine	/	L.Co-Tang.	L. Tangens.	ı		L. Secant.	M
•					GREES.				

40	A TABLE of Natural and									
ت ا	24 DEGREES									
M N. Sine N. Co-Sine. N. Tangent. N. Co-Tang. N. Secont N Co-Secont										
0	4067366	2135454	! :	4452287	22460368		10946363	24585933	60	
I	4070023	9134271	i	4455723	22442796	1:	10947781	24569882	59	
.2	4072680	9133087	ľ	4455260	22425247		10949201	24553853	58	
3	4075337 4077993	9131902		4462748 4466237	22407721		(10950622 (10952044	24537848 24521865	57	
,5	4080649	9129529		4469727	22372738	[-	10953467	24505905	55	
. 6	4083305	9128342		4473217	22355280	<u> </u>	10954892	24489968	54	
7	4085960	9127154	1	4476708	22337845	· .	10956318	24474054	53	
8	4088615	9125965		4480200	22320433	l .	10957746	24458163	52	
9	4091259	9124775		4483693 4487187	22303043 22285676		10959174	24442294 24426448	51	
14	4096577	9122393		4490682	22268331		10962036	- 24410624	50	
32	4099230	9121201		4494178	22251009	Ì	10963468	24394823	49 48	
33	4101883	9120008		4497675	22233709		10964902	24379045	47	
14	4104536	9118814		4501173	22216432		10966337	424363289	46	
TŞ	4107189	9117620		4504672	22199177		10967774	24347555	45	
17	4109841	9115229		4508172 4511 6 73	22181944 22164733		10969212	24331844	44 43	
18	41:5144	9114032		4515174	22147545		10972091	24300489	42	
- 29	4117795	9112835	;	451867C	22130379		10973533	24284844	-	
20	4120446	9111637	;	4522179	22113234		10974976	24269222	41	
. 21	4123096	9110438		4525683	22096112		10976420	24253622	38 30	
22	4125746	19109238	,	4532694	22079012 22061934		10977866	24238044 24222488	38	
24	4131044	9106837		4536201	22044878		10980761	24206954	36	
1	457747	9105635		4539709	22027843		10982211	24191442		
26	4133693	9104432	1	4543218	22010831		10983662	24175952	35	
27	4138990	9103228		4546728	21993840		10985114	24160484	33	
28	4141638	9102024 9100819		455G239 4553751	21976871 21959923		10986568	24145038 24129613	32	
30	4144285	9099613		4557264	21941997		10989479	24114210	30 31	
+		9098406		4960777	21926093		10990936	24098829	-	
31	4149579	9097198		4564291	21929210		10992395	24083469	29 28	
93	4154872	9095990	;	4567806	21892349		10993855	24068132	27	
34	4160163	9094781 9 09 3571		4571322 4574839	21875510		10995317	24052815 24037520	26	
35	4162868	9092361		4178357	21841894		10998243	24022247	24	
122	A Property of	9051150	ì	4581876	21825110		10999709	24006955	-	
37	4163433 4168667	9089938	. !	4585396	21808364	,	1.1001176	23991764	23	
39	4170741	9088725	;	4488917	21791631		L1002644	23976555	21	
40	4173385	9087511 9086297		4 \$ 92439 4 \$ 95962	24774920 24758229		11004113 11005584	23951367 23946201	20	
41 42	4178671	9085082		4999486	21741559		LI007056	23931055	19 18	
+	-	9083866	†				TICOPEC	-		
43	4183955	9083808	h	4603011 4606537	24724911 21708283		11008529 11010004	23915931 23900828	17 16	
45	4186597	9081432		4610064	21691677	.	11011480	23885746	15	
: 46	4189239	9080214	ı	4613591	21675091 21658527		L101 2957	23870685	14	
47	4191880	9070995		4617119 4620648	21641983	. 1	11014436 11015916	23855645 23840625	13	
+										
19	4197151 4199801	9076554 9075333		4624178 4627709	21625460 21608958		11017397	23825627 23810650	11	
51	4302441	9074111	·	4631242	22592476		14020363	23795693		
: 52	4205080	9072888		4634776	21576015	,	1:1021849	23780758	8	
53	4207719 4210358	9071664 9070440		4638311 4641846	21559575 21543156		1.1023335 1.1024823	23765 ⁸ 43 23 7 50 94 9	7	
+	-									
77	4212996	90679 ⁸ 9		4645382	21526757	.	14026313 11027803	23736075 23721222	5	
96	4215634 4218272	9067909	.	4648919 4652457	21510378 21494020		11027803	23721222	4	
1 48	4220909	9065535		4655996	21477683		11030789	23691578	3.2	
199	4223546 4226183	9064307 9063078		46 595 3 6 46 630 7 7	21461366	 	11032283 11033779	23676787 23662016	1	
•0	N. Co - Sine	N. Sine.	:	N.Co. Tang.	N. Tangent.	f j	N.Cb-Secant.	N. Secans	M	
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MI	L. Sine.	L. Co-Sine		L. Tangent	L. Co. Sang.		L. Secant.	L Co-Sec.ant	
0	9.6093133	9.9507302		9.6435831	10.3514169	,	10.0392698	10.3906007	6a
	9.6095969	9.9606739	1	9.6489230	10.3510770	!	10-0393251	10.3904031	59
1 2	9.6093803	9.9606176		9.6492528	10.3507372		10.0393821	10.3931197	58
3 1	9.6101635	9.9605612		9.6496023	10.3503977	!	10.0394388	10.3838365	57
4	9.6104465	9.9625048	1	9.6499117	10.3500583	:	10.0394952	10.3895535	56
5	9.6107293	9.9604484	j	9.65028/39	10'3497191	;	10.039 5 516	10.3892707	55
6	9.6110118	9.9603919	1	9.6506199	10.3193801	ļ.	10.0390031	3009552	54
	9.5112941	9.9603354		9.6509587	20.3490413	1	10.0396646	10.3887059	53
7.	9.5115762	9 96 2788		9.6512974	10.3437026	,	.10.0397212	10.3884228	52
9	9.6118580	9.9502222	/	9.6516359	10.3483641		10.0397778	10.3381420	51.
10	9.6121397	9.9601655		9.6519742	10.3480258		10-0398345	10.3878603	50
71	9.6124211	9.9601088		9,6523123	10.3476877		10:0398512 10:0399480	10.3875789	49
12	9.6127023	9.9600520		9.6526503	ID*3473497	;	1	- 39/29//	48
	9.6129833	9.9599952	1	9.6529381	ID. 3470119	1	10.0400018	10.3870167	47.
13	9.6132641	9.9599384		9.6533257	10.3466743	;	10.0400616	10.3867350	46
15	9.6135446	9.9593815	•	9.6536631	10.3463369		10.0401185	10.3864554	45
16	9.6138250	9.9598246		9.5540001	IP-3459996		10.0401754	10.3861755	44
17	9.6141051	9.9597676		9.6543375	10.3456625	;	10.0402324	10.3858949	43.
18,	9.6143850	9.9597106		9.6546744	10.3453256		10.0402891	10.3856150	42'
	0.6146645	9.9596535		9.6550112	10.3449888		10.0403465	10.3853353	41:
19	9.6146647 9.6149441	9.9595964		9.6553477	10.3446523		10.7404736		40
20; 21	9.6152234	9.9595393		9.6556841	10.3443159	li	10.0404607	10.3847765	39
22	9.6155024	9.9594821		9.6560204	10.3439796	[]	,10.0405179	10.3844976	38;
23	9.6157812	9.9594248		9 6563564	10.3436436		,r0.0405752	10.3842188	37
24	9.6160598	9.9593675		9.6566923	10.3433077	;	,10.0105325	10.3839401	36
	26162080	2 2522722		9.6570280	10.3429720		10.0406898	10.3836518	-
25	9.6163382	9.9593102		9.6573636	10.3426364	1	10.0407472	10.3833836	7,35
. 26 27	9.6168944	9.9591954		9.6576989	10.3423011	l i	10.0408046		34
28	9.6171721	9.9591380		9 6580341	10.3419659		10.0408620	10 3828279	32
29	9.6174496	9.9593805		9.6583692	10.3416308		10.0409195	10.3825504	-31
30	9.6177270	9.9590219		9.6587041	1C-3412965	;	10.0409771	10-7822730	30
	6.8004	0.0480640		9.6590387	16.3409613		T 0.0410347	13.3819950	
31	9.6180041	9.9589653 9.95890 77		9.6593733	10.3406267		10.0410923	10.3817191	29 28
32	9.6185576	9.9588500		9.6597076	10.3402924		10.0411500	10/3814424	27
33 34	9.6188341	9.9587923		9.6600418	10.3399582	1	110.0412077	10281164	1626
35	9 6191103	9.9587345		9.6603758	10.3396242	11	13-0412655	10,3808397	₹825
36.	9.6193864	9.9586767		9.6607097	10.3392903	11	10.0413233	10.3806139	24
	9.6196622	206.00		9.6610434	10.3389566		10 0413812	10.282222	
37	9.6199378			9.6613769	10.3385231		10.0414391	10.3803378 10.3800622	23
38	9.6202132			9.6617103	10.3382897		10.0414970	10,379786	21
39 40	400.	9.9584450		9.6620434	10-3379566		10.0415550	193795116	20
41	9.6207634	9.9583869	١,	9.6623765	1p.3376235		10,0416131	10.3792366	19
42	- /	9.2583288	l	9.6627093	10-3372907		10.0416712	10-3789619	18
	062233	0.0580505	l	9.6630420	10.3369580	li	10.0417293	10.3786837	
43	9.6213127			9.6633745	10.3366255		10.0417875		17
44	9.6218612	9.9581543	1	9.6637069	10.3362931		10.0418457		
45 46			1	9.6640391	10.3359609		100419039	10.3778649	9414
47	9.6224088	9.9580378	1	9.6643711	10.3356289		10.9419622	10-377.5912	- [2]
48			1	9 6647030	10.3352970	1	10.0420206	10.3773170	
_	- 600011		١.	0.6640346	10.2240664		10.0400700	10 27724	·
49			Ì	9 6650346 9.6653662	1p.3349654		10.0420790		
50	9 6232287		l	9.6656975			10.0421959		9;
51 52				9.6660288			10.0422544		\> 8
53	- (9 95 7 68 70	1:	9.6663598	10.3336402		10-0423130	10.3759532	C 7
54			L	9.6666907	10.3333093	1:	10.0423716	10.3756810	6
—	· (2/12)			0 66200	rb 2220286	1 !	0.0434303	10:336306	
55	9.6245911	9 9 5 7 5 6 9 7	1	9.6670214 9.6673519			10.0424303		11
56				9.6676823	10.3320431		10.0425478		
57				9.6680126			10.0426066		2
1 59	- /- /		1	9.6683426			10.0426654	10.3743228	1
60			1	9.6686725	10.3313275	1	10.0427243	10:3740517	_ 0
1-	L Co-Sine		1 .	L.Co-Tnag.	L. Tangent.	1	L.Co-Secant	L. Secant.	M
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1				25 D	EGREE	S			
M	N. Sine	N. Co-Sine	r	N. Tangent.		•	N. Secant	N Co-secant	
0	-1	9063078		4663077		1		23662016	60
1	-1	9061848	ł		21445069	-1.	110337:9		1
1	1 ' '	9061648	1	4666619	21428793	ľ	11035277	23647265	58
2	1.3.177	9059386		4670162 4673706	21412537	ł	11036775	23632535	58
3	1	9058154	1	4677251	21396301 21380085	1	11038275	23617826 23603136	57
5		5056921	1	4680797	21363889	1	11039777 11041279	23588457	56
6	4241994	9055688	ı	4684343	21347714	1	11042783	23573818	55
	4-4-774		·I	4004345	2234//14	.]	11042/33	-5,7,3010	54
7	4244628	9054454	ì	4687895	21331559	1	11044289	23559189	53
8		9053219	l	4691438	21315423	1	11045795	23544581	52
9	4249895	9051983	i	4694988	21299308	I	11047303	23529992	51
IQ		9050746	1	4698539	21283213	1	11048813	23515424	50
11	4255161	9049509		4702090	21267137		11050324	23500875	
12	4257793	9048271	l	4705643	21251082	1	11051836	23486347	49 48
			l			1			
13	4260425	9047032	l	4709196	21235046		11053349	23471838	47
14	4263056	9045792	j	4712751	21219030	I	11054864	23457349	46
15	4265687	9044551	l	4716306	21203034		11)56380	23442880	45
16	4268318	9043310	l	4719863	21187057		11057898	23428431	44
17	4270949	9042825		4723420	21171101		11059417	23414002	43
18	4273579	9040027		4726978	21155164	[11060937	23399593	42
	4276209	9039582		4730538	97.500.44	1	110624-0	23385203	-
19 20	4278838	9038338		4734098	21139246	1	11062458	23370833	4
21	42/0030	9037093		4734096 4737659	21123348 21107470		11003901	23356482	40
22	4284095	9035847		4/3/039	21091611		11067031	23342152	39
23	4286723	9034600		4744785	21075771	1 1	11068558	23327840	
24	4289351	9033353		4748349	21059951		11070087	23313548	37 36
				77777		.			,,,
25	4291979	9032105		4751914	21044150		11071616	23299276	35
26	4294606	9030856		475548E	21028369	1 1	11073147	23285023	34
27 28	4297233	9029606		4759048	21012607	1 1	11074680	23270790	33
28	4299859	9028356		4762616	20996864	1 1	11070214	23256575	32
29	4302485	9027105		4766185	20981140	1 1	11077749	23242381	31
30	4305111	9025853		4769755	20965436	l l	11079285	23228205	30
!		0004600	•	4550006		l l		0.074040	
431	4307736	9024600	. `	4773326	20949751		11080823	23214049	29
_32	4310361	9023347 9022093		4776899	20934084	1	11082363	23199911	28
33;	4312986	9020838	1	4780472 4784046	20918437		11083903	23185794 23171695	27
:34	4315610	9019582		4787621	20902809 20887200	1	11086989	23157615	26
- ~35,	4313234 4320857	9014325			20871610		11088533	23143554	25
36	4320057	90,43-7		4791197	200/1010	1 1.	11000733	-3.13/74	24
37	4323480	9017068		4794774	20856039		11090079	23129513	23
38.	4326103	9015810		4798352	20840486	l I	11091627	23115490	22
. 39	4328726	9014551		4801932	20824953	1	11093176	23101486	21
40	4331348	9013291	1	4805512	20809438	1 1	11094726	23087501	20
41	4333970	9012031		4809093	20793942		11096277	23073535	19
42	4236591	9010770		4812675	20778465	l	11097830	23059588	18
						l	<u> </u>		
43	4339212	9၀၀၇၄၀8		4816258	20763007	i	11099385	23045660	17
44	4341833	9008245	: I	4819842	20747567	ľ	11100941	23031751	16
45	4344453	9006982		4823427	20732146		11102498	23017860	15
46	4347073	9005718	-	4827014	20716743		11104056	23003988	14
47	4349692	9004453	ı	4830601	20701359	ŀ	11105616	22990134	13
48	4352311	9003187	; !	4834189	20685993	ł	11107177	22976299	12
	1011000	000111		4837778	20670646	l	11108740	22962483	
49	4354930	9001921		4841368	20070046		1110304	22948685	11
50	4357548	900c654 8999386	I	4844959	20640008	1	11111869	22934906	10
51	4360166 4362784	8998117	1	4848552	20624716	· •	11113436	22921145	8
52·	4365401	8996848	ı	4852145	20509442	i	11115004	22907403	7
54	4368018	8995578	i	4855739	20594187		11116573	22893679	6
74	75-0-10	-,,,,,,	. 1			1			
. 55	4370634	8994307	. [4859334	20578950		11118144	22879974	5
56	4373250	8993035		4862931	20563732		11119716	22866286	. 4
57	4375866	8991762	; 1	4866528	27548531		11121290	22852618	3
58	4378482	8990489	: [4870126	20533349		11122865	22838967	2
59	4381097	8989215	1	4873726	20518184		11124442	22825334	1.
60	4383712	8987940	1	4877326	20503038	1.	11126019	22811720	_ 0
	N. Co-Sine	N. Sine.	- 1	N Co Tang.	N. Tangent.		N.Co-Secant.	N. Secant	M
<u>_</u>					GREES	•			

M. L. Sime. O. 02519433 pyr32767	 				25 D E	GREES				
	- M	L. Sine	L. Co Sine					I. Secont.	L. Con Second	
90464701 99773168 96650032 10.3109777 10.0128732 10.9773160 30.906381 90.90638197 90.971678 96695013 10.3103357 10.0428021 10.3773299 77 90.907303 99.963966 90.967303 99.963966 90.9703170 99.963976 90.967370 99.963976 90.967370 99.963976 90.967370 99.963976 90.96370 90.9637										
2 9.0626497 9.957988 9.6593319 10.330681 10.0439112 10.3773109 58 59 59 59 59 59 59 5										
3 96227601 0.9770987 9.0509601 0.320920 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.31010000 0.310100000 0.310100000000 0.3101000000000000000000000000000000000							l			59
0.647/002									10-3735103	
5 9.6437303 9.9505876 9.9570877 9.9505873 9.6706345 10.3293214 10.0439785 10.7374499 54 8 95431000 9.968379 9.9578372 9.9576377 9.9578839 9.9573782 9.9576437 9.957837 9.957437 9.957837 9.957437 9.957837 9.957437 9.957837 9.957437 9.957837 9.957437 9.957437 9.957459 10.3283372 10.043375 10.327459 12 9.958372 9.9576376 9.957370 10.3273700 10.3273700 10.327353 10.043375 10.327373 9.958372 9.9576456 9.957370 10.3273700 10.3273700 10.327370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.043370 10.327353 10.327		9.6270202					1		10.2720607	
6 9.6475701 9.9562415 9.9560415 10.3293144 10.0430785 10.3714259 14. 7 9.6478307 9.9568303 9.6719306 10.3283545 10.0431975 10.3718301 53. 9 9.6433782 9.9567437 9.95716345 10.3283545 10.0431931 10.3718318 51 10.96488472 9.956844 9.6719306 10.3177090 10.0431370 10.3718318 51 10.96489472 9.956844 9.6719306 10.3177090 10.0431370 10.3718318 51 10.9648946 10.916484 9.6719301 10.3177300 10.0431370 10.3718328 51 10.946894 9.956845 9.956845 9.9574810 10.3177300 10.0431370 10.3718328 51 10.946894 9.956845 9.9574817 10.3677315 10.0431316 10.371840 49 19.049741 19.9569370 9.956845 9.9573474 10.3267355 10.0431315 10.370840 49 19.049741 19.9569370 9.956845 9.6732745 10.3267355 10.0431315 10.3708474 47 19.9569347 9.9578456 10.3267355 10.0431315 10.3708474 47 19.9569347 9.9578456 10.3267355 10.0431315 10.3708474 47 19.9569347 9.9578456 10.3267355 10.0431316 10.3708474 47 19.9569343 9.956845 9.6778372 10.3267355 10.0431316 10.32694774 47 19.9569343 9.956845 9.6778372 10.3267365 10.0431316 10.32694774 47 19.9569343 9.956886 9.6778372 10.334164 10.0437979 10.3669414 41 10.3667442 40 10.3667444 41 10.3667444 41 10.366744 40 1					9.6703197		I		10.3726007	
7 9.0578397 9.956803 9.05709774 BD.3292226 10-0431377 10.372603 53 9.0538782 9.9559437 9.0713050 12-3238595 10.0431970 10.3718010 52 9.05684472 9.0568459 9.0713050 10.3233955 10-04331315 10.3718313 50 11.96589100 9.956859 9.0713050 10.3273310 10.04337310 10.04337310 10.04337310 10.03731032 12 9.0591845 9.956565 9.0723745 10.3277032 10.0433731 10.03731032 10.037310									10-3724200	
8 9'5481cpo 9,4583pd 9,6713pd 10-3483pd 10-0413pd 10-3718al 51 10-9688472 9,956844 9,6719648 10-3883pt 10-0413pd 10-3718al 51 19.618pd 10-9686472 9,956856 9,6719648 10-3883pt 10-0413pd 10-3718al 51 19.618pd 10-9686472 9,956856 9,6719648 10-3873pd 10-0413pd 10-0313pd 10-3718al 51 19.618pd 10-9686456 9,671946 10-37193pd 10-0313pd 10-3718al 51 10-9686456 9,9573dpd 10-3273pd 10-0413pd 10-3718al 51 10-3718al 5							l			
9 9.6283782 p.965437 p.965437 p.96716345 io.3283555 loo.432163 lo.3715432	7	9.6278397	9.9568023							53
10 9.6486472 9.9766844 9.9719632 10.34383372 10.04333146 10.3713438		9.0781090				10.3280940	1			
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64 DEGREES.		L. Co-Sme.	L Sine.					L.Co-Secent	L Secant	M
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M	N. Sine.	N. Co-Sine.		N. Tangent.	N. Go-Tang.		N. Secant.	N Co-secant	
0	4383712	8987940		4877326	20503038		11126019	22811720	60
<u> </u>	4386326	8986665		4880927	20487910				
2	4388940	8985389		4884530	20472800		11127598	22798124	-59 -58
	4391553	8984112		4858123	20457708		11129179	22784546	
3	4394166	8982834		4891737	20442634		11130761	22770986	57
	4396779	8981555		4895343	20427578		11132345	22757445	56
5	4399392	8980276		4898949			11133930	22743921	55
	739939-	0900270	·	4090949	20412540	1	11135516	227 30415	54
7	4402004	8978996		4002557	62 0207510	1	*****	222422	
7 8	4:04616	8977715		4902557	2 0397519 2 038 2 517	1	11137103	22716927	53
	4407227	8976433		4906166)	11138692	22703457	52
9	4409838	8975151		4909775	27367532	1 1	11140282	22690005	5 I
10	4412448	8973868		4913386	20352565	.]	11141874	22676571	50
. 11	4415058	8972584		4916997	20337615	i i	13.143467	22663155	49
12	441)0)0	109/2304		4920610	20322683		11145062	22649756	48
	4417668	8971299		1001001	20202760		*********		
13	4420278	8970013		4924224	20307769		11146658	22630375	47
14	4422887	8968727		4927838	20292473		11148255	22623012	46
15		8967440		4931454	20277991		11149854	22509667	45
16	4425496	8966152		4935071	20263133		11151454	22590339	44
17	4428104	8064864		4938689	20248289	ì	11153056	22583029	43
18	4430712	8964864		4942308	20233462		11154659	22569736	42
	4422222	8063655		40441-0	200:86:0				<u> </u>
.19	4433320	8963575		4945928	20218653	1	11156263	22556461	41
20	4435927.	8962285		4919549	20203862	}	11157869	22543204	40
21	4438534	8960994		4953171	20189088		11159476	22529964	30
22	4441140	8959703		4956794	20174331	i i	1,1161084	22516741	38
23	4443746	8958411		4960418	20159592		11162694	22503536	37
24	4446452	. 8957118		4964043	20144869		11164306	22490348	36
		00				1			
25	4448957	8955824	: -	4967669	20130164		11165919	22477178	35
26	4451562	8954529		4971297	20115477	1	11167533	22464024	34
27	4454167	8953234	٠.	4974925	20100806		11169149	22450889	33
28	4456771	8951938.	1	4978554	20086153		11170766	22437770	32
29	4459375	8950641		4982185	20071516		11172384	22424669	. 31
30	4461978	: 8949343	1	4985816	20056897		11174004	22411584	3c (
31	4464582	8948045	μ,	4989149	20042295		11175625	22393517	29
32	4467184	8946746		4993082	20027710		11177248	22385467	28
33	4469785	8945446	è	4996717	20013142		11178872	22372435	27
34	4472388	8944145	ŀ	6000352	19998590		80498	21359419	26
35	4474990	8942844		5003989	19984056	i	1119 25	22346420	
36	4477591	8941542)	5007627	19969539	l	11183753	22333438	25
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37	4480192	8940239	ĺ	5011266	19955038	l	11185383	22320474	22
38	4482792	6938936		5014906	19940554	į.	11187014	22307526	23
39	4485392	8937632		5018547	19926087	1	11188647	22294595	21
40	4487992	8936327		5022189	19911637	l	11190281	22281681	20.
41	4490591	8935021	•	5025832	19897204	l	11191916	22258783	19
42	4493190	8933714		5029476	19582787	l	11193553	22255903	18
			ł			į.			
43	4495789	8932496	1	5033121	19863387	ł	11195191	22243039	17
44	4498387	8921098	ı	5036767	19854003	ŧ .	11196831	22230192	16
45	4500985	8929789	1	5040415	19839636	ł	11198472	22217362	
46	4503582	8928479	l	5044063	19825286	ł	11200115	22204548	15
47	4506179	8927169	l	5047713	19810952	ł	11201759	2219175	14
48	4508776	8925858	1	5051363	19796635	l	11203405	22178971	13
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49	4511372	8924546	l .	5055015	19782334	l	11205052	22165207	I I
50	4513968	8923233		5258668	19768050	l	11206700	2215346	11
	4516563	8921920	•	5062322	19753782	ł	11208350		10
51.	4519158	8920606	l	5065977	19739531		11210001	22140730 22128016	9
52 53		8919291	Į	5069633	19725296		11211653	22115318	8
53	4521753	8917975		5073290	19711077	I	15213307	22102637	7
54	4524347	1	Ī	7 73590		i l	-,,	-210203/	6
	4526941	8916659		5076948	19696874		11214953	22089972	
55				5080607	19682688		11216620		5
56	4529535	8915342		5084267	19668518	1		22077323	4
57	4532128	8914024		5087928	19654364		11218278	22064691	3
58	4534721	8912705			19640227	t l	11219938	22052075	2
59	4537313	8911385	1	5091591 5095254	19626105		11221600	22039476	1
_60	4539905	8910765	1				11223262	22026893	<u> </u>
	N Co-Sine.	N. Sine.	<u></u>	N. Co-Tang.	N. Tangent		N. Co-Secant.	N. Secont.	M
				63 DE (GREES.				
									

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M	L. Sine.	L. Co. Sine.		L. Tangent	L. Co-Tang.		L. Secont.	L. Co-Secant	-
-	9.6418420	9.9536602		9.6881818	19.3118182	1	10.0463398	T	
I	.——			9:6885023				10.3581580	60
2	9.6421009	9-9535369 9-9535985		9.6888227	19.3114977 19.3111773		10.046463	123578991	.52 58
3	9.6426182	9.9534751		96891430	10.3108570		10-0465249	10.3576404 10.3573818	
4	9.6428765	9.9534134		9.6894631	19.3105369		10.0465866	10.3571295	57 56
5	9-6431347	9-9533515		946897831	13-3102169		19.0466485	40.3568653	55
6	.9.6433926	9.9532898		9,6901030	19-3098970		10.0467103	10.3566074	54
						l		,	
7	.9.6436504	9.9532278		96994226	14309577	1	10-0467722	10.3563496	53
8	9.6439080	3.3531928		9,6907422 9,6910616	14.3092578 14.3089384		10.0468342	10.3560926	52
9	.9.644165 4 9.64442 26	9.9531038		9,6913809	19.3086191		10.0469582	10 3558346	51
11	9.6446796	99529797		9,6917000	10.3083000	l	10.0470203	10.3555774	90
12	9.6449365	9.9529175		9,6920189	10.3079811	l	10-0470825	10.3550635	49 48
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13	9.6451931	9.9528553		946923378	19.3076522	}	10.0471447	10.3148069	47
14	9.6454496	9.9527931		9,6926565	10.3073435	}	10.0472069	10-3545904	46
15	9.6457058	9-9527308		9,6929750	19.3070250	i	10.0472692	10-3545942	45
16	9.6459619	9.9526685		9,6932934	10.3067066	1	10.0473315	10-3540381	44
17	9-6462178 9-6464735	0.0526001		9,6936117 9,693 9298	10.3063883. 10.3060702	1	10,0473939	10-3537823	1 43
10		9-9525437	· ·	22.52.22	-145000/01		5064 1404.	103535265	42
19	9.6467290	9.9524813		9.6942478	10,3057522	l	10-0475187	10.3532710	- , -
20	9.6469844	9.9524188		9-6945656	10,3054344		10.0475812	10-3530156	41
21	9-6472395	9.9523562	•	94948833	10,3051167	1	10.0476438	10.3927605	
22	9.6474945	9-9522936		3432303	10,3047991	l	10.0477064	10.3525055	38
- 23	9.6477492	9.9522310		9.6955183	1013044817	'	10-0477690	10.3522508	37
24	9.6480038	9.9521683		97958355	1013041645	1	10.0478317	10-3519963	36
•	9.6482582	0.0531055		9.6961527	10:2028472	Ī	100478045	**************************************	+ + +
25 26	9.6485424	9.9521055 9.9520428		9-6964697	10:3038473 10:3035303		10,0478945	10.3517418	32
27	9.6487665	9.9519799		9.7967865	10:3032135		10.0480201	10-3512335	34
28	9-6490203	9.9519171		9-6971032	10,3028968		10,7480829	10-3509797	33
29	9-6492740	9.0518541		9-6974198	10,3025802		10-0481459	10°3507260	32
30	.9-6495274	9.9517912	;	9-6377363	10,3022637		10,0482088	10 3504726	31
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31	9.6497807	9 9517282		9.6980526	10:3019474		10.0482718	10.3202103	29
<u> </u>	9.6500338	9.9516651		9. 6 983687 9. 6 98 6 847	10.3016313		10.0483349	10.3499662	28
33	9.6502868	9.9516020		9.0999999	10:3013153		10.0483980	10.3497132	27
34	9.650539 5 9.6507920	9.9515389		9.6993164	10-3009994		10.0484611 10.0485243	10.3494605	26
35	9.6510444	9,9514757 9,9514124		9.6906320	10,3003680		10,0485876	10.3492080 10.3435556	25
36	**************************************	3131) - 4		-				10.34.05.7.70	24
27	0.6518966	9.9513492		9.6999474	10,3000526		10.0486508	10.3487034	1 22
37	0.6515486	9,9412858		9.7002628	1012997372		10.0487142	10 3494514	23
39	0.6518004	9-9512224		9 .700 5780	10,2994220		10.0487776	10.3481998	21
49	p.6520521	9-95 LESPO		9.7008930	10,2991070		10,0488410	10-3479479	20
: 41	9.6583935	9-9510956		9.7012080	17 29 7920		10-0489044	10-3476965	1 10
, 42	9.0535548	9.9510320		9.1015227	10,2984793.		10.0489680	10.3474452	18
4.0	p-6528a59	9.9509685	[']	9.7018374	10,2981626		10,0490315	10 347477	
43	9.6630868	9.9509049		9.7031519	10,2978481		19.049095	10.3471941 10.3469432	17
: 44 : 45	9.6533075	9.9508412		9.7024663	10,2975337		10.0491588	10.3466929	10
46	0.4435881	9.9507775	, 1	9.7027805	10 2972195		10.04572229	10-3464419	13
47	p.0538084	9.9507138		9.7030946	10/2969054		10.0492862	10'3461916	13
. 48	0.6540586	9,9506500		9.7034086	10,2964914		10.0493500	10-3459414	32
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1 49	9.6543086	919595861		9 7037225	10,2962775	1	100494135	10-3456914	11
50	9.6545584	9.9505223		9.7040362 9.7043497	10.2959698		100494777	10-3454416	10
; 5,1	9.6548081 9.6550575	9,950458a 9,9593944		9.7046632	10-2956503		10-0495417	10.3451919	, ş
; \$2 ; 53	9.6553968	9,9503303		9.7049765	80,2050235		130496197	10-3449425	
54	9.655559	9,9502663		9.7052897	10,2947103	.	10-0407327	10.344444	7
						h .			لتنا
: 55	2.6558048	9.9502022		9.7056027	10,2943973	ŀ	10,0407978	10.3441952	5
; 56	9.6560536	9,9501380		9.7759156	10,294,3844		10,0498620	10.3439404	4
57	9.6563721	9,9400738		9.7062284	10-2937716		100499262	10.3436979	3
; 58	9.6565505	9.9400095	;	9.7065410	10,2994496	' I	10 0499905	10.3434499	2
		9.9499452		9.7068535	10,293146		19,0500548	10.3432013	1
; 59	9.6567987			0.73746-0	10.0000		1 7 A A A A A		
\$9	9.657.0468	9,9498809		9.707.1659	10:2928341	,	10,050119	10.3429538	0
				L. Co-Tang.	10;2928341 L. Tangent: GREES	-	L.Go-Secant	£ Sécant	M _.

A TABLE of Natural and

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M	N. Sine.	N. Co-Sine.		N. Cangent.	N. Co-Tang.	<u> </u>	N. Secant.	N Co-Secant	
0	4539905	8910065	:	5095254	19626105		<u> </u>	22096893	<u> </u>
-	4542497	8908744		5098919		- [11223262		60
• 2	4545088	8907422	ż	5102585	19612000	,	11224926	22014326	58
3	4547679	8906100		5106252	19597910	Į.	11226592	22001775 21989240	58
4	4550269	8904777	. '	5109919	19569780	1	11229928	21976721	57
	4552859	8903453	1 .	5113588	19555739	1	11231598	21964219	55
5	4555449	8902128		5117259	19541713	1	11233269	21951733	54
	44.90		l .						
7 8	4558038	8900802		5120930	19527704	1	11234942	21939262	53
	4560627 4563216	8899476 8898 1 49		\$124602	19513711	ì	11236616	21926808	52
9 10	4565804	8896821		5128275	19499733	•	11238292	25914370	51
11	4568392	8895493		5131950 5135 6 25	19485771	ł	11239969	• 21901947	50
12	4570979	8894164		5139302	19457896	1	11241648	21889541	43
				7,5373	7777-70			210//130	48
13	4573566	8892834		5142980	19443981	i	11245010	21864775	47
14	4576153	8891203		5146658	19430093	1	11246593	21852417	46
15	4578739	8890171		5150338	19416200	ł	11248377	21840074	45
.16	4581325	8888839		5154019	19402333	1	11250063	21827746	44
17 18	4583910	8887506 8886172		5157702	19388481	I	11251750	21815435	43
10	4740497	00001/2		5161385	19374645		11253439	21803139	42
19	4589080	18884837		5165060	19360825	1	11255129	217000-	
20	4591664	8883502		5168755	19347020	1	11256821	21790859 21778594	41
21	4594248	8882166		5172441	19333231	l	11258514	21766346	40
22	4596832	8880829		5176129	19319457	ŀ	11260209	21754112	38
· 23	4599415	8879492		5170818	193 05698	,	11261905	21741895	37
24	4601998	8878154		5183508	19291956	l	1 1263603	21729593	36
-	4604580	8876815	1	6197100	T0078000				-
25 26	4607162	8875475	ş.	5187199 5190891	19278228	ľ	11265302	21717506	35
27	4609744	8874134		5194584	19250819	ł	11267003	21705335	34
28	4612325	8872793		5198278	19237138		11270408	21693180	33
29	4614906	8871451		5201974	19223472		11272113	21681040 21668915	32
30	4617486	8870108		5205670	19279821		11273819	21656806	31
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31	4620066	8868764		5200368	19196186		11275527	21644712	29
32	4622646	8867420		5213067	19182565	`	11277237	21532633	28
33	4625225	8866075		5216767	19168965		11278948	21620570	27
34	4630382	8864725 8863383		5220468	19155370		11280660	21608522	26
35	4632960	8862036		5224170 5227874	19141795 19128 2 36		11282374	21596489	25
	4030900	-	. !	7557674	19420250		11284089	21584471	24
37	4635538	8865688	. 1	5231578	19114691		11285806	21572469	23
38	4638115	,8859339	1,	5235284	19101162		11287524	21560482	23
39	4640692	8857989	:	5238990	19087647	5 ;	11289244	21548510	21
40	4643269	8856630	1:	5242698	19074147		11290965	21536553	20
41	4645845	8855288	• :	5246407.	19060663	(X)	11292688	21524611	19
42	4648421	8853936		5250117	19047193	Υ .	11294412	21512684	18
43	4650996	8852583	:	5253829	19033738		Tracking	01/2022	
44	4653571	8851230		5257541	19033/30		11296137 11297 8 64	21500772	17
45	4656145	8849876		5261254	19006874		11299593	21406875	16
46	4658719	18848521		5264969	18993464	ν,	11301323	21465127	15 14
47	4661293	8847166		5268685	189 80 068		11303055	21453275	13
47 48	4663866	8845810	. !	5272402	18966688	Y	11304788	21441437	12
	1666.00	884445		1276:00	.00				
49	4666439 4669012	8844453 8843095		5276120 5279839	18953322		11306522	21429615	11
50 51	4674584	8841736	t	5283559	18939971 18926634		11308258	21417808	10
52	4674156	8840377		528728I	18913313	×	11309996	21406015	• 9
53	4676727	8839017		5291004	18900006	[, 	11311/35	21394238	
54	4679298	8837656		5294727	18886713		11315217	21382475 21370726	7
55	4681869	8836294	1 1	5298452	18873436		11316961	21358993	. 5
56	4684439	8834932		5302178	18860172	. ,	11318706	21347274	4
57 58	4687009	883 3 569 883 22 05	:	5305906	18846924	;	11320452	21335570	3
50	4689578 4592147	8830841	' '	5309634 5313364	18833690 18820470		11322200	21323880	2
60	4694716	8829476		5317094	18807265		11323950	21312205	1
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1 96972946	0	9.6570468	9.9498809	9.7071659	10-292834	1	10.0501191	10,3420532	60
2 9.4577543 3 9.459763 5 9.70502 10.3932098 10.050317 10.050417 2	1	9.6572946	9.9498165		· • —— ——				-
3 9/65/7888 9/0496820 9/048141 10.21878 10.0490342 10.04819539 10.0490343 10.0490344 52.049034 10.0490343 10.0490344 10.0490343 10.0	2	9.6575423	9.9497521				10.0502470		
4 9658371 9-949582 9-949585 9-769738 10-3909620 10-090978 10-341658 14 6 9.658371 9-949585 9-769738 10-3909620 10-090978 10-341658 15 7 9.658786 9-9494202 9-7099581 10-3909399 10-0909378 10-3407380 11 9 9.658787 9-9494202 9-7099581 10-3903399 10-0909578 10-3407380 11 10 9.6595173 9-949364 9-7099581 10-3903399 10-0909578 10-3407380 11 11 9.0590793 9-9491700 9-7105933 10-380959 10-0909581 11 12 9.650093 9-9491701 9-710593 10-380959 10-0909584 10-3399907 40 13 9.650250 9-9490700 9-711248 10-388782 10-050959 10-3399907 40 13 9.650250 9-9490700 9-711248 10-388782 10-050959 10-3399907 40 13 9.650250 9-9490700 9-711248 10-388782 10-050959 10-3399907 40 14 97605005 9-948978 9-711248 10-388782 10-050959 10-3399907 40 15 9.6502911 9-9488490 9-7112461 10-387883 10-0510248 10-3399907 40 16 9.6502911 9-9488490 9-7112461 10-287833 10-0510248 10-3399097 40 17 9.6512361 9-948799 9-712465 10-287333 10-0512301 10-3339439 41 19 9.6517477 9-9488492 9-712365 10-287333 10-0512301 10-3339439 42 19 9.6517477 9-9488492 9-712365 10-287333 10-0512301 10-3339439 42 19 9.6517477 9-9488492 9-712365 10-287333 10-0512301 10-3339439 42 19 9.6517477 9-9488492 9-712365 10-285933 10-0512301 10-3339439 42 19 9.6517477 9-9488492 9-712465 10-287333 10-0512301 10-3339439 42 19 9.6517477 9-9488492 9-712365 10-285933 10-0512301 10-3339439 42 19 9.6517479 9-9488492 9-712365 10-285933 10-0512301 10-3339439 42 19 9.6517479 9-9488492 9-712365 10-285933 10-0512301 10-3339439 42 19 9.6517479 9-9488492 9-7124765 10-285933 10-0512301 10-3339439 42 19 9.6517479 9-9488492 9-7124765 10-285933 10-0512301 10-3339439 42 19 9.651749 9-948789 9-718478 10-285930 10-051418 10-3339439 42 19 9.651749 9-948789 9-718478 10-285930 10-051418 10-3339439 42 19 9.651749 9-948789 9-718478 10-0285930 10-051418 10-3339439 42 19 9.651749 9-948789 9-718478 10-0285930 10-051418 10-333993 44 19 9.651749 9-948789 9-718478 10-0285930 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051349 10-051	3	9.6577898	9.9496876	9.7081022			10-0503124		, ,
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7 9.6587780 9.9491492 9.7093485 10.2906512 10.29065705 10.3407295 13.9659717 9.9492947 9.709505 10.3903399 10.0606357 10.3407395 12.96597073 9.9492949 9.7102824 10.2897176 10.2697070 10.3407295 12.96597073 9.9492949 9.7102824 10.2897176 10.2697070 10.3407295 12.9659067 9.9481917 9.710904 10.289095 10.0609705 10.3407295 12.96500093 9.9481051 9.7112845 10.289095 10.0609095 10.3399495 43 10.2609705 10.3407295 10.3307495 10.3407295 10.3407295 10.3407295 10.3407295 10.3407295 10.3307495 10.3307495 10.3407295 10.3407295 10.3407295 10.3407295 10.3307495 10.3307495 10.34072	6	9.6585312	9-9494938	9.7090374	10.2909626	5	10.0505062	10-3414688	,,,
8 9-6590246 9-9493645 9-7109531 10.2903287 10.063515 10.3407380 10.3903287 10.9905297 9-7109324 10.2807176 10.063615 10.3407380 10.3407380 11.90597170 9-7102824 10.2807176 10.060820 10.3407380 11.90597170 9-7102824 10.2807176 10.060820 10.3407380 10.3407380 11.90597170 9-7102824 10.2807176 10.060820 10.3407380 10.34073780 11.905060000 9-7112146 10.2809059 10.0608940 10.3399907 40.80507459 9-9489171 9-7112451 10.2881440 10.0610248 10.3394907 10.90507459 10.90507459 10.9189171 9-7112451 10.2881440 10.0610248 10.3394951 10.90507459 10.948845 9-7112461 10.28178433 10.0611250 10.3390380 10.3390380 10.9050741 10.9050791 10.948845 9-7112461 10.28178433 10.0611250 10.3390380 10.3390380 10.9050741 9-948845 9-7112465 10.28178433 10.0611250 10.3380738 12.9050741 9-948845 9-7112465 10.28178433 10.0611250 10.3380738 12.9050741 9-948845 9-7112465 10.28178433 10.0611250 10.3380738 12.9050741 9-948845 9-7112465 10.28178433 10.0611250 10.3380738 12.9050741 9-948845 9-7112465 10.28178433 10.0611250 10.3380738 12.9050741 9-948845 9-7112465 10.2850741 10.0611250 10.3380744 9-712465 10.281785 10.2805074 11.00511245 10.0388098 10.031845 10.038818 9-7140051 10.285074 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.3380744 9-712465 10.281785 10.0611250 10.031785		6 0 - 0	2.242.42.42	7222.00		•		,	
9 9.6552710 9.9492979 10 9.6595717 9.9492940 10 9.6595717 9.9492940 11 9.65926917 9.9492140 12 9.6502091 9.949100 13 9.650250 9.949101 14 9.650209 9.949101 15 9.6502609 9.949111 16 9.6502609 9.949111 17 9.650200 9.949111 18 9.650201 9.948111 19 9.650201 9.948111 10 9.948111 10 9.650201 9.948111 10 9.948111 10 9.650201 9.948111 10 9.948111 10 9.650201 9.948111 10 9.948111 1	7						10-0505708		53
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62 DEGREES.		- CU BINE	L SINE.				. Co-Secant	L- Secant.	M.
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	· N Cina	N C C	· .		GREES		A7 . Sa. 10.4 . 1	A. C. Marie	
M	N. Sine	N. Co-Sine	I	N. L'angent.	V. Co Lang.	l	N. Secant.	N Ca-Secard	
0	46947 6	8829476		5317091	18807265		11325701	21300545	60
1	4697284	8828110		5320826	18794074		11327453	21288899	53
2	4699852	8826743	I	5324559	18780898		11329207	21277267	58
- 3	4702419	8825375	1	5328293	18767736		11330962	21265651	57
4	4704986	8824007 8822638	ı	5332029	18754588		11332719	21254048 21242460	55
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. 6	4/10119	0021206		5339503	10/20330			30,07	
7	47.12685	8819898	ł	5343242	18715231		11337999	21219328	53
7 8	4715250	8818527		5346982	18702141		11339762	21207783	52
9	4717815	8817155	- 1	5350723	18689064		11341527	21196253	51
10	4720380	8815782	4	5354465	18676203		11343193	21184737	50
11	4722944	8814409	- 1	5358208	18662955		11345090	21173235	49
12	4725508	8813035	1	5361953	18649921		11346829	21161748	48
	4728071	8811660	- 1	5055600	18636902	1	11348600	21150274	47
13	4730634	8810284		5365699	18623896		11350372	21138815	46
14	4733197	8808907	1	5369446 5373194	18610905		11352146	21127371	45
15 16	4735759	8807530	1	5376943	18597928		11353921	21115940	44
17	4738321	8806152	1	5380694	18584965		11355698	21104523	43
18	4740882	8804773	- 1	5384445	18572015		11357476	21093124	42
			J						
19	4743443	8803394	1	5388198	18559080		11359255	21081733	41
20	4746CO4	8802014	1	5391952	18546159		11351036	21070359	40
21	4748564	8800633		5395707	18533252	1	11362819	21058998	39
22	4751124	8799251	•	5399464	18520358	ļ	11364603	21047652	38
23	4753683	8797869	- 1	5403221	18507479		11366389 11368176	21036320	37
24	4756242	8796486	1	5406980	18494613			21025002	36
	475880I	8795102	ı	5410740	18481761		11369965	21013628	35
25 26	4761359	8793717	- 1	5414501	18468923	. 1	11371755	21002408	34
27	4763917	8792332	ı	5418263	18456099		11373547	20991131	33
28	4766474	8790946	ŧ	5422027	18443289		11375340	20979869	32
29	4769031	8789559	. 1	5425791	18430492		11377135	2 0968 62 5	31
30	4771588	8788171	1	5429557	18417709		11378932	20957355	30
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31	4774144	8786783	1	5433324	18404939	i	11380730	20946164	29
32	4779700	8785294		5437092	18392184 18379442	1	11384330	20934357	28
33	4779255	8784004 8782613		5440862	18366713		11386133	20923764 20912584	27 26
34	4781810	8781222		5444632	18353999		11387937	20901418	25
35	4784364 478 6 918	8770830		5448404 5452177	18341297		11389743	20890265	24
36	+//00/10								
37	4789472	8778437		5455951	18328610	•	11391550	20879127	23
38	4792026	8777043		5459726	18315936		11393359	20858002	22
39	4794579	8775649		5463503	18303275	1	11395169	20856890	21
40	4797171	8774254		5467281	18290628	1	11396981	20845792 20834708	20
41	4799683	8772858		5471060	18277994 182 6 5374	1	11390795	20823637	19 18
42	4802235	8771461		5474840]			<u></u>
	4804786	8770064		5478621	18252767	1	11402425	20812580	17
43	4807337	8768666		5482404	18240173	ł .	E1404243	20801536	16
44 45	4809888	8767267		5486188	18227593	ŧ	11406062	20790506	15
45	4812438	8765868	•	5489973	18215026	1	11407883	20779489	14
47	4814983	8764468		5493759	18202473	•	11409706	207684.6	13
48	4817537	87630 67	•	5497546	18189932	•	11411530	20757496	12
}	1800-06	0-6-66	1	200000	18177405		11413356	20746519	
49	4820086	8761665 8760262	1	5505125	18164892	1	11415183	20735556	10
50	4822634 4825182	8758859	1	5508916	18152391	1	11417012	20724606	
51	. 0	8757455	1	5512708	18139904	1	11418842	20713670	9
52		8756050	1	5516502	18127430	1	11420674	20702746	7
53 54		8754645		5520257	18114969	1	11422507	20691836	6
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55	4835370	8753239	1	5524093	18102521	1	11424342	20680940	5
. 56	4037910	8751832	1	5527890	18090086	1	11426179	20670356	4
57	4840402	8750424	1	5531688	18077664	1	11428017	20648328	3 2
58	4843007	8749016	i	'5535488 5539288	1805,2860	1	11431698	20537484	1
55	4845552	8747607	1.	5543090	18040478	1	11433541	20526653	oi
60		8746197	L	N. Co-Tang.		1	N. Co Secant.		31
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L. Tangent.	L. Co-Secant	L. Secans.	M
17-2562480	10.0581807	10.3144288	0
10-2565450	10.0381107	10.3146568	. 1
10.2568441	10.0380408	10.3148849	2
10.2561423	10.0579709	10.3151132	3
10 2574406	10.0579010	10-3153417	4
10.2577391	10.0578312	10.3155703	5
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10 2580376	10.0577614	10.3157990	7
19.2583362	10/0576221	10-3162570	8
10.2589338 10.2586350	10.0575524	10.3164863	9
10.2592328	10.0574329	10-3167157	10
10,52522315	10.0574134	10-3169452	11
10-2598311	10.0573439	10-3171750	12
10-2601304	10.0572745	1063174048	13
10,20,342,90	10.05/2051	10-3170349	14

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MI	N. Sine.	N. Co-Sine		N. Tangent.	N. Co-Tang.		N Second 1	N Co-Secant	
	4848096	8746197	1		18040478	ı	·	20626653	60
	4850640	8744786	ł	5543090		I	11433541		
1 2	4853184	8743375	1	5546894 5550 6 98	18028108 1801575 <u>1</u>		11435385	2061 5836 20605031	59 58
3	4855727	8741963		5554504	18003408		11439078	20594239	57
4	4858270	8740550	1	5558311	17991077		11440927	20583460	56
5	4860812	8739136		5562119	17978759		11442778	20572695	55
6	4863354	8737722	1	5565929	17966454		11444630	20561942	54
	18648-4	8726206	ı	1.6.7.7.				00444000	
7 8	4865895 4868436	8736307 8734891		5569739	17954162		11446484	20551203 20540476	53 52
9	4870977	8733475		5573551 5577364	17929616		11450196	20529762	51
10	4873517	8732058	ı	5581179	17917362		11452055	20519061	50
11	4876057	د487306 8		5584994	17905121		11453915	.20508373	49
12	4878597	8729221		5588811	17892893		11555776	20497698	48
	4881136	8727801		5400600	1799-649		11467620	20487036	4.7
13	4883574	8726381		5592629 5596448	1788 6678 17868475		11457639	2 0476386	47 46
15	4886212	8724960		5600269	17856285		11461370	20465750	45
16	4888750	8723538		5604091	17844107		11463238	20455125	44
17	4891287	8722116		5607914	17831943		11465108	20444515	43
18	4893824	8720693		5611738	17819790		11466979	20433916	42
	1806-6-	8719269		chicis.	17807651		11469852	2742222	
19 20	4896361 4898897	8717844		56155 6 4	17795524		11470726	20423330 20412757	41 40
21	4901433	8716419		5623219	17783409	·	11472602	20402197	
22	4903968	8714993		5627048	17771307		11474479	20391649	38 39
23	4906503	8713566		5630879	17759218		11476358	20381114	37
24	4909037	8712138		5634710	17747141		11478239	20370592	36
	400000	8710710		562844	17720016		11480121	20360082	
25 26	4911571	8709281		5638543 5642378	17 7 35076 17 7 23024		11482005	20349585	35
27	4914105 4916638	8707351		56.15213	17710385		11463897	20339100	34 33
28	4919171	8706420		5650050	17698958		11485777	20328627	32
29	4921704	8704989		5653888	17686943		11487665	20318168	31
30	4924236	. 8703557		5657728	17674910	٠,	11489555	20307720	.30
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31	4926767	8702124 8700690	.	5661568 5665410	17662950	٠,	11491447	20297286 20286863	.29 .28
32 33	4929298 493182 9	8699256	'	5669253	17639007	;	11495235	20226453	27
34	4934359	8697821		5673098	17627053		11497132	20266056	26
35	4236889	8696385		5676944	17515112		11495030	20245670	25
36	49394:9	8694949		5680791	17603183		11500030	20245297	24
		8693512		5684630	17591267		11502821	2)234037	
37 38	4941948 4944477	8692074	•	5688488	17579362	}	11504734	20224589	23
39	4947005	8690635		5692339	17507470	}	11502638	20214258	21
40	4949533	8689196		5696191	17555590		11508544	20203929	20
41	4952050	8687756		5700045	17543722	i :	11519452	20193617	19
42	4954587	8686315		5703899	17531866	. !	11512361	20183318	_18
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43 44	4957113	8683431		5707 7 55 5 711612	37508191		11516135	201/3031	17 16
45	4962165	8681988	1	5715471	17496371	l	11518099	20152494	15
46	4964690	8680544	1	5719331	17481564		11520015	20142243	14
47	4967215	8679100	ł	5723192	17472768		11521932	20132005	13
48	4969740	8677555	l	5727054	17460984	j i	11523851	20121779	12
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49	4972264 4974787	8676209	i	5730918 5734783	17449213 17437453	}	11525772	20111564 20101362	11
50	4974707	8673314	ĺ	5738649	17425705	1 1	11529518	20091172	10
52	4979833	8671866		5742516	17413959	} {	11531543	20080994	9
53	4982355	8670417	I	5746385	17402245	1	11533470	20070828	7
54	4984877	8668967	•	5750255	17390533		11535399	20060674	. 6.
	4987399	. 8667517	l	5754126	17378833		11537329	20050532	
55 56	4987399	8666066	•	5757999	17367144		11539261	20040402	5
57	4992441	8664614	ŧ	5761873	17355468		11541195	20030283	4 3
58	4994961	8663161	1	\$765748	17343803	'	11543130	20020177	2
49	4997481	, 8661708	ł	\$769625	. 17332149	1	11545067	20010083	1
60	5000000	8660254	1	5773503	17820508	1	11547:05	2000000	0
	N. Co-Sine.	N.Sine.	<u></u>	N. Co.Tang.	N. Tangent	·	N. Co.Secans.	N. Secant.	M
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Artificial Sines, Tangents and Secants.

29 D E G R E E S. M L. Sine. L. Co-Sine 9.6855712 9.9418193 9.743752 10.2562480 10.2582508 10.31442 1 9.6857901 9.0417492 9.7440499 10.2559501 10.2582508 10.31423	
0 9.6855712 9.9418193 9.743752 10.2562480 10.0581807 10.31442	
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3 9.6862542 9.9416590 9.7440473 10.2559572 10.0584612 10.31351	
5 9.6867088 0.9414685 9.7452403\ 10.2547597 10.0585315 10.31329	
6 9.6869359 9.9413982 9 745\$376 10-2544624 10.0586018 10-31306	1 54
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10 10 4880688 10 2470461 0 7470227 10 2520772 10 0580529 10 24102	2 49
11 9.6882949 9.9409755 9.7473194 10.2526806 10.0590245 10.31170	1 48
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13 9.6885200 9.9409048 9.7476160 10.2523840 10.0590952 10.31147	
1 14 9.0887407 9 9408342 9.74/9.25 10/2/2007 10/07/9103/11 10/07/9103/11 10/07/9103/11	21 7 1
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16 9.0891978 9.9406910 9.7488012 10.2511087 10.0502781 10.251057	ודי ומי
18 9.6896484 9.9405510 9.7490974 10.2503026 10.0594490 10.31035	-
9.6898734 9.9404801 9.7493934 10.2526066 10.0595199 10.31012	
9.7490892 10.2503108 10.0595909 10-30993 10-30993 10-30993 10-30993	7 40
9.6903231 9.9403381 9.7499350 10.2560150 10.0596519 10.30967	
9.6905476 3.9402670 9.7502806 10.2497194 10.0597330 10.30945	4 38
23 9.6907721 9.9401959 9.7707702 10.2494230 10.399341 10.39922	7 7 1
24 9.6909964 9.9401248 9.7508716 10.2491284 10.0538752 10.30900	0 36
9.6912205 9.9400535 9.751(669 10.2488331 10.0599465 10.30877	25
10.20856	5 35 5 34
7517572 10.2482427 10.0620800 10.20822	
0.6018010 0.0308396 2.7520523 10.2479477 10.0501604 10.30810	1 32
20 0.6021145 0.0307682 2 7523472 10.2476528 10.06 22318 10.30788	5 21
30 9.6923388 9 9396968 9.7526420 10.2473580 10.0603032 10.30766	2 30
31 9.6925620 9.9396253 9.7529368 10.2470632 10.0603747 10.30743	
22 [9.0927851 [9.9395537 [9.7532314] 10.2407030 [10.0004403] 20.30721	
32 9.6930300 9.9394021 9.733737 10.461707 10.99604864 10.20676	_ I I
9.7541115 10.2458854 10.00606612 10.30654	
1 37 1 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2	
30	
37 9.6938981 9.9391953 9.7547729 F0.2452971 10.0608247 10.30610	9 23
1	7 22
20 9.6543423 9.5390515 9.7552908 10.2447092 10.0009485 10.40565	7 21
40 9.6945642 9.9389796 9.7555846 10.2444154 10.0010204 10.30543	
41 9.6947859 9.9389-76 9.7558763 162241217.	
42 9.6950074 9.9388356 9.7561718 10-2438282 1,00611644 10-30499	6 18
42 9.6952288 9.9387635 9.7564653 10.2435347 10.0612365 10.30477	2
0.7567687 10.2422452 10.0612086 10.20154	
0.0000000000000000000000000000000000000	
0.6048022 0.0285470 9.7573452 10-2426548 10.0614530 10.30410	8 14
77 0.6961130 0.0284747 9.7576383 10.2423617 10.0615253 10.30388	0 12
48 9.6963336 9.9384024 9.7579313 10.2420687 10.0615976 10.30366	1 12
49 9.6965541 9.9383300 9-7582242 10.2417758 10.0616700 10.30344	
50 9 9 9 9 7 7 4 5 9 9 9 8 2 5 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	
0 7007227 10 2408378 10 2618874 10 20278	
0.7502047 10.2406052 10.061060vi to 20256	3 7
73 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5 6
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55 9.6978741 9 9378947 6.7599794 10,2409206 10,0621053 10,30212	
10.301780 10.301784 10.301784 10.301780 10.301	4
57 [9.6983129 9.9377492 9.7605637 10.2394303 10.0022508 10.30158	71 . 3
68 9.6985321 9.9376764 9.7698557 10.2391443 10.0623236 10.30146	9 2
59 9.6987511 9.9376035 9.7611470 10.2388524 10.0023965 10.30123	19 7
60 9.6989700 9.9375306 9.7614301 10.2385000 10.0074094 10.30103	I I
L.Co-Sine L. Tangent. L.Co-Secant L. Secant	1
60 DEGREES	

		•		30 D	EGREE	S			1
M.	N. Sine	N. Co-Sine	ı		N. Co-sang.		N. Secant	NCo-secant	
0	5000000	8660254	' 1	5773503	17320508		1154 005	20000000	6 0
	5002519	8658799		5777382	17368878		11548945	19989929	59
2	5005038	8657343		5781262	17297260		11550887	19979870	, śś
3	5007556	8655887		5785144	17285654		11552830	19969823	57
4	501∞74	8654430		5789027	17274060		11554775	19959788	56
5	5012591	8652972	i	5792911	17262477		11556722	19949764	55
6	5015108	8651514		5796797	17250905	•	11558670	19939753	54
	5217624	8550055		5800684	17239345		11560620	19929752	53
7 8	5020140	8648595		5804573	17227797		11562572	19919764	52
و	5022655	8647134		5808462	17216251	;	11564525	19909787	51
IO	5025170	8645673		5812353	17204736		11566183	19899822	50
11	5027685	8644211		5816245	17193222		11568436	19889869	49 48
12	5030199	8642748		5820139	17181720	r :	11570394	19879926	48
	4.00710	8641284		1801001	12170000	3	11692264	19869997	47
13	5032713	8639820		5824034 582 7 930	17170230		11572354	10800080	47 46
14	5035227 5037740	8638355		5831828	17147293	'	11576278	19850172	45
15	5040253	8636889		5835727	17135827		T1578243	19840276	44
17	5042765	8635423		5839527	17124382	;	11580209	19830393	43
18	5045277	8633956		5843528	17112949		11582177	19820520	42
						;		********	
19	5047788	8632488	}	5847431	17101527		11584147	19810659 19800810.	41
20	5050299	8631019		5851335	17090116		11588091	19790972	40
21	5052809	8629549		5855241			11590065	19781146	38
22	5055319	8628079		5859148	17067329 17055953	1	11592041	19771331	37
23	5057828 506033 7	8626608 8625136		5863056 5866965	17044587	l .	11594019	19761527	36
24	7000337			700000		}			
25	3062846	8623664	•	5870876	17033233	l	11595999	19751735	35
26	5065355	8622191		5874788	17021890	ł	11597980	19741954	34
27	5067863	8620717	: :	5878702	17010559	1	11599963.	19732185	33
28	5070370	8619243		5882617	16999238		11601947	19722426	32
29	5072877	8617768		5889533	16987929		11603933	19712680	31
30	5075284	8616292		5890450	16976632	l	11605921	19702944	30
	1077866	05,40-4		4804060	16965344	l: .	11607911	19693220	29
31	5077890 5080396	8614815 8613337		5894369 5898289	16954069		11609902	19683507	28
32	5082901	3611859		5902211	16942804		11611895	19673805	27
33	5085406	8610380	,	5906134	16931550		11613889	19664114	26
34 35	5087910	8608900		5910058	16920308	1	11615885	19654434	25
30	5590414	8607420		5 91 3983	16909077		11617883	19644767	24
								10604010	_
37	5092918	8 6 05939	:	5917910	16897856		11619882	19635110	. 23
38	;5095421	8604457	i	5921839	16886647	1	11621883	19615829	· 22
39	5097924	, 8602974		5925768	16875449 16864261		11625891.	19606206	20
40	5100426	8601491	4	5929699	16853085		11627897	19596593	19
41	5102928	8500007		5933532 5937566	16841919		11629905	19586992	18
42	5105429	0)90)22	: :	1931 100		1			<u> </u>
-75	5107930	8597037		5941501	16830765	ŀ	11631914	19577401	17
43 44	5110431	8595551		5945437	16819621		11633925	195-67822	16
4<	5112931	8594064		5949375	16808489		11635938	195-58244	15
45 46	5115431	,8592576		5953314	16797367		11637953	195-48697	14
47	5117930	8591088		5957254	16786256		11639969	195 39150	13
47 48	5120429	8589599		5961196	16775156	;	11641987	195 29615	12
	5122927	10208100	į	5965140	16764067	:	11644007	195 20091	. 11
49	5125425	8588109	.	5969084	16752688	1	11646028	19510577-	10
5b	5127912	18585127		5973030	16741921		11648051	19501075	•
5°1 52	5130419	8583635	1	5976978	16730864	١ '	11650076	19491583	8
53 53	5132916	8582142	· '	5980927	16719818		11652102	19482102	. 7
54	5135412	8580649	+ 1	5984877	16708782		11654130	19472632	6
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53	5137908	8579155	. !	5988828	16697758 16686744	l i	11658191	19453725	5
56	5140404	18577660		5992781	16675741		11650224	19444288	3
57	5142899	8576164		5996735 6000691	16664748		11662259	19434861	2
58	5145393 5147887	8574668 8573171	i i	6004648	16653766		11664296	19425445	1
59 63	5147887	8571673		6003606	16642795	ì	11666334	. 19416040	. 0
-33	N. Co-Sine	N. Sine.		N Co Tang.	N. Tangent.		N.Co-Secant.	N. Secant	M
لتنا	14. Co-377E	44. Oinc.			GREES		;		
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				30 D	EGREE	S.			
M	1 L. Sine.	L. Co-sine		L. Tangent	L. Co. Tang.		L. Secant.	L Co-Sec.ant	
1	9.6989700			9.7614394	10 238 5606		10.0624694	10.3010300	·I ———
1-		9.9375306		9.7617311	10.2382689		10.0625423		
1 2	9.6991887	9•9374577 9•9373847		9.7620227			10.0626153	10,3005927	
3	9.6396258	9.9373116		9.7623142			10.0626884	10.3003742	58 57
1 4	9.6998441	9.9372385		9.7626056	10.2373944		10-0627615	10-3001559	56
5	9-7000622	9.9371653	ł	9.7628969	17.2371031	1	10.0628347	10.2999378	55
6	9.7002802	9.9370321	1	9-7631881	10.5368110	1	10.0629079	10.2997198	54
_	2 7 1 2 2 2		Ī	2 2 4 2 2 2 2		1	10 . 60 - 9	-	
7 8	9.7004981	9.9370189 9.9369456	Ì	9 .7 634792 9 .7 637 7 02	10 2365208 10.2362298		10,0629811 10,0630544	10.2995019	,,,
1	9.7007158	9.93687.2		9.7640612	10,2352398		10.0631278	10.2992842	,- (
10	97011508	9.9367988		9.7643520	10.2356480		10-0632012	10.2988492	50
111	9.7013681	9.9367254		9.7646427	10.2353573		10-0632746	10.2986319	
12	9.7015852	9.9366519		9.7649334	10.2350666		10.0633481	10.2984148	48
1						1			
13	9-7018022	9.9365783		9,7652239	10.2347761		10.0634217	10.2981978	
14	9.7020190	9.9365047		9.7655143 9.7658047	10.2344857		10-0634953	10.2979810	
15	9.7022387	9.9364311 9.9363 57 4		9.7660949	10.2341953 10.2339051	i	10.0635689	10.2977663	1 7/
16	9.7021687	9.9362836		9.7663851	10.2336149	ľ	10.0637164	10.2973413	44
17	9.7028849	9.9362098		9.7666751	BO.2333249		10.0637902	10.2971151	43 42
1					-	j l		-	
19	9.7031011	9.9361360		9.7669651	10.2330349	1	10.0638640	10.2968989	41
20	9.7033170	94360621		9.7672550	10.2327450]	10.0639379	10-2966830	40
21	9.7035329	9.9359881		9-7675448	10.2324552		10.0640119	10.2964671	
22	9.7037486	9.9359141		9-7678344	10.2321656		10.0510859	10.2962514	
23	9.7039641	9.9,58401		9 7681240 9.7684135	10.2318760		10.0641599	10.2967359	2/1
24	9.7041795	9.9357660		9.7004137	10-2315865	ļ ļ	10.0642340	10.2958205	36
25	9.7043947	9.9356918		9.7687029	13.2312971	1 1	10-0643082	10.2956052	
26	9-7046099	9.9356177		9.7689922	10.2310078	i i	10.0643823	10.2953901	21
27	9.7048248	9.9355434		9.7692814	10-2307186		10.0644566	10.2951752	34 33
28	9.7050397	9.9354691		2.7695705	10.2304295	!!	10.0645309	10.2949603	22
29	9.7052543	9.9353948		9.7698596	10-2301404	1 1	10.0646052	10.2947457	31,
30	9.7054689	9 9353204		9.7701485	10.2298515	1 1	10.0646796	10,3042311	30,
1	9.7056833	0.0340460		0.7504053	10 2004625		10.0647541	10 2042165	
31	9.7058975	9.9352459 9.9351715		9.7704373 9.7707261	10.2295627 10.22 9 2739		10.0648285	10.2943167 10.2941025	29
32	9.7061116	9.9350969		9.7710147	10.2289853		10.0649031	10.2938884	
33 34	9.7063256	9.9350223		9.7713033	10.2286967		100649777	10.2936744	-/.
35	9 7005394	9.9349477		9.7715917	10.2284 783		10.0650523	10.2934636	26 25
36	9.7067531	9.9346735		9.7718801	10.2281199		13.0651270	10-2932469	
1—								-	
37	9.7769667			9.7721684	FO-2278316		10-0652017	10.2930333	23
38	9.7071801	9.9347235		9.7724566			10.0652765	10.2928199	22
39	9.7073933 9.7076064	9.9346486		9.7727447 9.7730327	10.2272553 10.2269673		10.0653514	10.2926067	21
40	9.7078194	9.9345738		9:7733206	10.2266794		10.0054202	10.2923936	
41	9.7080323	9.9344938		9.7736084	10.5503010		10.0655762	10.2919677	19 18
]					-				_ 10
43	9.7082450	9.9343488		9.7738961	10.2261039		10,0656512	10-2917550	17
44	9.7084575	9-9342737		9.7741838	10.5528165		10.0657263	10-2915425	16
45	9.7086699			9'7744713	10.2255287		10.0658014	10.2913301	15
46	9.7088822	9.9341234		9.7747588	10-2252812		10.05587 6 6 10.0659518	10.2911178	14
47	9.7090943 9.7093063	9.9340482		9.7 7 50462 9.7753334	10.2249738		10.0059518	10.2909057	13
48		9.9339729			20.24000				12
49	9.7095182	9-9338976		9-7756206	10.2243794		10.0661024	10.2904818	11
	9.7097299	9.9338222		9.7759077	10.2240923		10.0661778	10.2902701	10
51	9.7099415	9.9337467		9.7761947	10.2238053		10.0652533	10.2303585	9
52	9.7101529	9.9336713		9.7764816	10.2235184		10.0663287	10.2398471	8
53	9.7103642	9.9335957	1	0.7757685	10.2232315		10.0664743	10,28,6358	7
51 52 53 54 55 56 57 58	9.7105753	9.9335201	1	9.7770552	10.2229448		10 0664799	10.2894247	6
	9.7107863	9.9334445	•	D-7773418	10.2226582		.10.0665555	10.2892137	
55 56	9.7179972	9.9334445	1	9-7776284	10.2223716	·	110.0666312	10.2892028	5
57	9.7112080	9.9332931	ı	9.7779149	10.2220851		10.0667069	10.2887920	4.
58	9.7114186	9.9332173	1	9.7782022	10.2217988		10.0657817	10.2885814	. 3
59	9.7116290	9.9331415	· • 1	0.7784875	10.2215125		10-0668585	10.2883710	1
60	9.7118393	9.9330656	1	D-7787737	10,2212265	ı	10,0669344	10.2881607	_ 0
	L Co Sine.	L. Sine	1	L.Co. Tauz.	L. Tangent.		L.Co-secant	L. Secant.	M
1				59 D E	GREES	• .			
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104			21 1	5	L O D E L				
M	N. Sine	N. Co-Sine		N. Tangent.		8	N. Secant	NCo-secant	
-0	5150381	8571673		6008606	16642795	1	11666334	19416040	- 6 0
1	5152874	8570174		6012566	16631834	1	11668374	19406646	
2	5155367	8568675		6016527	16620884	l	11670416	19397262	59 58
3	5157859	8567175		6020490	16609945	l	11672459	19387889	57
4	5160351	8565674		6024454	16599016		11674504	19378527	56
5	5162842	85641 7 3 85626 71		6028419	16588097	l	11676551	19369176	55
-	5165333			6032386	105//109	ļ	110/0399	-9339037	54
7	5167824	8561168		6036354	16566292		11680649	19350525	53
8	5170314	8559664		6040323	16555405	i	11682701	19341185	52
9 10	5172804 5175293	8558160 855665 5		6044294 6048266	16533663	i	11684755	19331876 19322578	51
11	5177782	8555149		6052240	16522808	l	11688867	19313290	50 40
12	5180270	8553642		6056215	16511963	l	11690926	19304013	49 48
	4190549	9440104		6060192	26402108		2562296	10004746	
13 14	5182758 5185246	8552135 8550627		6064170	16501128 16490304	1	11692986	19294746	47 46
15	5187733	8549118	·	6068149	16479490	Ī	11697112	19276244	45
16	5190219	8547603		6072130	16468686	i	11699178	19267009	44
17	5192705	8546099		6076112	16457893		11701245	19257784	43
18	5195191	8544588		6080095	16447111	l	11703314	19248570	42
19	5197676	8543076		6084080	16436338	1	11705385	19239366	. 41
20	5200161	8541564		6088067	16425576	l	11707457	19230173	40
21	5202646	8540051		6092054	16414824		11709531	19220990	38
22	5205130	8538537		6096043	16404082		11711607	19211817	
23	5207613	8537023 8535508		6100034 6104026	16393351 16382630	l	11713685	19202655 19193502	37
24	5210096				10302030	Ì	11713314		36
25	5212579	8533992		6108019	16371919		11717845	19184362	35
26	5215061	8532475	,	6112014	16361218	j	11719928	19175230	34
27	5217543	8530958 8529440		6116011	16350528		11722013	19166109	33
28 29	5222505	8527921		6124007	16339847 16329177	ł	11724099	19156999	32 31
30	5224986	8526402		6128008	16318517		11728277	19138809	30
	1007466	8524881		6132010	16053863			1050-700	-
31 32	5227466 5229945	8523360		6136013	16367867 16297227		11730369	19129729	29 28
33	5232424	8521838		6140018	16286597		11734557	00011101	27
34	5234903	8520316		6144024	16275977		11736654	19102551	26
35	5237381	8518793		6148032	16265368		11738752	19093512	25
36	5239850	8517269		6152041	16254768		11740852	19084483	24
37	5242336	8515744		6156052	16244178		11742954	19075464	23
37 38	5244813	3514219		6160064	16233599		11745058	19066456	22
39	5247290	8512693 8511166		6164077 6168092	16223029 16212469		11747164	19057457	21
40 41	5249766 5252241	8509639		6172108	16201920		11749271 11751380	19048469	20 19
42	5254716	8508111		6176126	16191380		11753491	19030522	18
		0.56.05		6-8					
43	5257191	850658 2 85050 52		6180145 6184166	16180850		11755603	19021564	17
44	5254665 52 621 35	8503522		6188188	16170330 16159820		11757717	19012616 19003678	16 15
45 46	5264612	8501991		6192211	16149320		11761951	18994710	±3 }4
47	5267085	8500459		6196236	161388 2 9		11764070	18985832	13
48	5269558	8498927		6200263	16128349		11766191	18976924	12
49	5272030	8497394		6204291	16117878		11768314	18963026	I.I
50	5274502	8495860		6208320	16107417		11770439	18959138	10
51	5276973	8494325		6212351	16096966		11772566	18959259	9
52	5279444	8492790		6216383 6220417	16086525		11774694	18941391	
53 54	5281914 5284384	8491254 8489717		6224452	16076094 16065672		11776824	18932532 18923684	7
55	5286853	8488179		6228488	16055260		11781790	18914845	5
56	5289322	8486641 8485102		623 2526 6236566	16044 8 58 16034465		11783225	18906016 18897197	4
57 5 8	5291 7 90 5294258	8483562		6240607	16024082		11787501	18888388	3 2
59	5296726	8482022		6244650	16013709		11789542	18879589	1
6၁	5299193	8480481		6248694	16003345		11791784	18870799	_ 0
	N. Co-Sine	N. Sine.		N Co Tang.	N. Tangent.		N.Co-Secant.	N. Secant	M
				58 DE	GREES	i			

Artificial Sines,	Tangents	and Secants.
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l				31				1.6.6	
M	L. Sine.	L. Co. Sine.		L. Tangent	L. Co Tang.		L. Secant.	L Co-Secant	\
0	9.7118393	9.9330656		9.7737737	10.2212263		10.0669344	10.2881607	60
ī	9.7120495	9.9329897		9.7790594	10.2209401		10.0670103	10.2879505	59
2	9.7122596	9.9329137		9.7793459	10.2206541		10.0670863	10.2877404	58
3	9.7124695	9.9328376		9.7796318	10.2203682		10.0671624	10.2875305	57
4	9.7126792	9.9327616		9.7799177	10.2200823		10.0672384	10.2873208	56
5	9.7128859	9.9326854		.9.7852534	10.2197966		10.0673146	10.2871111	55
6	9.7130983	9.9325092		9.7834891	10.2195109	1	10.0673908	10.2869017	54
				9.7807747	10.2192253		10.0674670	10.2866923	
7 8	9-7133077	9.9324330		9.7810602	10.2192253		10.0675433	10.2864531	53
	9.7135169	9.9324507		9.7813456	10.2186544		10.0676196	10.2862640	52 51
9	9.7137260 9.7139349	9.9323504		9.7816309	10.3183631	•	10.0676960	10'2860651	50
10 11	9.7141437	9.9322276		9.7819162	10,2180838	1	10.0677724	10.2858563	49
12	9-7143524	9.9321511		9 7822013	10.2177987		10.0678489	10.2856476	48
	77.437.4								
13	9.7145609	9.9320746		9.7824864	10.2175136		10.0679254	10-2854391	47
14	9.7147693	9.9319980		9.7827713	10.2172287		10.0680020	10.2852307	46
15	9.7149776	9.9319213		9.7830562	10.2169438		10.0680787	10.2850224	45
16	9.7151857	9.9318447		9.7833410	10.2166590		10.0681553	.10-2848143	44
17	9.7153937	9.9317679		9.7836258	10-2163742		10.0682321	10.2846063	43
18	9.7156015	9.9316911		9.7839104	10.2160896		10.0683089	10.2843985	42
	0.00000			9.7841949	10.2158051	· ·	10.0683857	10.2841908	
19	9.7158092 9.71 60 168	9.9316143		9.7841949	10.2155206	l	10.0684626	10.2839832	41
20		9.9315374		9.7847638	10.2152362		10.0685395	10.533322	40
21	9.7162243	9.9314605		2.7850481	10.2149519	Ì	10.0686165	10-2835684	39 38
22	9.7166387	9.9313835		9.7853323	10.2146677		10.0686235	10-2823613	27
23	9.7168458	9.9313005		9.7856164	10.2143836	1	10.0687706	10.2831542	36
24	217.00470	7.937-94							
25	.9.7170526	9.9311522	· '	9.7859:04	10.2140996		10.0688478	10.2829474	35
26	9.7172594	9.9310750		9.7861844	10.2138156		10.0689250	10.2827406	34
27	9.7174660	9-9309978		9.7854682	10-2135318		10.0690022	10.2825340	33
28	9.7176725	9.9309205		9.7867520	13-2132480		10.0690795	10.2823275	32
29	9.7178789	9.9308432	1	9.7870357	10-2129643		10.0691568	10'2821211	31
30	9.7180851	9.9307658	1	9.7373193	10 2126897		10.0692342	10.2819149	30
			l				10.0602112	12.001.000	
31	9.7182913	9.9306883		9.7876028	10.2123972		10.0693117 10.06938 9 1	10.2817088	29
32	,9-7184971	9.9306109		9.7873863 9.7881696	10.2121137		10.0694657	10.2813029	28
33	97187030	9.9305333		9.7884529	10.2115354		10.0695143	10.2810914	27
34	9.7189085	9.9304557		9.7887361	10.2113471		10.0696219	#0°2808858	26
35	9.7191142	9.9303781		9.7897301	10.2109808		10.0696996	10.2 06801	. 25
36	9.7193196	9.9303004		7 / 093192					_24
	9.7195249	9.9302226		9.7893023	10.2106977		10.0697774	10.2804751	23
37	9.7197300	9.9301448		9.7895852	10.2104148		10.0698552	10.2802700	22
38	9-7199350	9.9300670	,	9.7898681	10,5101316		10.0699330	10.28 00655	2(
39 40	0-7201399	9-9299891		9.7901508	10.2098492		10.0700109	10.2795601	20
41	9.7203447	9,9299112		9.7904335	10.2095665		10.0700888	10.2795553	19
42	0.7205493	9.9298332	1	9.7907161	10-2092839		10.0701668	10.2794507	18
1			1				10.020044	10.270046	
43	9.7207538	9.6297551		9.7909987	10.2090013		10.0702149	10.2792162	17
44	9.7209581	9.9296770		9.7912811	10,2087189 10,2084365		10.0703230. 10.0704011	\$0.2790419 \$0.2783377	10
45	9 72116231	9.9295989	1	9.7915 6 35 9.7918458	10,2081542		10.0704011	10.2785336	15
46	9.7213664	9.9295207		9.7910450	10-2078720		10.0705576	10.2784256	.14
47	9.7215704	9,9294424	1	9.7924191	10 2075899		10.0706359	#0.5222228	$\frac{1}{12}$
48	9.7217742	9.9293541	l			,			1.1.2
1	9.7219779	9.9292857	1	9.7926321	102073079		10.0707143	10.2780221	1,1
49	9.7221814	9,9292073	1	9.7929741	10.2070259		10.0707927	40.2778186	10
50 51	9.7223848	9,9291289	}	9.7932560	10.2067410		10.0708711	10.2776152	
5/2	9.7225881	9.9290504		9.7935378	10.2054522	/	10.0709495	10.2774119	8
53	9.7237913	9.9289718		9.7938195	10,2061805	-	10.0710283	10.2772087	7
54	9.7229943	9.9289932	1	9.7941711	10.2058989		10.0711068	TO-2770057	_ 6.
-	·			0.7043935	TO PORTE	-	10-0711855	10-2768 728	
55	9.7231972	9.9288145	:	9.7943827	10.2056173		10,0712643	10-2766030	5
56	y.7234000	9.9287358	Ī	9.7946641 9.7949455	10.2053359 10.2050545		10,0712043	LO.2763974	4
57	9.7236026	9.0286571	I	9.7952268	10.2047732		10.0714217	10.2761949	3
58	9.7238051	9.9285783	l	9.7955081	10.2044919		10.0715006	10.2759625	1
59	9.7240075	9•9284994 9 . 9284205	1	9.7957892	10.2042108		10,0715795	10-275790}	0
60	9.7242097		1		L. Tangent.		L. Co Secont	L. Secant.	M
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3 5306591 8474809 626384 15907312 11795222 1834480 57 4 5309056 8474809 6263834 1590737 11803372 18337738 56 5 5311591 8474706 6268335 15951672 1180373 18325997 55 6 5311591 8474706 6268335 15951672 1180373 18325997 55 6 5311591 846673 628707 6285916 1591005 1180476 18381265 54 7 5316450 8469673 6281916 15920733 11805831 18806833 52 9 53131376 8466778 6285916 1591005 1181147 18924913 52 10 532839 8461930 6389215 15900233 11805831 18806833 52 9 53131376 8466778 6285916 1591005 1181147 18924913 52 11 532691 8461481 629377 15900233 1181397 189783438 50 12 532859 8461930 639713 15900233 1181397 189783438 50 13 5321484 846181 6793738 6190799 1488979 1181763 1876532 48 13 531248 8461381 679389 1588979 1181763 1876532 48 14 533164 8477273 6790799 14889261 11819799 1877488 47 15 533164 8477273 6790799 14889261 11829790 1877488 47 16 5338607 8457278 6790790 14889261 11829790 1877488 47 17 534062 8457278 6790790 14889261 1182950 1877484 47 17 534062 847678 679279 14889261 11829790 1877488 47 17 534062 847678 679279 14889261 11829790 1877488 679774 177547 1788849 1878788 868643 177978 178748 178			8477376					11796074	18853249	58
5 \$311521 8472764 6265935 15951672 11804570 55 6585126 5318613 8465126 54 65938 1592078 11804570 11804570 11804570 11804570 55 658513 15920783 11804570 11804570 11804570 11804570 11804570 11804570 11804570 11804570 11804570 11804570 11804570 11804571 11804571 11804570 11804571 11804570 11804571 1180	.3	5306591	8475853		6260834	15972312		11798222	18844489	57
6 5313986 8471219 6272988 15941365 1180.6576 188.18266 54 7 5316450 8469673 627042 15931070 1180.6531 188.06313 53 8 5318913 8468126 6285136 15910505 118113171 188.06331 53 9 5313176 846578 6285136 15910503 11813337 188.06333 53 11 532338 846578 6285136 15910503 1181147 18792331 51 12 5328763 8461931 6292374 15889979 1181,4650 18782475 42 12 5328763 8461931 6292336 1587979. 1181,4650 18782475 42 13 5331224 8460381 6301399 15889491 1181,9790 18757418 47 14 5331368, 845830 6305404 15889261 11821906 1878475, 42 15 533664 8457278 630330 638941 15819608 18746782 44 16 5338605 8457278 631350 15938530 1182050 1873485 44 17 5344064 845477 6317067 158.8628 1182050 1873485 44 17 5344064 845477 6317067 158.8628 1182050 1873485 44 18 5343622 845050 63 632831 15908653 11828479 1872285 42 12 534584 844950 632831 17908653 11832829 18705637 41 12 533840 844950 633833 1798079 1183708 18007020 21 21 533850 8447972 633083 179787915 1183283 1806843 30 21 533851 8444395 634031 177764 1839170 1839708 1807020 21 22 533351 8444837 634031 177765 1839170 1839708 1807020 21 23 533351 8444837 634031 1777769 1839170 1807073 1806737 41 24 533868 8447270 63603 67924 1777764 1839170 1806737 34 25 533850 8443279 63603 6793171 177724 11845027 1865747 32 25 533858 8443279 63603 679317 177724 1184691 1860747 32 25 533858 8443279 63603 679317 177724 1184691 1860747 32 25 533858 8443279 63603 679317 177724 1184691 1860747 32 25 533858 8443279 63603 679317 177724 1184691 1860747 34 26 5350744 8441720 636074 1560644 157729 1184691 1860747 34 26 5350744 8441720 636074 1560644 157729 1184691 1860747 34 26 5350744 8441720 636074 156064 187729 1860747 18			8474309						18835738	
7 \$316450 8469673 627042 15931070 11805831 18809845 53 8181087370 8468578 628116 631098 15920783 11806831 18809845 53 9331370 8468578 628116 15920783 11806831 18806845 18806845 12920783 11806881 18806845 12920784 11811471 18792131 51 1592018 4644861 6292736 15920288 11813307 18784785 50 1821547 18792131 51 1592018 4644861 6292736 1589279 11814632 18784785 50 18784785 12 5328769 8461931 6297330 1587979. 11814633 18766582 48 113 331024 8460381 6301399 1586941 11819799 18775788 48 114 5333684 845936 630444 1589261 11821960 18748746 47 15933685 8457728 6309330 15849-41 11824133 1874020 45 15933685 8457728 6317667 15828628 11882879 1877488 6309330 15849-41 11824133 1874020 45 1593368 8457728 6317667 15828628 1182850 1877486 17 5341064 845472 6317667 15828628 1182850 1877486 17 5341064 845472 6317667 15828628 1182850 1877486 17 5341064 845472 6317667 15828628 1182850 1877486 17 5341064 845472 6317667 15828628 1182850 1877486 12 1595386 844975 6339833 15778079 11837508 1869703 40 12133785 844975 633983 15778706 11833758 1868843 22 5353858 844975 633803 15777706 11833718 1868843 22 5353858 844975 633803 15777706 11833718 18686743 32 22 5353358 844975 633803 15777706 11833707 18677777 38 1868747 36 365747 36 36574 1867770 1867777 38 1868777 37 38 37 37 37 37 37 37 37 37 37 37 37 37 37	5	5311521	8471210	1			i		18818266	
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9	7	5316450							18809545	
10			8466678		6281098		•	11808083	18800833	
11 1 3326901			8465030		6280215			11812207	18782428	
12		5326301	8463481		6293275	15889979		11815469	18784755	
14 1 533268	12	5328763	8461931			15879730.		11817633	18766582	48
14 1 533268	12	F221224	8462381		6201200	15860401		11810700	18757418	
15	- 1	5333685	8458830		6305464	15859261		11821966	38748764	4/
10 (3338004 8454172 0313398 1533830 11320306 18731485 4 18 (5343004 8454172 0317657 158:8638 11337054 1870637 4 18 (5343622 8451063 6321738 158:84836 11337054 1870637 4 18 (5343622 8451063 6321738 158:84836 11337054 1870637 4 18 (534362 8440 84900 6320833 15908073 1133708 18007020 40 21 5350838 8447052 6320833 15798079 11337188 18688443 30 22 534840 844637 6338055 15777706 11337188 18688443 30 23 5355812 844637 6338055 15777706 11337188 18688443 30 23 5355812 8444837 6338013 15777706 11837188 18688443 30 23 5355812 8444837 6338013 15777706 11837188 18688443 30 23 5355812 8444837 6338013 15777706 11837188 18688443 30 23 5355812 8444837 6338013 15777706 11837188 18688473 6338013 15777706 11837188 18688473 6338013 15777706 11837188 18664747 36 26 5303170 8440160 6354357 15777341 11848116 18645677 34 27 5366584 8437039 635257 1777124 11850307 18637126 23 5358088 847053 6365614 15702036 1185200 1886405 22 29 5370442 8435477 6366614 15702036 1185200 1886405 22 29 5370442 8435477 6366614 15702036 1185200 1886505 23 29 5370442 8435477 6366614 15702036 1185200 1886505 23 23 5377540 844707 638667 1574703 11864374 18662003 31 33 538031 842022 638203 15966665 1185301 18811590 30 32 33 538031 842022 638203 15966650 1185301 18811590 30 32 33 538031 842022 638203 15966665 1185301 18811590 30 32 35 358031 842022 638203 15966665 1185301 18811590 32 35 358031 842022 638203 15966665 1185301 18811590 32 35 358031 842022 638203 15966665 1185301 1881169 1596070 18502016 22 4 4 539050 844784 641679 1596650 1185400 1185400 1885000 1885000 1885000 1885000 1885000 18850		5336145	8457278		6309530	15849:41		11824135	18740120	
18		5338605	8455725	ı		15333830		11826306	18731485	
19 5245982 8449599 622883 15708079 11832830 18705637 41 20 5348440 8449590 622883 15708079 11832830 18705637 41 21 535085 8447952 623893 15708079 11837188 18688433 39 22 5353355 8446357 6238035 15777760 11837188 18679575 33 23 535812 8444837 634213 1570765 1184154 18679575 33 24 535085 8443279 6346133 1570765 1184154 18679575 33 25 5360724 8441720 6350274 15747352 11845927 18624197 35 26 5363179 8440160 6354357 15717214 11848116 18645677 34 27 536594 8438600 6358411 15727126 11850307 1862126 32 28 536088 8437039 6362127 15717026 11850307 1862126 33 29 5370542 8435477 636564 15706916 11854604 18620092 31 30 5372996 8433914 6370703 15636784 11850307 1863605 33 31 5375449 8432731 6370703 15636784 11854801 1864189 32 32 5377902 8439797 6380703 15636669 1185491 186391 1861189 32 33 538554 842922 638278 15636669 1185491 186591 28 33 538554 842922 639160 1564530 1185690 18577672 26 34 5382506 8427677 6387073 1563664 11870107 1850108 22 37 5390188 842296 639366 1564540 11870107 1850206 22 37 5390188 842288 6403467 1565642 11870107 1850206 22 37 5390188 842288 6403467 1565642 1187430 1857457 26 44 5407208 841963 6419886 15576661 11881171 1854260 1853368 17 45 5412191 8403816 6443629 15556663 1188660 1886665 188781 188781 1884366 188781 1884366 188781 1884366 188781 1894366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188781 1884366 188736 1887366 1887366 1887366 1887366 1887366 1887366 1887367 1887366 1887366 1887366 1887366 1887366 1887366 1887366 1887366 1887366 1887366 1887366 1887366	17	5341004	8454172			15020028			18714242	
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1	97244118	9,9283415		9.7960703			10.0716585	10.2755882	
2	9.7246138	9,9282625	i	9.7963513	10.203648	7	10.0717375	10.2753862	1 48
3	97248156	9.9281834	1	9.7966322			10.0718166	10.2751844	57
1 :	9.7250174	9.9281043	•	9.7969130	10.2030876		10.0718957		56
5	9.7254204	9.9279459	ŀ	9.7974745			10.0719749	10.2747811	
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7 8	9.7256217	9.9278666		9.7977551	10.2022449		10.0721334		53
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10	9.7262249	9.9276285	l	9.7985964	10.2014036		10.0723715	10-2739760	
11	9.7264257	9.9275490		9.7988767	10,201123	: [10.0724510	10.2735743	50 49
12	9.7266264	9.9274695		9.7991569	10.2008431	1	10.0725305	10.2733736	48
13	9.7268269	9.6273899		9.7994370	10.2005630	5	10,0726101	10.073.70	-
14	9.7270273	9.9273103		9.7997170			10.0726897	10.2731731	47
15	9.7272276	9.9272306		9-7999970	10.2000030		10.0727694	10.2727724	45
16	9.7274278	9.9271509		9.8002769			10-0728491	10-2725722	1 44
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19	9.7280275	9.9269114		y-8011161	10. 1988839		10.0730886	10.2719725	41
20	9.7282271	9.9268314		9.8013957			10.0731686	10'2717720	40
21	9-7284267	9.9267514 9.9266714		9.8016752 9.8019546	10.1983248		10.0732486	10.2715733	30
23	9.7288253	9.9200/14	•	9.8022340	10.1977660	I	10.0733286 10.0734087	10.2713740	38
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25	9.7292234	9.9264310	•	9:8027925 9:8030716	19.1972075		10.0735690	10*2707766	35
26 27	9.7294223 9.7296211	9.9263507 9.9262704		918033710	10-1959284		10.0736493 10.0737296	10.2705777	34
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30	9.7302165	9.9260292		9.8041873	10.1358127		10.0739708	10.2697835	30
31	9.7304148	9.9259487		9.8044661	101955339		10.0740513	10.2695852	
32	9.7306129	9.7258681	;	9.8047447	17 1952553		10.0741319	10.2693871	29
33	9.7308109	9.9257875		9:8050233	101949767	ŧ l	10.0742125	10.2691891	27
34	9.7310087	9.9257069	Š	948053019	101946931	i	10.0742931	10.2689913	26
35 36	9.7312064 9.7314040	9.9256261 9 9255454		9.8058587	10-1944197 10-1941413		10.0743739	10°2687936 10.2685960	25
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37	9.7316015	9.9254646		9 8061370	10.1938630	1	10.0745354	10.2683985	23
38	9.7317989	9.9253837		9.8064152 9.8066933	10.1935348		10.0746163	10.5895.01	22
39 40	9 .7 31996 1 9.7321932	9.9253028		9.8059714	10.1933067		10.0746972	10.2680039	21
41	9.7323902	9.9251408	- 1	9.3072494	10.1927506	i	10.0747782	10.2676098	20
42	9.7322870	9.9250597	ı	9.8075273	10.1924727		PO-0749403	10-2674130	18
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46	9.7333731	9.9247349	<i>'</i>	9/8086383	10.1913617		10.0752651	10.2666269	15
47	9.7335693	9.9246535	J	9.8091933	10.1910842	1	10-0753465	10,2564307	13
48	9.7337654	9.9245721	1	A 20031313	10 1908067	ŀ	10.0754179	10.3662346	_12
49	9.7339614	9.9244907		9.8094797	10-1905293	Į į	10-0755093	10.2660386	- 1
50	9.7341572	9.9244092	1	9.8097480	19.1902520		10.0755908	10.2658428	10
51	9.7343529	9.9243277	- 1	9-810 ⁰ 253 9-8103025	19.1899747		10-0756723	10.2656471	9
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56 57	9.7353295	9.9238373	: [9.8116873	19.1883127		10.0760809	10-2646704	41
57 58	9.7357195	9-9237554	•	9.8119641	14.1880320		10.0762446	10.2642805	3 2
59	9.7359142	9.9236734	1	9.8122458	10.1877592		10.0763266	10.2640858	i l
63 ———	9.7361088	9.9235914	1	9.8125174	10.1574826		10.0764086	10-2638912	0
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!			14. Tangent		` i	L. Secant.	L Co-Sec.ans	
M	1. Sine.	L. Co-Sine	9.8125174	10-1874826	,	10.0764286	10.2638917	50
<u>'</u>	9.7361088	9.9235914	9.8127939	10,1872061		10.0764907	10.2636968	— li
. 1	9.7363032	9.9235093	9.8130704	10.1869296	,	10.0765728	10.2635024	59
2	9.7364976 9.7366918	9.9234272 9.9233450	9.8133468	10.1866532		10.0766550	10.2633082	57
3	9.7368859	9.9232628	9.8136231	10.1863769	:	10 0767372	10.2631141	56 1
5	9:7370799	0.9231605	9.8138993	10.1861007	1	10.0768195	10.2629201	55
ó	9:7372737	9.9230982	9.8141755	10-1858245	·	10.0769018	10-2627263	54
		2 22227 5	9.8144516	10,1855484	1	10.0769842	10.2625325	(2)
7 8	9.7374675 9.7376641	9.9230158 9 9229334	9.8147277	10,1852722	. 1	£0.0770666	10.2623389	53 52
	9.7378516	9.9228509	9.8150036	10,1849964		10.0771491	£0.2621454	51
9	9.7380479	9.9227684	9.8152795	10,1847205		10.0772316	10.2619521	50
11	9.7382412	9.9226858	9,8155554	10.1844446		10.0773142	10.2617588	49
. 12	9.7384343	9.9226032	9.8158311	10.1841689		10.0773969	10'2615657	48
	9.7386273	9.9225205	\$8161068	10.1838932		10.7774795	10.2613727	47
13	9.7388201	9:7224377	3.8163824	10.1836176		\$0.0775623	10.2611799	46
14	9.7390129	9.9223549	9,8166580	10.1833420	:	40.077645I	10.2609871	45
16	9.7392055	9.9222721	9.8169335	10.1830665	•	10-0777279	10.2607945	44
17	9.7393980	9.9221891	9.8172089	101827911		10.0778100	10.2606020 10.2604096	43
18	9.7395904	9.9221062	9.8174842	101825158		10.0778938	50.2004090	42
	9.7397827	9.9220232	9.8177595	10,1822405		10.0779768	10,2602173	41
19 20	9.7399748	9.9219401	9.8180347	10.1819653	1	10.0780599	10.2600252	40
21	9.7401668	9.9218570	9.8183098	10-1816902		10.0781430	10.2598332	39
22	9.7403587	9.9217738	9.8185849	10.1814151	:	ED-0782262 ID-0783094	10.2596413 10.2594495	38
23	9.7405505	9.9216906	9.8191348	10,1808652		ID-0783927	10,2592579	37
24	9.7407421	9.9216273	-					36
25	9.7409337	9.9215240	\$8194096			1p.0784760	10.2590663	35
26	9.7411251	9.9214406	9.8196844	101803156	[]	10.0785594	10.2588749	34
27	9.7413164		9.8199492	10.1800468	:	10.0786428 10.0787663	10.2586836	33
28	9.7415975	9.9212737	9.8205084			1p.0788098	10.2583014	32
.29	9.7416986	9.9211902	9.8207829		٠.	10 0788934	10.5281102	31
30	97410097	9.9211000						30
31	9.7420803	9.9210229	9.8210574	141789426		10-0789771	10-2579197	29
32	9 7422710		9.8213317		1	\$0.0790607	10.2577290	28
33	9.7424616		9.8216060 9.8218803		i	10.0791445	10.2575384	27
34	9.7426520				i	10/793122	10.2571577	26
35 36			9.8221545 9.8224286	10.1775714		10.0793961	10.2569675	25
30	ــــــــــــــــــــــــــــــــــــــ		8227026					
37	9.743222		9.8227020	, • <- / - / +		10 0794800	10.2567774	23
37 38	9.7434126	9.9204360	9.8232505		į	10.0795640 10.0796481	10.2565874	22
39	9.7436024	9.9203519	9.8235244	10-1764756		40.0797322		21
40 41	9.7439817		9.8237981	10.1762019		10.0798164	10.2560188	20
42			1104		j	10.0799006	10.2558288	19 18
<u> </u>	-		7 	10000000		10.070094-	10.244622	
43	9.7443606		9.8243494		1	10.0799849		1 -/ 1
44	9.7445499				l .	10.0801536		1 10
45 46	9.7447390	9.9190404	0.8251666	191748340	! '	10.0802381	10.2550720	1 :41
47		9.9196775	0.8254394	10.1745606		10.0803225	10.2548831	1 12
48				7 10.1742873		10.080407	10.2546944	
1	-	-	1	10 1740140		10.0804917	10.2545057	
49		9.9195083	I Pakara			10.080576		
50			9.826532	3 10.1734677		10.080661	10.2541288	
51 52			0.826804	3 10.1721047	I	10.080745	10.2539405	8
53	9.746247	9.9191694	9.827078	3 10.1729217	1	10.0808300	10.2537523	
54				10.1726487	Í	10.080915	10.2535642	6
	0.756000	0.0180006	5-827624	1 10-1723759	1	10.081000	10.2533763	1-
55	9.7466237		110-02			10.081085		
57	9.746999	9.9188296	9.828169	6 10.1718304		10.081170	10.2530008	2
38		9.9187445	9.828442	3 10.1715577		10.081255	5 10.2528132	2 2
59	9-747374	3 9.9186594	9.828714			10-081340	6 10.2526257	7 1
60			9.828987		1	10.081425		
1_	L Co-Sine.	L. Sine	L. Co Tan		<u></u>	L.Co-Secan	L. Socant.	M
4			56 D	EGREE	S.			-

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17/1	I N. Sine	N.Co-Sine.	1	N. Tangent.	N. Co-Tang.	,	1 N. Secant	NGo-Secans	
-	5591929	8290376		6745085	14825610	1	12062180	1788 916	60
		8288749	ł			1:		17875208	59
1 2	5594340	8287121		6749318	14816311	ł '	1206;518	17867508	28
3	5596751 5599161	8285493	!	6753553	14797738	! ·	12069289	17859817	58
4	5601571	8283864	1	6762028	14788463	1	12071662	17852133	.57
5	5603981	8282234	١.	6766268	14779197	;	12074037	17844457	55
6	5606390	8280603	!	6770509	41769938		12076414	17836790	54
			1			1			1
7 8	5608798	8278972	'	6774752	14760688	1	12078793	17829131	53
	5611206	8277340	•	6778997	14751445		12081175	17821479 17813836	52
9 10	5613614	8275 7 07. 8274074	;	6783244 6787492	14742210		12083559	17806201	51
111	5616021 5618428	8272440		6791742	14732983 14723764	ł	12088331	17798574	50
12	5620834	8270305	'	6795993	14714553	,	12090720	17790955	49
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13	5623239	8269170	ï	6800246	14705350		12093112	17783343	47
14	5625644	8267534	1	6804501	14696155	1.	12095505	17775740	46
15	5628049	8265897		6808758	14686967	Į.	112097900	17768145	45
16	5630453	8264260	} ;	6813016 6817276	14677787	1	12100297	17760558	44
17 18	5632857	8262622 8260983		6821538	14668616 14659452	ŀ	12102696	17752979 17745408	43
	5635260		ľ	1730	140)94)2	1	,12105C97		42
19	5637663	8259343	. i	6825801	14650296	I)	12107500	17737845	41
20	5640065	8257703		6830066	14641147	1	12109905	17730290	40
21	5642467	8256062		6834333	14632007		12112312	17722743	
22	5644869	8254420	. j	6838601	14622874	1	12114721	17715204	39
23	5647270	8252778		6842871	14613749	!	12117132	17707673	37
24	5649670	8251135		6847143	14604632		12119545	17700149	36
25	5652070	8249491		6851417	14504520	i i	12121960	17692633	
25 26	5654469	8247847		6855692	14594522. 14586420		12124377	17685125	35 34
27	5656868	8246202		6859969	14577326	l i	12126796	17677625	33
28	5659267	8244556		6864247	14568240	1;	12149217	17670133	32
29	5661665	8242909		6868527	14559161		12131640	17662640	31
30	5664062	8241262	;	6872810	14550090	1	12134064	17655173	30
		04	•	40==0=4		į.			-
31	5666459	8239614		6877094 6881379	14541027	1	12136491	17647704	29
32	5668856 5671252	8237965 8236316		6885666	14531971		12138920	17640243	. 28
33 34	5673648	8234666		6889955	14522923 14513883	:	12143783	17625345	27 26
35	5676043	8233015		6894246	14504850	l i	12146218	17617908	25
36	5678437	8231364		6898538	14495825	1	12148655	17610478	24
			•			1 ?			
37	5680831	8229712		6902832	E4486808		12151094	17603056	23
38	5683225	3228059		6907128 6911425	14477798		12153535	17595642	22
39	5685618	8226405	?	6911425	14468796	;	12155978	17588236	
40	5688011 5690403	8224751 8223096	;	0920025	14459801		12158423	17580837 17573446	20
41	5692795	8221440	;	6924328	14441834		12163319	17566063,	
	7092/97				-7441.034				10
43	5695186	8219784	i	6928633	14432862] :	12165770	17558087	.17
44	5697577	8218127		6932339	14423897		12168223	17551319	16
45	5699968	8216469		6937247	14414940	l .	12170678	175439591	
46	5702358	8214811		6941557	14405951		12173135	17536627	14
47	5704747	8213152		6945868	14397049	į.	12175594	17529252	13
48	5707136	8211492		20101	14388114		12178055	17521924	12
49	5709524	8209831	1	6954496	14379187		12180518	17514594	11
50	5711912	8208170		6958813	14370268	•	12182083	17507273	10
51	5714299	8206508		6963131	14361356		12185450	17499958	
52	5716686	8204846		6967451	14352451		12187919	17492651	. 9
53	5719073	8203183	,	6971773	14343554		12190390	17485352	7
54	5721459	8201519	•	6976097	14334664	,	12192864	17478060	6
55	5723844	8199854		6980422	14325781	'	12195339	17470776	
56	5726229	8198189	,	6984749	14316906	į .	12197816	17463499	5
57	5728614	8196523		6989078	14368039		12200296	17456230	3
58	5730998	8194856		6993409	14299178		12202777	17448969	2
59	5733381	8193189	,	6997741	14290326	,	12205260	17441715	1
60	5735764	8191521		7002075	14281480	: 1	12207746	17434468	0
	N. Co-Sine	N. Sine.	<u> </u>	N Co Tang.	N. Tangent.	,	N.Co-Secant.	N. Secant	M
				- 55 DE	GREES.				
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	İ			34	DEGREI	e e			
	1	A L. Sine.	L. Co-Sine	L. Tange	nt L. Co. Tang		110		•
	1	0 9.7475617		9.828987	_	: 1	L. Secani		
		9.7477489					10.08142		3 50
	•	2 9.7479360	9.9184037	9.829259 9.829532			10.08151	10 10.252251	1 50
		3 9.7481230	9.9183183	9.829804	7 10.1704677	<u> </u>	10.081590	3 10.252064	0 68
		4 9.7483099	9.9182320	9.830076	9 10.1699231	1	10.081691	7 10.251877	0 67
	,	9.7484967	9.9181475	9.830349	2 10.1696508		10.081767		11 56
	(5 9.7486833	9.9180620	9 830621			10.081338	0 10.251503	1 ,,
	~	9.7483693			-	.		0 201251310	54
	7	9.7490562	9.9179764	9.830893	4 10.1691066	1	10.082023	6 10.2511302	2 50
1			9 9178908 9-9178051	9.831165. 9.831437.	4 10.1688346	Ì	10.082100	2 10.2500128	ا دُمُ ا
- 1	10	0 7 40 400 -	9.9177194	9.831709	4 10.1635626 3 10.1682697	l	10.082194	9 10.2507575	اینا
- 1	11	0.7436.48	9.9176336	9,831981		1	10.582280	0 10.2405712	1 1
- 1	12		99175478	9.8322529	10.1677471	i	10.082452	1 10.2502852	
1					-	l	.0.052452	2 10-2501993	49 48
- 1	13		9.9174619	9,8325240	10.1674754	l	10.082538	10.2500134	<u>'</u>
1	14	0.7500440	9'9173760	9.832796			10.082621	10.2108277	1 4/ 1
- [15 16		9.9172900	9.8330679 9.8333394			10.0827100	10.2496421	1 40
- 1	17	1 0 7 6 0 - 0 0 - 1	9.9171179	9.8336100	10.1663891	1	10.082796	10.2491566	1 7/1
1	18		9.9170317	9.833882	10.1661177		10.0828821	10.2492712	1 77 1
1		.			10.1001(//		10.082968	10.2490965	42
1	19	9.7510991	9.9169455	9.8341536			10.0830545	10,2489209	احتا
1	20	9.7512842	9.9168593	9.8344249	10.1655751		10.0831407	10.2487158	1 4 1
ł	21	9.7514591 9.7516538	9.9167730	9.8346961	12.1643039		10.0832270	10.2485309	1 45 1
1	22	9.7518385	9.9166866	9.8349673			10.0833134	10.2183462	
ı	23	9.7520231	9.9166002	9 8352384 9 8355094		•	10.2833008	10.2481615	38
١.	24	1	7.9.0513/	9.0377094	10-1644906		10.0834863	10.2479769	37 36
	25	9.7522075	9.9164272	9.8357804	10.1642196		10.00		
	26	9.7523919	9.9163.106	9.8360513	10-1639487		10.0835728 10.0836594		35
1	27		9.9162539	9.8363221	10.1636779		10.0837461	10.2476081	34
1	28		9.9161673	2 8365929	10.1634071	•	10.0838327	10.2472398	33
;	29		9 9160805	9.8368636	10.1631364		10.0839195	10.2470558	32
	-30	77551200	9 9159937	9.8371343	10.1629657		10 0842063	10.5468250	31
-17	31	9.7533118	9.9159069	9.8374049	10.150.41				30
	32		9.9158200	9.8376755	10.1625951		10.0840931	10.2465882	20
T	33		9.9157330	9.8379460	10.1620540		10.0841865	10.2465046	28
1.	34	9.7538024	9.9156460	9.8352164	10.1617836		10.0842 6 70 10.0843540	10.2463210	27
1	35 36	9-7540457	9.9155589	9.8384867	10.1615133	:	10.0844412	10.2461376 10.2459343	26
I	36	9.7542288	9.9154718	9.8387571	10.1612429		10.0845292	10.2457712	25
1-		9.7544119	2.02429.4	0		,		7)//12	24
1	37		9 9153846 9.9152974	9.8390273	10-1609727		10.0846154	10.2455881	22
1	38 39	9.7547777	9.9152101	9.8392975 9.8395676	10.1607052		100847026	10.2454751	23
١.	40		9.9151228	9.8398377	10.1604324		10.0847899	10.2452223	21
ľ	41	9.7551431	9.9150354	9.8401077	10.1598923		10.0848772	10.2450395	20
1	42	9.7553256	9.9149479	9.8403776	10.1596224		10.0849646 10.0850521	10.2448569	19
-	-					- 1	10.0050521	10.2446744	18
	43	9.7555080 9	0.9148604	9.8406475	10.1593525	1	10.0851396	10.2444920	
	44	9.7556902 g 9.7558724 g	0.9147729	9.8409174	10.1290326	l	10.0852271	10 2443098	17
l	45 46		9146 ⁹ 52	9.8411871	10.1588129	1	10.0853148	10.2441276	15
	47	9.7562364 0	.9145999	9.8417265	10-1585431	l	10.0854024	10.2139456	14
	48		.9144221	9.8419961	10:1532735	1	10.0854501	10.2437636	13
-					,,,,,,,		10.0855779	10.2435818	12
	49		9143342	9-8422657	10.1577343	ı	10.0856658	10.2434001	
	50		.9112464	9.8425351	10.1574645	I	10.0857536	10,2432185	11
	51		9141584	9.8428046	10.1571954	1	10.0858416	10.2430370	9
	52 53		.9140704 91398 2 4	9·8430739 9.8433432	10.1569261	į	10.0859296	10.2428556	8
	54		.9138943	9.8436125	10.1566568	1	10.0860176	10.2426741	7
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		9-7576878 9	9138061	6-8438817	10.1201183	1	10.0861939	10.270	
•	56	9·757 8 587 9.	9137179	9.8441508	10.1558402	- 1	10.0862821	10.2423122	5
•	57	9.7580425 9. 9.7582302 9.	91 36296	9.8444199	10.1555801			10.2419505	4
			9135413	9.8440839	1211553110		10.0864587	10.2417698	3 2
	50	~ m = 0 .	9134530	9.8449579 9.8452268	10.1550421	- 1	10-0365471	10.2415892	1
<u> </u>	-1		9133645 L. Sine		10.1547732		10.0866355	10.2414037	
-		- 20	2.01/16		L. Tangent.	1.	L.Co-Secant	L. Secant.	M
_				55 DE	GREES.				-l

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1/1	_	N. Sine	N.Co-Sine.		N. Taugent.	N. Co-Lang.	ı	N. Secant.	NCo-Secant	
	!	5735764	8191521	j	7002075	14281480		12207746	₹743446¥	6ე
			8189852	ŀ	7006411	14272642		12210233	17427229	59
		5738147	8188182		7010749	14263811	1	12212723	17419997	59 58
		5740529	8186512	1	7015089	14254987	i	12215215	17412773	57
	- 1	5742911	8184841	,	7019430	14246171		12217708	17405556	56
1		5245 2 9 2 574 7672	8183169	- 1	7023773	14237362		12220204	17398347	55
1	5	5750052	8181497	1	7028118	14228561	1	12222702	17391145	54
Ì	<u> </u>			- 1					220020	
	7	5752432	8179824	· .	7032465	14219766	ŀ	12225202	17383951	53
ł		5754811	8178150		7036813	14210979		12227703	17376764	52
	۰۱	5757190	8176476		7041163	14202200		12230207	17362413	51
	o l	5759568	8174801		7045515	14193422		12232713	17355247	50
1		5751946	8173125		7049869	14184662		12235221	17348090	49 4 8
. 1	2	5764323	3171449	į	7054224	14175904		1223//32		40
			0.60772		7058581	14167153		12240244	17340941	47
1		5766700	8169 7 72 8168094		7062940	14158409		12242758	17333798	46
		5769076	8166415		7067301	14149673	1	12245274	17325663	45
		5771452	8164736		7071664	14140943		12247793	17319535	44
		5773827	8163056		7076029	14132221		12250313	17312414	43
1 1	3	5776202	8161376		7080395	14123566		12252836	17305301	42
1 '		5778576					•			
		5780950	8155635		7084763	14114799	i i	12255361	17298195	41
	20	5783323	8158013		7089133	14106098	1	12257887	17291096	40
7	11	5785696	8156330		7093505	14097405		12260416	17284005	39 38
	22	5788068	8154647		7097878	14088718	1	12262947	17276921	
	23	5790440	8152963	1	7102253	14080039	l	12265480	17269844	37
	24	5792852	8151278	1	71 0 6630	14071367	}	12268015	17262774	36
							I	10070660	17255712	•
	25	5795183	8149593	ŀ	7111009	14062702	į	12270552	17255712	35
	26	5797553	8147906		7115390	14054944	i	12273091	17241609	34
	27	5799923	8146219		7119773	14045393	ł	12275633	17234568	33
1 2	28	5802292	8144532		7124157	14036749	1	12280721	17227534	32 31
1 2	29	5804661	8142844		7128543	14028113		12283269	17220508	30
	30	5807030	8141155		7132931	14019483	1			
1-	1	0	0.0046	1	7137321	14010860	1	12285819	17213489	29
	31	5809398	8139465	Ì	7141713	14002245	į	12288371	17206477	28
	32	5811765	8137775 8136084	•	7146106	13993636	t	12290925	17199472	27
	33	5814132	8134393	[7150501	13985034	ŧ	12293481	17192475	26
	34	5816498	8132701	•	7154898	13976440	Ī	12296039	17185484	25
	35	5819864	8131008	1	7159297	13967852	1	12298599	17178501	24
	36	5821230		l			4		-	
Ι.	27	5823595	8129314	1	7163698	13959272	1	12301161	.17171525	23
	37 38	5825959	8127620	1	7168101	13950698	1	12303725	17164556	22
	39	5828323	8125925		7172505	13942131	1	12306292	17157594	21
	40	5830687	8124229	l	7176911	13933571	ł	12308861	17150639	20
	41	5833050	8122532		7181319	13925018		12311431. 12314005	17143691	19 18
	42	5835412	8120835		7185729	13916473	1	123.400)	17:30/70	1
-			0	ŀ	7190141	12004014	1	12316580	1712,817	17
1.	43	5837774	8119137	1	7194551	13899401	1	12319157	17122890	16
1	44	5840136	8117439	1	7198970	13890876	1	12321736	17115970	15
ł	45	5842497			7203387	13882358	1	12324317		14
	46	5844857	8114040		7207806	13873846	1	12326900	17102142	13
į.	47	5847217	8110638		7212227	13865342	ł	12329486	17095254	12
1	48	5849577		.]			-		-	-
-	<u></u>	-5851936	8108936	1	7216650	13856844	1	12332074	17088362	111
1	49	5854394	8107233		7221075	13848353	1	12334664	17081478	10
	50 51	5856652	8105530	1	7225502	13839869	1	12337256	17074600	8
	52	5859010	8103826	1	7229931	13831392	1	12339850	17057730	
ı	53	5861367	8102121	1	7234361	13822922		12342446	17060866	7 6
	54	5863724	8100416	1	7238753	13814458	. 1	12345044	17054010	J.,
 _	, T		.	-1	201222	******	' l	12347645	17047160	5
	55	5866080	8798710	ł	7243227	13806001		12347043	17040318	4
1.	56	5868435	8097003	1	7247663	13797551	1	12352852		3
I	57	5870790	8095296		7252101	13789108	1	12355459		2
1	58	5873145	8793588		7256541	137000/2		12358068	.17019831	1
1	59	5875499	8091870		7265426	13772242		12,60680		0
1	65	5877853	8090170	-1				N.Co-Secant		M
1		N. Co-Sin	N. Sine.		N Co Tang.			1	1	
Ι.					51 D	EGREE	3.			_

Artificial Sines,	Tangents.	and Secants.
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35 DEGREES.										
M	L. Sine.	L. Co. Sine.	1	L. Langent	L. Co-Tang.	-	L. Secant.	W.C. C.		
0	9.7585913	9.9133645	1	9.8452208		.		L Co-Secant	-	
1	9.7587717		ļ		10.1547732		10.0866353	10.2414087	60	
2	9.7589519	9.9132760		9.8454950 9.8457644	10.1545044		10.0867240	10.2412283	59	
3	9.7591321	9.9130989		9.8460332	10.1539668		10.0869011	10.2419481	58	
4	9.7593121	6.9130102		9.8463018	10.1536982		10.0869898	10.2408679		
5	9.7594920	9.9129215	ĺ	9.8465705	10.1534295		10.0370785	10.2405080	56 55	
6	9.7596718	9.9128328	l	9.8468390	10.1531610) .	10.0871672	10.2403282	54	
7	9.7593515	0:0107110	l	9.8471075	10.140900		15 48-2-4			
7 8	9.7600311	9.9127440		9.8473760	10.1528925		10.0872560	10.2401485	538	
9	9.7602106	9.9125652	l	9.8476444	10-1523556		10.0874338	10.2399589 10.2397894	52	
10	9.7603899	9.9124772	1	9.8479127	10-1520873		10.0875228	10,532,204	51	
11	9.7605692	9.9123882		9.8481810	10,1518190		10.0876118	10.2394308	50 49	
12	9.7677483	9.9122991		9.8484492	10.1515508]:	10.0877009	10.2392517	48	
	9.7609274	20122000	ł	9.8487174	10.14.0806		10.00			
13 14	9.76.1063	9.9122099	l	9.8489855	10.1512826		10.0877901	10.2390726	47	
15	9.7612851	9.9120315	l	9.8492536	10.1507464		10.0879585	10.2388937	46	
16	9.7614618	9.9119422		9.8495216	10,1504784		10.0880578	10-2385362	45	
17	9.7616424	9.9118528		9.8497896	10-1502104		40.0881472	10.2383576	44	
18	9.7618208	9.9117634	[·	9.8500575	10-1499424	11	0.0882366	10.2381792	43 42	
	0.7610000	0.0116730	1	9.5503253	10 -4-5					
19 20	9.7619992 9.7621775	9.9116739	I	9.3503253	10.1496747 10.1494069		10.0883261 10.0884156	.10.2380008	41;	
21	9.7623556	9.9114948	l	9.8;08608	10.1491392		10.0385052	10.2378225	40	
22	9.7625337	9.9114051	l	9.3511285	10.14.8715	l .	10.0885040	10-2370444	39	
23	9.7627116	9.9113155		9.8513961	10.1486039	١.	10.0886845	10-2372884	38. 37	
24	9.7628894	9.9112257		9.8516637	10.1483363	1	10.0887743	10.2371106	36	
	0:262067	9.9111359	,	9.8519312	10:480608	1. 1	10 00006			
25 26	9.7630671 9.7632447	9.9110460		9.8521987	10.1480688 10.1478013		10.0889641 10.0889540	10.5369339	35	
27	9.7634222	99109561		9.8524651	ID-1475339		10:0890439	10.2367553	34	
28	9.7635996	9.9108661		9.8527335	15-1472665		10.0891339	10.2364004	33	
29	9.7637769	9.9107761		9.8530008	10-1469992		10.0892230	10°2362231	32 31	
30	9.7639:40	9.9106860		9.8532680	10 1467320		10.0893140	10.2360460	30	
	9.7511311	9.9105959		9.8535352	10.1464648		- D 0 2 4 4 4 4 4	10000		
31 32	9.7643080	9.9105057		9.8538023	10.1461977		10.0894041 10.0894943	10.2358659	29	
33	9.7614849	9.9104155		9.8540694	10.1459306		10.0895846	10-2356920 ,10-2355151	28	
34	9.7546616	9. 103255		2.8543365	10.1456635	1	16.0896740	10-2353384	27 : 26 :	
35	9.7648382	19.9102348		9.8545014	10.1453965		10.0897652	10'2351618	25	
36	9.7650147	9.9101444		9.8548704	10.1451296		10.0898556	10-2349853	24	
27	9.7651911	9.9100539		.9.8551372	10.1448638		FD 080046:			
37 3 8	9.7653674	9.9099634		9.8554041	10.1445959		10.0099461	10.2348089	23	
39	9.7655436	9.9098728		3.8556708	10'1443292		10.0901272	10.2346326	22	
40	9.7657197	9-9097821		9.8559 376	10.1440624		10-0902179	10.2342803	2I 20	
41	9.7658957	9.9096915		9.8552042	10-1437958		10.0903085	10.2341043	19	
42	9.7660715	9.9096007		9.8564708	10.1435292	:	10.0903993	10.2339285	18	
43	9.7662473	9.9095099		9.8567374	10.1432626	ľ	10.0904901	10 9339555		
43	9.7661279	9.9094190		9.8570039	10.1429951		10.0904901	10,2337527	17	
45	9 7665985	9.6093281		9.8572704	10.1427296	· I	0.0906719	10.2334015	16	
46	9.7667739	9.9092371	- 1	9.8475368	16.1424632	·	10.0907620	10.2332261	14	
47	9.7659.192	9.9071461	I	9.8578031	10.1421963	[,]	10.0908539	10.2330508	13;	
48	9.7571214	9.9090550	l	9.8580691	10 1419306	:	10,0909150	10.5358226	12	
49	9.7672996	9.9089639	. [9.8583357	10.1418643	[i]	10.0910361	10-222222		
50	9.7674746	9.9088727		98586019	10.1413621		10.0911273	10-2327004	11	
51	9.7676494	9.9087814		9.8588680	16.1411320	· 1	10.0912186	10.2323506	10	
52	9.7678242	9.9086901	1	9.8591341	10.1408659	: 1	10.0913099	10.2321758	9	
53	9.7679989	9.9085988	Į	9 8594002 9 8596661	10,1405998	.	10 09 14012	10.2320011	7	
54	9'7681735	9.9085073	ſ	A 0230001	10.1403339		10.0914927	10.2318265	6	
- 55	9.7683480	9.9084159	1	9.8599321	10.1400679	' f	10-0915841	122216200	1	
56	9.7685223	9.9083243	1	9.8601980	10.1398020	1	10,0916757	10-2316520	5	
	9.7686966	9.9082327	1	9.8604638	10.1395362	, [0'0917673	10.2314///	4	
57 58	9.7688707	9.9081411	}	9.8607296	10.1392704	1	10-0918589	10.2311293	3	
59		9.9080494		9.8609954	10.1390045	1	0.0919506	10.2309553	i	
6o	9.7692187	9.9089575	. 1	9.8612610	10.1387390	<u> </u>	0.0910424	10-2307813	O	
	L. Co-Sine.	L Sine.		L.Co Tang.	L. Tangent.	; J	Co-Secant	L. Secant.	M	
				54 D E	GREES					
								THE PERSON NAMED IN	7	

74 ATABLE of Natural and										
	, , , , , , , , , , , , , , , , , , , 			36 D E	GREES	5			_1	
141	N. Sine	N.Co-Sinc.		N. Tangent.			N. Secant	NCo-Secant	<u>_</u>	
0	5877853	8090170		7265426	13763819		12300680	17013013	6: —	
1	5880206	8088460	1	7269871	13755403	ı	12363294	17006201	59	
2	5882558	8086749	l	7274318	13746994	i	12365909 12368526	16999407 16992612	5 ⁵ .	
3	5884910	8085037 8083325	į	7278767 7283218	13738591		12371148	16985825	56	
4 5	5887262 5889613	8081612		7287671	13721805		12373768	16979044	Ś.	
6	5891964	8079899		7292126	13713422	ı	12376393	16972271	54	
7 8	5894314	8078185		7296582	13705047		12379019	16965504 16958743	53	
	5896663	8076470 8074754		7301040 7305501	13696678 13688315	ı	12384278	16951990	52 51	
9 10	5899012	8073038		7309963	13679959	ı	12386911	16945244	50	
111	5903709	8071321		7314427	13671610	1	12389546	16938504	49	
12	5906057	8069603	1	7318894	13663267	ı	12392183	16931771	48	
13	59c8404	8067885		7323362	13654931	ı	12394822	16925045	47	
14	5910753	8066166	ŀ	7327831	13646602	l	12397464	16918326	46	
15	5913096	3064446		7332303	13638279	- 1	12400108	16911613 16904907	45	
16	5915442	8062726 8061705	1	7336777	13629963 13621653		12402754 12405402	16898208	44 43	
17	5917787	8059283	į	7341253 7345730	13613350		12408052	16891516	42	
10	79-0-56		1	,,,,,,		ŀ		- 400 .0	-	
19	5922476	8057560		7350210	13605054		12410704	16884830	4:	
20	5924819	8055837	ı	7354691	13596764 13588481	ı	12413359 12416016	16878151 16871479	40 39	
21	5927162	8054113 8052389		7359174 7363660	13580204	1	12418675	16864814	38	
22	592950 5 5931847	8052369 805C664		7368147	13571934		12421336	16858155	37	
24	6934189	8048938	1	7372636	13563670	·	12423999	16851503	36	
25	5936530	. 8047211		7377127	13555413		12426665	16844857	35	
26	5938871	8045484		7381620	13547162		12429333	16838218	34	
27	5941211	8043756	j	7386115	13538918		12432003 12434675	16831586 16824961	33	
28	5943550	8042028	- 1	7390611 7395110	13522449		12437349	16818342	32 31	
29 ; 30	5945 88 9 5948 228	8040299 8038569		7399611	13514224		12440025	16811730	30	
	5950566	8036838		7404114	13505006		12442705	16805124	29	
31 32	5952903	8035107	1	7408618	13497794		12445386	16798525	28	
. 33	5955240	8033375		7413124	13489589		12448069	16791933	27	
34	5957577	8031642		7417633	13481390		12450754	16785347 16778768	26 25	
35	5959913 . 5962249	8029909 8028175		7422143 7426655	13473197 13465011		12456131	16772195	24	
-	5964584	8026440		7431170	13456832		12458823	16765629	23	
237 238	5966918	8024705		7435686	13448658		12461518	16759070	22	
.39	5969252	8022969		7440204	13440492		12464214 12466913	16752517 16745970	21 20	
40	5971586	8021232	i i	7444724	13432331 13424177		12469614	16739430	19	
41	5973919 5976251	80194 94 801 7 756		7449246 7453770	13416029		12472317	16732897	18	
	5978583	8016017		7458296	13407888		12475022	16726370	17	
43	5980915	8014178		7462824	13399753		12477730	16719850	16	
44	5983246	8012538		7467354	13391624	1	12480440	16713336 16706828	15	
46	5985576	8010797	}	7471886	13383502	1	12483152	16700328	14	
47 48	598 7 90 6 . 5990236	8009056 8007314		747 6420 7480956	13375386 13367276	1	12488583	16693833	12	
				7485494	13359172		12491302	16687345	11	
49	5992565 5994893	8005571		7490033	13351075	1	12494023	16680864	10	
.50 51	5997221	8002083	•	7494575	13342984	1	12496746	16674389	8	
52	5999549	8000338	l	7499119	13334900	1	12499471	16667920 16661458	8 7	
53	6001876	7998593 7996847		7503665 7508212	13326822	l	12504929	16655002	6	
54	6004202		1				12507661	16648552	5	
55	6706528	79951CO	I	7512762 7517314	13310684	1	12510396	16642109	4	
56		7993352	l	7521867	13294571	1	12513133	16635673	3	
57 58	6013503	1 ' ~ ^	l	7526423	13286524	1	12515872	16629243	2	
59		7988105	1	7530981	13278483	1	12518513	16622819	1	
60		7986355	1	7535540	13270448	4	12521357 N. Co-Secant		M	
	N Co-Sin	N. Sine.	<u> </u>	N. Co Tang	N. Tangent.	<u></u>	Its. Co-Jecani	11. 00001		
				53 D	EGREE	3.				

			36 E	EGRE	ES.			
M	L. Sine.	L. Co-Sine	L. Tangent		,	L. Secant.	L Co-Sec.ant	<u> </u>
0	9.7692187	9.9679576	9.8612610		l	10.0920424	10.2307813	
1	9.7693925	9.9078658	9.8615267			10,0921342	10.2306075	
2	9.7695662	9.9077740	2.8617923		ł	10.0922260	10.2304338	
3	9.7697398	9.9076820	9.8520578	10.1379422		10.0923180	10,2302602	57
4	9.7699134	9.9075901	2.8623233	10.1376767	l	10.0924099	10-2300866	56
5	9.7700868	9.9074980	2.8625887		i	10.0925020		
6	9.7702601	9.9074059	, 98628541	10.1371459		10.0925941	10.2297399	54
	9.7704332	9.9073138	9.8631195	10.1368805	I	10-0926862	10.2295668	1
7 8	9.7776263	9 9072216	9.8633848	10.1366152	1	10.0927784	10.2293937	53
9	9.7707793	9 9071293	9.8636500	10.1363500	l .	10.0928707	10.2292207	51
10	9.7709522	9.9070370	9.8639152	10.1365848		10.0923630	10.2290478	50
71	9.7711249	9.9069446	9,8641803	10,1358197		10.0930554	10.2288751	49
12	9.7712976	9.9068522	9.8644454	10.1355546	1	10.0931478	10.5384054	48
	9.7714702	9.9067597	9.8647105	10-1352895	1	10,0932403	10-2285298	12
13 14	9.7716426	9.9066671	5.8649755	10-1350245	1	10.0933329		
15	9.7718150	9.9065745	9.8652404	10.1347590	1	10.0934255	10.2281850	
16	97719872	9.9064819	9.8655053	10.1344947	l	10.0235181	10.2280128	44
17	9-7721593	9.9063892	9.8657702			10.0936108	10.2278407	43
18	9.7723314	9.9062964	9.8660350	10.1339650	I	10.0937036	10.2276686	. 42
	9-7725033	9.9062036	9-8662997	10-1337003	l	10.0937964	10,2274967	<u> </u>
19 20	9.7726751	9.9061107	9.8665644		l	10.0938893	10.2273249	T -
21	9.7728468	9.9060177	9.5668291	10.1331709	l	10.0939823	10.2271532	7-
22	9.7730185	9-9059247	9.8670937	10.1329063		10-0940753	13.5759812	38
23	9.7731990	9.9058317	9 3673583		1	10-0941633	10.2263100	27
24	9.7733614	9.9057386	9.8676228	10.1323772	l	10.0942614	10,2266386	36
	9.7735327	9.9056454	9.8678873	10-1321127	ŀ	10.0943546	10.2264673	
25 26	9.7737039	9.9055522	9.8681517			10.0941478		37
	9.7738749	9.9054589	9.8684160			10.0945411	10.2261251	34
.27 28	9.7740459	9.9053656	9 8686804	10-1313196	1	10 09 16344	10.2259541	33 32
29	9 7742168	9052722	9 8689446		l	10.0947278	10.2257832	31
30	9-7743876	9 4051787	. 9.3692089	10-1307911	l	10 0948213	10.5526154	30
1	9.7745583	9.9050852	9.8694731	10.1305269	1	10:2040148	10.224412	-
31	9.7747288	9.9049916	9.8697372	10,1305058	1	10:0949148	10.2254417	29
33	9.7748993	9.9048980	9.8700013		ì	10.0951020		
34	9.7750697	9.9048043	9.8702653		1	10:051957	10.2249303	26
35	9-7752399	9.9047106	9.8705293		l	10.0952894	10.2247601	25
36	9.7754101	9.9246168	9.8707933	10.1292067	l	10.0953832	10.2245899	24
	9.7755801	9 9045230	9.8710572	10.1289428	l	10.0341750	10 2244100	
37 38	9.7757501	9.9044291	9.8713210	10.1296790		100354770		ן כ־
39	0.7759199	9.9043351	9.8715848	10-1284152	l	10.0956649	10.2240801	22 21
40	0.7760897	9.9042411	9.8718486	10.1281514		12.0957589	10-2239103	20
41	3.7762593	9.9041479	9.8721173	10.1278877		10.0958530	10.2237407	19
42	7764289	9.9040529	9.872376)	10.1276240	•	10.0959471	10.2235711	18
	9.7765983	9.9039587	9.8726396	10.1272524	1	10.00561	10.222.	
43 44	9.7767676	9.9039507	9.8729032	10.1273604		10.0960413 10.0961356	10-2234017	17
44	9.7769369	9.9037701	9.8731668	10.12/090		10.0961350	10.2232324	
46	9.7771060	9.9036757	9 8734332	10.1265598	ſ	120963243	10.2228940	15
47	9-7772750	9.9035813	9.8736937	10.1263063		10.0964187	10.2227250	
48	y•7774439	9.9034868	9 8739571	10 1260429		10.0965132	10-2225561	12
	0.7776:00	0.0000000	0.801000	10.101555		10.004/22	In coose -	
49	9.7776128 9.7777815	9.903392 <u>3</u> 9.9032977	9-8742204 9-8744838	10.1257796		10.0966077	10.2223872	11
50 51	9.7779501	9.90329//	9.8747470	10.1255162	l	10.0967023 10.09 6 7969	10,2222185	10
52	9.7781186	9.9031084	9.8750102	10.1249898		10.0968916	10.221-8814	8
53	9.7782870	9.9030136	9.3752734	10.1247266		10.0969864	10.2217130	7
54	9.7784553	9.9029188	9.8755365	10.1244635		10 0970812	10.2215447	6
	0.2286005	0.0008000	0 974554					
55	9.7786235 9.7787916	9.9028239 9.9027289	9.8757996 9.3762627	10.1242004		10.0971761	10.2213756	5
56 57	9.7789596	9.902/209	9.8763257	10-1239373		10.0972711	10.2212034	4
57 58	9.7791275	9.9025389	2.8765886	10.1230/43		10.0974611	10.2210404	3
59	9-7792953	9.9024438	3.8768515	10.1231485		10-0975562	10.2207047	2
δ'n	9.7794630	9-9023486	9.8771144	10.1228856	4	100976514	10.2205370	0
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9 10	6177224	7862165	1	7855103 7859808	12730578		12716235	16188502 16182510	51
11	6181798	7860367	- 1	7864515	12715342		12722751	16176524	50 49
12	6184084	7858569	1	7869224	12707733	1	12724963	16170544	48
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13	6186370	7856770	1	7873935	12700130	1	12727877	16164569	47
14	6188655	7854970	ı	7878649	12692532		12730794	16158600	46
15 16	6190940 6193224	7853169 7851368	ŀ	7883364 7888082	12684939 12677353		12733712	16152637	45
17	6195507	7849566		7892802	12669772		12736634 12739557	16146728	44
18	6197790	7847764		7897524	12662196		12742484	16134783	43 42
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19	6200073	7845961	٠ ١	7902249	12654626		12745412	16128843	41
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21	6204636 6206917	7812352		7911703	12639503		12751276	16116980	39 38
22	6209193	7840547 7838741		7916434 7921167	12631950 12624402		12754212	16111057	38
23 21	5211478	7836935		7925902	12615860		12757150	16 99228	37
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25	6213757	7835128		7937640	12609323		12763034	16093323	35
26	6216036	7833320		7935379	12601792		12765980	16c87423	34
27	5218314	7831511		7940121	12594267		12768928	16081528	33
28	6220592 6222869	7829702 7827892		7944865	12586747		12771878	16075640 16069757	32
29	6225146	7826082		7949611 7954359	12579232		12774831	16063879	31
30	0223:40	7020002		7914319	125/1/23		12////0/	10003079	30
31	6227422	7824271		7959110	12564219		12780745	16058008	29
32	6229698	7822459		7963862	12556721		12783705	16052142	28
33	6231973	7820646		7968617	12549229		12786667	16046281	27
34	6234248	7818333		7973374	12541742		12789632	16040426	26
35	6236522	7817019		7978134	12534260		12792600	16034577	25
36	6238796	7815205		7982895	12525784	1	12795570	10328/34	24
1 - 27	6241069	7813390		7987659	12519313		12798543	16022896	23
37	6243342	78115:4		7992425	12511848		12801518	15017064	22
39	6245614	7809757		7997193	12504388		12804495	1601 1237	21
40	624;835	7807940		8001963	12496933	}	12807475	16005416	20
41	6250156	7806122	I	8006736	12481484	1	12810457	15599600	19 18
42	6252426	7804304	1	1151108	12482040	1	12313442	15993790	18
1	6254696	7802485	l	8016288	12474602	l	12816430	15987986	17
43	6256966	7802485	•	8021067	12467169	1	12810430	15982187	16
44 45	6259235	7798845		8025848	12459742	l i	12822412	15976394	15
46	6261503	7797024	1	8030632	12452320	1	12825407	15970606	14
47	6263771	7795202	l	8035418	12444903	Į.	12828404	15964824	13
47 48	6 266 038	7793380	1	8040206	12437492	1	12831404	15959047	12
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49	6268305	7791557	1	8049790 8049790	12430030	l	12834406 12837411	15953276	11
50	6272837	7789733	1	8054535	12415290	1	12840418	15941751	10
51 52	6275102	7786083	1	8054382	12407900	1	12843428	15935996	8
53	6277366	7784257	1	8064181	12400515	1	12846440	15930247	7
54	6279630	7782431	Ī	8068983	12393136	1	12849455	15924504	6
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1	9.7895036	9.8964334	1	9.8930703	10.1059298		10.1035666	10.2104964	59
2	9.7896652	9.8963346	1 1	9.8933336	10.1056691		10.1036654	10.2103348	. 58
3	9.7898266	9.8962358	1	9.8935939	10.1064091		10.1037642	10.2101734	57
4	9.7899880	9.8961369	1	9.8938511	10.1061489		10.1038631	0.5100150	56
5	9.7901493	9.8960379	ł	9.8941114	10.1058386	•	10.1039621	10.2098507	55
٥	9.7903104	9.8959389	1 1	9.8943715	10.1056285	1	10.1040611	10.2095896	54
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7.8	9.7904715	9.8958398		9.8946317	10.1053683		10.1041602	10.2095285	53
	9.7906325	9.8957406		9.8348918	10.1051082	1	10.1042594	10.2093675	52
9	9-7907933	6.8556414	1 1	9.8951519	10.1018481	1	10.1043586	10.2092067	51
10	97909541	9.8955422	1 1	9.8954119	10.1042881	l	10-1044578	10.5000120	50
11	9.7911148	9.8954429	1 1	9.8956719	10,1013281		10-1015572	10.2088852	49
12	9-7912754	9.2953435		9.8959319	10.1040681		19.1046565	10.2087246	48
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13	9.7914359	9.8952440	.	9.8961918	10.1038082		19.1047560	10.2085641	47
14	9.7915963	9.8351445		9.8964517	10.1035483		10.1048222	10-2084037	46
15	9.7917566	9.8950450		9.8967116	10.1032884		10.1049550	10.2082434	45
16	9.7919168	9.8949453	i i	9.8969714	10,1030286		10,1050547	10.2080832	44
17	9.7926769	9.8948457		9.8972312	12-1027688	l	10.1051543	10.2079231	
18	9.7922369	9.8947459		9.4974910	10-1025090		01.1052541	PO-2077631	43
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19	9.7923968	9.8946461		9.8977507	10.1022493	;	10,1053539	10.2076032	41
20	9.7925560	9.8945463		9.8980104	10-1019396		10,1054537	10.2074434	
21	9.7927163	9.8944461	1	9.8982700	10.1017300		10,1054537	10.2072837	40
22	9.7927103	9.8943464	1	9.8985296	101014704		10,1056536	10.2071240	39
23	9.7930355	9.8942463		9.8984892	10.1012108		101057537	10.2071240	38
24	9.7931949	9.8941462		9.8990187	10.1009513		10,1058538	10.2068051	37
24	9/931949	9.0941402	•	71375457	10.1059513		10,10,0,30	0.2000051	36
-	9.7933543	9.8940451	1	9.8993032	10,1006918		101059539	10.2056457	
25 26		9.8939458		9:8995677			10 106 2542		35
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27	9.7936727	9.8938456	l '	9.9000865	10.1001729		101051544	10.2063273	33
28	9.7938317	9.8937452			12-0939135		10 1062548	10.2051683	32
` 29	9.7939907	9.8936448	i	9,9003459	10.0996541		101063552	10.3003003	31
30	9.7941496	9.8935444	1	9-9006052	10 0993948		10,1064556	1b.2058504	30
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31	9.7943083	9.8934439	l	9.9008645	10.0991355		10-1065561	10.2056917	29
32	9.7944670	9.8933433	1	9.9011237	17.0938763		10,1066567	10 2055330	28
33	9.7946250	9.8932426		9.9013830	10,0985170		10/1067574	10.2053744	27
34	9.7947841	9.8931419		9.9016422	10.0983578		10/1068581	10.2052159	26
35	9.7949425	9.8930412		9.9019013	10.0980937		1011069588	10.2050575	25
36	9.7951008	9.8929404		9.9021604	10-0978396		1011070596	10-2048992	24
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37	9.7952590	9.8928395		9.9024195	10.0975805	. [10,1071605	10.2047410	23
37	9.7954171	9.8927385		9:9026786	10.0973214	١ ١	10/1072615	10.2045829	22
39	9.7955751	9.8926375		9,3039376	10.0970614	1	10/1073625	10.2044249	21
40	9.7957330	9.8925365		9,9231966	10.0958034	. : I	10/1074635	10.2042670	20
41	9.7958909	9.8924354		9.9034555	100965445	: :	1011075646	10-2:41091	io
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43	9.7952062	9.8922329		9 9039733	100960267	1	10/107/671	10.2037638	17
44	9.7963638	9.8921316		9,9042321	100957679	į	10,1078684	10.2036362	16
45	9.7965212	9.8920303		9.9044910	1010955030		101079697	10-2034788	15
46	9.7966786	9.8919289		9-9047497	10,0952503		17 1280711	10.2033214	14
47	9.7968359	9.8918274	1	919050085	100949915	. 1	101081726	10.2031641	
48	9.7969930	9.8917258		9,9052672	10.0947328	. 1	101082742	10.2031041	13
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49	9.7971501	9.8916242		9.9055259	100944741		10.1083758	10-2028499	11
50	9.7973071	9.8915226		9.9057845	10.0942155		10.1084774	10.2026929	
51	9.7974640	9.8914208	1	919050431	10-2939569	l	101085792	10.2025360	10
52	9.7976208	9.8913191		9.9063017	10.0936983	l	101036809	10-2023792	8
53	9.7977775	9.8912172		9-9065603	10.0934397	1	13.1087828	10-2023/92	
33	9.7979341	9.8911153		9.9068188	10-0931812	•	101087828	10.2720659	76
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55	9.7980906	9.8910133		9.9070773	100929227	1	10.1089867	10-2019094	
56	9.7982470	9.8900113		9.9073357	10,0926643				5
	9.7984034	9.8908092		9.9075941	10.0924059		16.1090887	10.2017530	4
57	9.7985596	9.8907071		9.9078525			10.1091908	10.2015966	3 [
58	9.7987158	9.8906049			10.0921475		10.1092929	1062014404	2
59 60	9.7988718			9.9081109	10.0918891		19.1093951	10.2012842	z į
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7 8	9.8001169	9.8896822	9.9104347	10.0895653	10.1103148	10.1998831	52
9	9.8002721	9.8835794	9.9106927	10.0893073	10.1104206	10.1997279	51
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13	9.8008921	9.8891675	9-9117245	10.0882755	10.1108325	121991079	47
14	9.8010468	9.8890644	9.9119824	10 0880176	10.1109356	10.1989532	46
15	9.8012015	9,888,612	9.9122403	10.0877597	10.1110388	10 1987985	45
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17	9.8013106	9.8887547	9.9127559	10.0872441	10.1112453	10.1984894	43
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24	9.8025894	9.8880293	9.91 45596	10.0854404	10.1119702	10.1974106	37 36
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33	9.8039099	9.887.934	9.9168765	10.0831239	10.1129066	10.1960301	27
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48	9.8062544	9.8855215	9.9207329	10.0792671	10.1144785	10.1937456	13
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57	9.8076154	9.8845717	9.9230437	10.0763563	13.1154283	10-1923846	. 3
58			1 2 2 2 2 2 2	10.0765996	110 .166241		
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	9.8080675	9.8442540	9 9 2 2 8 1 3 9	10.0761807	,	10.1157450		-1
	9.8082180		9 9240701		- 1	10.115852		-
1 2	1 0 0 00		9.9243266	10.0756734				. ,,
3	1 0 0 00	9.8939357	9.9245831			10.11.50283		
4			9 9248396		1	10-116064		² 57
	0.00		9.9250960		1	10.1161706		1 56
5	9.8089692					10 1162768		3 5<
1. "	9 0009092	9 0030100	9.9253524	10.0746476	'l	10.1163832	10.1910308	3 54
	9.8091192	9.8835104	9.9255088	10.00.00	1	1.0		-
7 8	9.8091192	9.8834039	9.9258652			10.1164896		53
1	- 0 0	9.8832974	9.9251215		ſ	10.1165961		1 52
. 9	-0. /0.	9.0032974			i	10.1167026	10.1905811	1 6
10	- 0 0		9.9263778		j	10.1163092	10.1004214	50
11	9.8057182	9.8830841	9,9266341	10.0733059		10.1169159	10.1902318	49
12	9.8098678	9.8829774	9.9268904	10.0731096	ł	10.1170226	10.1901322	48
					!		-	40
13	9.8100172	9.8828706	9.9271466	10.0728534	l	10.1171294	10.1899828	
14	9.8101666	9.8827638	9.9274028	10 0725972	1	10.1172362	10.1898334	1 7/
15	9.8103159	9.8826568	9.9275599	10.0723410	l	10.1173432	10.1896841	7 -
16	9.5104650	9.8825499	9.9279152	10.0720348		10.1174501	10.1895350	1: 7/
17	9.8106141	9.8824428	9.9281713	10.0718287	i	10.1175572	10.1893859	77
18	9.8107631	9.8823357	9.9284274	10.0715726	l .	10.1176643	10.1892363	1. 7. 1
			7				10.1092309	42
. 19	9.8109121	9.8822285	9.9286835	10.0713165	i	10.1177715	10.100.	
20	- 04	9.8821213	9.9289396	10.0710604	l	10.1178787	10.1890879	1 4 1
21	9.8112096	9.8820140	9.9291956	10.0708044	į	10.1170850	10.1889391	40
22	9.8113583	9.8810067	9.9294516	10-0705484	i	10.1180933	1 2 2 4 / 9 0 4	39
23	9.8115069	9.8817992	9.9297076	10.0702321		10.1182038	10 1886417	1. 28 1
	9.8116554	9.8816918	9.9293636	10.0720364		10 11 620 36	10.1884931	27
24	7 021-774		79-77-30	2010/ 30304		10.1183082	10.1883446	36
	9.8118038	9.8815842	9.9302195	10.0697805		12.20		1. 1
25	9.8119521	9.8814766		10.0097905		10.1184158	10-1881962	35
26	9.8121003	9.5813659	9.9304755	10 0095245		10.1185234	10.1880470	1 341
27		9.8812612	9.9307314	10.0692636		10.1186311	10.1878997	37 1
28	9.8122484		6.5309872	100690128		10-1187388	10.1877516	32
29	9.8123965	9.8811534	9.9312431	10.0687569		10.1188466	10.1876234	, , ,
30	9.8125444	9.8810455	9.9314989	10.0685011		10.1189545	10.1874556	30
	202422	- 20		- (0.		-		
31	9.8126923	9.8809376	9.9317547	10.0682153		10.1190624	10.1873077	20
32	9.8128401	9.8808296	9.9320105	10.0679395		10-1191704	10.1871599	28
33	9.8129878	9.8307215	9.5322662	17.0677338	1	10-1192785	10.1870122	
34	9.8131354	9.8806134	9.4325220	10.0674780		10-1193866	10.1868646	27
35	9-8132829	y.8805052	9.9327777	10.0672223		19.1194948	10.1867171	26
36	9.8134303	9 8803970	9.9330334	10.0569565		10.1196030	10.1862692	25
							100,097	24
37	9.8135777	9.8302887	9.9332890	10.3667110	·	10.1197113	10.1864223	
38	9.8137250	9.8801803	9.9335446	10.0564554		10.1198197	10,1862750	23
39	9.8138721	9.8300719	9.9338003	10.0661497		10.1100581	10.1861279	22
40	9.8140192	9.8799634	2 9 3 4 0 5 5 9	10.0659441		10.1200366	10.1859804	21
41	9.8141662	9.8798548	9 9343114	10.0656885		10-1201452	10 10 50 60 6	20
42	9.8143131	9.8797462	99345670	10.0554330		10-1202538	10.1858338	19.
						202750	10.1856369	18
43	9.8144600	9.8796375	9.9348225	10.0651775		10-1203625	10.10.	<u> </u>
44	9.8146067	9.8795287	9.9350780	10.0549220		10.1204713	10.1855400	17
45	9.8147534	9.8794199	0.0263325	10.0646665	,	10.1204713	10.1853933	16
46	9.8148999	9.8793110	9.9355889	10.0644111		10.1205801	10.1852466	15
	9.8150464	9.8792021	9.9358444	10.0044111		10.1206890	10.1851001	14
47 48	9.8151928	9.8790930	9.9350444	10.0633007		10.1207979	10.1849536	13.
40	200171920	7.0/90930	3.9300390	10.0039032		10-1209070	10.1848572	12
4	9.8153391	9.8789840	010063450	10.06060			-	
49	70473391		9.9363552	10.0636448	1	10.1210160	10.1846609	11
. 50		9 8788748	9,9369105	10.063389;		10.1211252	10.1845146	10
51	9.8156315	9.8787656	9.9363659	10.0631341	1	10.1212344	10.1843685	9
52	9.8157776	9.8786563	9.9371212	10.0628788	٠ ا	10.1213437	10.1842224	8
53	9.8159235	9.8785470	9 9373765	10.0626235	ł	10-1214530	10.1840765	
54	9.8160694	9.8784376	9.9376318	10-0623632	ı	10.1215624	10.1839306	7 6
	2846	0-0	^		i			
55		9.8783282	9.9378871	10.0621129	1	10-1216719	10.1837848	_
56		9.8782189	9.9381423	10.0618577		10.1217814	10.1836391	5
57		9.8781090	9 9383979	10.0616025	. (10.1218910	10-1834934	4
58		9.8779994	9.9386527	10.0613473	ı	10.1220006	10.1833479	3.
59	9.8167975	9.8778896	9.9389079	10.0610921		10.1221104	10.1832025	2
60	9.8169429	9.8777799	9.9391631	10.0508369	- 1	10.1222301	10.1830571	I
	L Co-Sine	L. Sine	L. Co-Tang	L. Langeni	. 1	L.Co-Secant	L. Secant.	<u></u>
			0) EURIN \ 1	2. Solant.	M
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WI	N. sine.	N. Co-sine	1	N. Tangent.	V. Co-Tang.		N. Secant.	N Co-Secant	
U	6560590	7547096		8692868	11503684	1	13250130	15242531	60
1	6562785	7545187		8697976	11496928	i	13253412	15237433	59
2	6564980	7543278		8/03087	11490176		13256837	15232339	- 58
3	6567174	7541368		8708200	11483429		1326)194	15227250	57
4	6569367	7539457		8713316	11476687		13263554	15222165	56
	6971560	7537546		3718435	11469949		13266918	15217087	55
5 6	6573752	7535634		8723556	11463215		13270284	15212012	54
	0)/5/12	7757057		0/23))0					74
. 7	6575944	7533721		8728680	11456486		13273653	15206942	53
. 8	6578135	7531808		87338n6	11449762	1 1	13277025	15201876	52
9	6580326	7529894		8738935	11443041	1	13280399	15196315	51
10	6582516	7527980		8744067	11436326		13283776	15191759	50
11	6584706	7526065	1	8749201	11429615	1	13287156	15186708	49
12	6586395	7524149		8754338	11422908	i 1	13290539	15181661	48
				-7,7750					-
13	6589083	7522233		8759478	11416206		13293925	15176619	47
14	6591271	7520316		8764620	11409508		13297314	15171581	46
15	6593458	7518398		8769765	11402815		13307705	15166548	45
16	6595645	7516480		8774912	11396126		13304100	15161520	44
17	6597831	7514561		8780062	11389441	1	13307497	15156496	43
18	6600017	7512641		8785215	11382761		13310897	15151477	42
									7.
19	6602202	7510721		8790370	11376085		13314300	15146462	41
20	6604386	7508800		8795528	11369114		13317706	15141452	40
21	6606570	7506879		8800689	11362747		13321115	15136447	
22	6608753	7504950		8805852	11356085		13324527	15131446	39 38
23	6610936	7503034		8811018	11349427		13327942	15126450	37
24	6613118	7501111		8816186	11342773		13331359	15121459	36
25	6615300	7499187		8821357	11336124		13334779	15116472	35
26	6617481	7497262		8826531	11329479	1	13338202	15111489	34
27	6619662	7495337		8831707	11322839		13341628	15106511	33
28	6621842	7493411		3 8 36886	11316203		13345057	15101538	32
29	6624022	7491484		8842068	11309571		13348419	15,796569	31
30	6626201	748 <i>9</i> 557		8847253	T1302944		13351924	15091605	30
31	6628379	7487629		8852440	11295321		13355362	15286645	29
32	6630557	7485781		8857630	1:289702		13358803	15081690	28
33	6632734	7483772		8862822	11283088		13362246	15076739	27
34	6634911	7481842		8868017	11276478		13365692	15071793	26
35	6637087	7479912		8873215	11269872		13369141	15066852	25
36	6639262	7 477981		8878416	11263271		F3372594	15061915	24
	•			000.				4.0	
37	6641437	7476749		8883620	11256674		13376049	15056982	23
38	6643611	7474117		8888826	11250081		13379507	15052054	22
39	6645785	7472184		8894034	11243493		13332958	15047121	21
40	6647959	7470251 74 68 317		8899245	11236909		13386432	15042211	20
41	6650132	7466382		8904459 8909675	11230329		13389899	15037297	19
42	6652304	7400332		09090/5			13393369	15032387	18
<u> </u>	6654475	7464446		8914894	11217183		13396842	15027481	
43	6656646	7462510		8920116	11210616		13400317	15022580	17
44	6658817	7460574		8925341	11204053	[13403795	15017683	16
45	6660987	7458637		8930569	11197495		13407276	15012791	15
46	16663156	7456699		8935749	11190941		13410761	15007903	14
47 48	6665325	7454760		8941032	11184391	1	13414248	15003020	13
40		1717100			- ,,,,,		-54-4-4	-,00,020	12
49	6667493	7452821		8946268	11177846		13417738	14998141	
49 50	666 9 661	7450881		8951506	11171305		13421232	14993267	11
50 51	6671828	7448940		8956747	11164768		13424728	14988397	10
52	6673994	7446999		1961998	11158235		13428227	14983531	9
53	6676160	7445057		8957238	11151706		13431729	14978670	7
73 54	6678326	7443115		8972487	11145182	l l	13435234	14973813	6
			l						
55	6680491	7448172	l	8977739	11138662	l	13438742	14968961	5
56	6682655	7439229		8982994	11132146	1	13442253	14964113	4
57	6684818	7437285		8988252	11125535	į į	13445767	14959270	3
58	1869899	7435340	1	8993512	11119127		13449284	14954430	2
50	6689144	7433394	:	8998775	11112624	1	13452804	14949596	1
6 0	6691306	7431448		9004041	11106125	I	13456327	14944765	0
-	N. Co-Sine.	N. Sine.	· '	N. Co-Tang.	N. Tangent		N. Co Secant.	N. Secant.	M
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Artificial Sines, Tangents and Secants.	Artificial	Sines,	Tangents.	and Secants.
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Artificial Sines, Tangents and Secants.										
				41	DEGRI					
M	L. Sine. o	L. Co. Sine.		L. Langent	L. Co Tang.		L. Secant.	- Co-Secant		
0	9.8169429	9.8777799		9.9391631	10.0608369		TO.1222201	10.1830571	60	
-	9.8170512	9.8776700		0.0304185	10.0505818		10.1223300	10.1930118		
2	9.8172334	98775601		9.9396733	10.0573267		10:1224399	10.1827666	59 5 8	
3	9.8173785	9.8774501		9.9399284	10.0600716		10-1225499	10.1826215	57	
4	9.8175235	9.8773401	1	9.9401835	10.0598165		10.1226539	10.1824765	56	
5	9.8176555	9.8772300		9.9474385	10.0595615		10.1227700	10.1823315	55	
0	9.8178133	9.8771198		9.9406936	10.0593064		10.1228802	10.1821867	541	
7	9.8179581	9.8770096		9.9479486	10.0590514		10.1229904	10.1820419		
7 8	9.8181028	9.8738993		y.9412036	10.0587961		10.1231207	10-1818972	53 52	
9	9.8:82174	4.8767889		9.9414585	10.0585415		10.1232111	10-1817526	Śī	
10	9.8.83919	9.8766785		9.9417135	10.0582865		10.1233215	10-1816081	50	
11	9.8185364	9 8765680		9.9419684	10,0580316		10.1234325	10-1814636	49	
I 2	£.8186807	9.8764574		9.9422233	10.0577767		10.1235426	10-1813193	48	
13	9.8188250	9.8763468		9.9121782	10.0575218		10.1236532	10.1811750	47	
14	9 8189692	9.8762361		9.9427331	10.057266		10.1237633	10.1810308	46	
15	9.8191133	9.8761253		9.9429879	10.0570121	i i	10-1238747	10.1808867	45	
16	98192573	9.8760145		9-9432428	10.0557572		10.1239855	10.1807427	44	
17	9.8194012 9.8195450	9.8759036		9.9434976	10.0565024		10.1240964	10.1805988	43	
18	y v 1 y) 450	9.8757927	1	9.9437524	10.0562476		01.1242073	10.1804550	42	
19	9.8196888	9.8756816		9.9140072	10.0559928		10.1243184	10.1803112	41	
20	9.8198325	9.8755706		9.9442619	10.0557381		10.1244294	10.1801675	40	
21	9.8199761	9.8754594		9.9415166	10.0554834		10.1245406	10.1800230	39	
22	9.8201196	9.8753482		9 94477 14	10.0552286		10.1246518	10.1798804	38	
23	9.8202630	9.8752369		9.9450261	10.0549739		10-1247631	10.1797370	37	
24	9.0204003	9.8751256		9.9452807	10.0547193		10.1243/44	10.1795937	36	
25	9.8205496	9.8750142		9.9455354	10.0544646		10.1249858	10-1794504	35	
26	9.8206927	9.8749027		9.9457900	10.0542100		10.1250973	10-1793073	34	
27	9.8208358	9.8747912		9.9460447	10.0539553		10.1252088	10.1791642	33	
28	9.8209788	9.8746795		9.9462993	10.0537007		10.1253205	10,1790212	32	
29	9.8211217	9.8745679 9.8744561		9.9465539	10.0534461		10-1254321	10.1788783	31	
30	9 02112040	9.0/44501		9.9168081	10 0531916		10.1255439	13-170/354	30	
31	9.8214073	9.8743443		9.9170630	10.0529370		10-1256557	10.1785927	29	
32	9.8215500	9.8742325		9.9173175	17.0526825		10.1257675	10.1784500	28	
33	9.8216926	9.8741205		9.9475720	10.0524280		10 1258795	10.1783074	27	
34	9.8218351 9.8219775	9 8740095		9.9475255	10.0521735		10-1259915	10.1781649	26	
35 36	9.3221198	9·8738953 9·8737844	İ	9.94 ⁸ 3355	10.0519190 10.0516645		10-1261035 10-1262156	10.1780225	25 24	
-30				3.9+73333						
37	9.8222621	9.8736722		9.0185899	10-0514101		10-1263278	10-1777379	23	
37 38	9.8224712	9.8735599		9.9188413	10.0511557		10.1264401	10.1775958	22	
3 9	9.8225463	9.8734476		6.6160082	10,020617		10.1265524	10.1774537	21	
40	9.8226883	9.8733 352 9.8732227		9.9493531	10.0506469		10-1266648 10-12677 7 3	10-1773117	20	
41 42	9.3229721	9.8731102		9.919 39 1 9 9.91960 7 5	100503925		10-12-688-98	10-1771698	18	
**										
43	9.8231138	9.8729975		9.9501162	10.0498838		10.1270024	10.1776865	17	
44	9.8232555	9.8728849		9.9503705	10.0496295		10.1271151	10-1767445	16	
45	9 8233971	9.8727722		9.9506248	10.0493752		10.1272278	10-1766025	15	
46 47	9.8235386 9.8236800	9 ⁸ 72 6 594 9 ⁸ 725466		9.9508791 9.9511354	10.0491209 10.0488566		10.1273406	10-1764614 10-1763200	14	
47 48	9.8238213	9.8724337	'	9.9513876	10 0486124		10.1275663	10-1761787	12	
							<u> </u>			
49	9.8239626	9.8723207		9.9516419	10.0483281		10.1276793	10-1760374	11	
50	9.8241037	9.8722076		9.9518961	10.048103		10.1277924	10.1758963	10	
51	9.8242448 9.8243858	9.8720945	l '	9.9521503	10.0475055	}	10.1279055	10-1757552	8	
52 53	9.8245267	9.8718681		9 .952 4045 9 . 9526587	10.0475955		10.1281319	10-1756142	7	
54	9.8246676	9.8717548		9.9529128	10-0470872		10.1282452	10.1753324	6	
			1			i				
55	9.8248083	9.8716414		9.9531670	10.0468330	Ì	10.1283586	10.1751917	5	
36	y-8249490	9.8715279	1	9.9534211	10.0465789	1	10.1294721	10.1750510	4	
57	9.8250896	9.8714144	l	9.9536752	fo.0463248 to.0460707	I	10.1285856	10-1749104	3	
58 59	9.8253705	9.8711872	}	9 9 5 3 9 2 9 3 . 9. 9 5 4 1 8 3 4	10.0458165		10.1288128	10-174/099	1	
65	9.8255109	9.3710735	1	9.9544374	10.0455626	ł	10.1289265	10.1744861		
	L. Co-Sine.	L Sine.	1	L. Co-Tang.		1	L. Co-Secant		M	
			<u> </u>		GREES					

i				42 D	EGREE	0			
M	N. Sine	N.Co-Sine.		N. L'angent.	N. Co-lang.	3	N. Secant	NCo-Secant	-1
0	65913:6	7431448	•	9004041	11106121		13450327	14944765	65
- 1	6692467	7429501		9009309	11099630		13459853	14639940	
2	6605628	7427554		9014580	11093140	1	13463382	14635118	. 58
3	6697788	7425606		9019854	11086653	l	13466914	14630301	57
4 5	6699948 6702107	7423657 7421708		9025131 9030411	11080171	ļ	13470449	14625488	56
6	6704266	7419758		9535411	11073693 11067219	1	13473987 13477528	14625680	55
						l	134//526	140156/5	54
7 8	6706424	7417808		9040979	11060750		13481072	14911076	53
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9 10	6710739 6712895	7413905 7 411953		9051558 9055851	11047823 11041365		13488169	14901489	51
11	6715051	7410000		9052147	11034912		13491721 13495277	14896 7 03 14891 92 0	50
12	6717206	7408046		9067446	11028463		13495836	14887142	49 48
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13	6719361 672151 5	7406092		9072748 9078053	11022019	l i	13502398	14882369	47
14 15	6723668	7404137 7402181		9078053	11005141		13505963	14877599	46
16	6725821	7400225		9088671	11009141	1 1	13509531 13513102	14872834	45
ij	6727973	7398258		9093984	10996281	Ì	13516676	14863317	44
18	6730125	7396311		9099300	10989856		13520254	14858565	43
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20 21	6736577	7392394		9115265	10977020 10970608	į	13527417	14849073	40
22	6738727	7388475		9120592	10964201		13531603 13534593	14844334 14839599	38
23	67 4 087 6	7386515		9125922	10957797	·	13538186	14834868	38
24	6743024	7384554	1	9131255	10951397		13541781	14830142	37 36
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27	6749466	7378-65		9147270	10933010	1	1354 ⁸ 980 13552585	14820702 14815988	34
28	6751612	7375702		9152615	10925840	f	13556193	14811278	33
29	6753757	7374738		9157962	10919465	1	13559803	14806573	32 31
30	6755902	7372773		9153312	10913085	ŧ.	13563417	14801872	30
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31 32	6760190	7368842	,	9174020	10906714 10900347	ł	13567034	14797176	29
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34	6764476	7364907	,	9184740	10887624		13577903	14783111	27 26
35	6766618	7362939		9190104	10881269		13581532	14778431	25
36	6768765	7360971	: :	9195471	10874918		13585164	14773755	24
37	677:901	7359002		9200841	10868571		13588800	14260-9	
38	6773041	7357032		9206214	10862228		13592438	14769084 14764417	23
39	6775181	7355061		9211590	10855889		13596080	14759754	22 21
40	6777323	7353090		9216968	10849554		13599725	14755095	20
41	6779459.	7351118		9222350	10843223		13503372	14750440	19
42	6781597	7349146		9227734	10836896		13607023	14745790	18
43	6783734	7347173		9233122	10830573		13610677	14741144	
44	6785871	7345199		9238512	10824254		13614334	14741144	17 16
45	6788007	7343225	l	9243905	10817939	ļ .	13617995	14731864	15
46	6790143	7341250		9249301	10811628		13621658	14727230	14
47	6792278	7339275		9254700	10805321		13625324	14722600	13
48	6794413	7317299		9260101	10799018		13628994	14717975	12
49	6796547	7335322		9265506	10792718		13632667	14713353	II
50	6798681	7333345		9270914	10786423		13636343	14708736	10
51	6800814	7331367		9276324	10780132		13640022	14704123	
52	6802946 6805078	7319388		9281738	10773844		13643704	14699514	8
53 54	6807209	7227409 7325429		9 ²⁸ 7154 9 ² 92573	10767561 10761282		13647389 13651078	14694910	7
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55	6800339	7323448	!	9297996	1,0755006		13654770	14585713	5
56	6811469	7321467		9303421	10748734		13658464	14681120	4
57	6813599	7319485	: ·	9308846	1,0742467	Ī	13662162	14676532	3
. 5 8	6815728 5817856	7317503	100	9314280	10736203		13665863	14671948	.2
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2 9.827713 9.8705158 9.907319 9.9043455 1.00457615 1.01432881 1.01432692 1.01432681 1.01432692 1.01432681 1.01432692 1.01432692 1.01432681 1.01432692 1.0143269							1			
3 0, 329314 0 9407319 0 9.951799 10.0448055 10.149281 10.1740586 57 6 9.8262114 0, 3470529 0.955777 10.0442935 10.129381 10.1740586 57 0, 32626121 0, 9470385 0.955777 10.0442935 10.129466 10.1737588 55 0.8262617 0, 3470529 0.955777 10.0442935 10.129466 10.1737588 55 0.8262617 0, 3470529 0.955777 10.0442935 10.129466 10.1737580 53 0.8360527 0, 3470047 0, 9.966772 10.0443767 10.129513 10.1733690 53 0.8360570 0, 3470613 0, 9.966772 10.0443767 10.129513 10.1733693 52 0.8360570 0, 3470613 0, 9.966772 10.0443767 10.129513 10.133297 51 10.837061 0, 38269059 0, 9.667772 10.0443767 10.130057 10.1735297 51 10.837061 0, 38269059 0, 9.667772 10.0443768 10.130057 10.1735297 51 10.837061 0, 9.967331 10.0447689 10.130057 10.1735297 51 10.837061 0, 9.967329 0, 9.67732 10.0442768 10.130057 10.1735207 52 0.957365 10.0447768 10.130057 10.1735207 52 0.957365 10.0447768 10.130057 10.1735207 52 0.957365 10.0447768 10.130057 10.1735207 52 0.957365 10.0447768 10.130057 10.1735297 51 10.0447768 10.130057 10.1735207 52 0.957365 10.0447768 10.130057 10.1735297 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.1735297 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.0447768 10.130057 10.173529 51 10.173529 51 10.044776 10.173529 51 10.173529 51 10.044776 10.173529 51 10.173529 51 10.044776 10.173529 51 10.173529 51 10.044776 10.173529 51 10.173529 51 10.044776 10.173529 51		9.8257913					1		10-1742087	58
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6 9.8263121 970-2358 9.9652613 10.040385 10.129612 10.173638 54 7 9.8264910 9.870-2756 9.9601613 9.9662134 10.0437366 10.1297344 10.1737369 53 8 9.82656397 9.870-1613 9.9662140 10.0437366 10.129383 10.1373699 53 10 9.8267101 9.870-0470 9.9967233 10.0437367 10.129539 10.1733699 53 11 9.8270-1919 9.8698183 9.9677731 10.043767 10.129539 10.17373693 51 12 9.8271837 9.86970-37 9.957831 10.0427673 10.130818 10.1739002 50 11 9.8270-491 9.8698183 9.9677331 10.0427673 10.130818 10.1739002 50 11 9.8270-491 9.8698183 9.9677331 10.0427673 10.130818 10.173969 10.173691 10.1726721 47 14 9.8274671 9.809444 9.9779917 10.042073 10.130450 10.1726721 47 15 9.8276603 9.8093597 9.968804 10.047733 10.130450 10.1726721 47 16 9.8276603 9.8093597 9.968804 10.0417935 10.130450 10.1726721 47 17 9.827843 9.8091301 9.9988004 10.0417935 10.130490 10.1726721 47 18 9.8280231 9.869130 9.9988004 10.0414935 10.130491 10.1726569 10.1723329 46 19 9.8281619 9.8585903 9.9998004 10.0404980 10.1307659 10.1722447 44 19 9.8281619 9.8585903 9.9998004 10.0404980 10.1307689 10.1718381 41 19 9.8281619 9.8585903 9.9998004 10.0404980 10.130698 10.1718381 41 19 9.8281619 9.8585903 9.9998004 10.0404980 10.130698 10.1718381 41 19 9.8281619 9.8585903 9.9998004 10.0404980 10.131140 10.7716994 40 19 9.8281619 9.858547 9.9998004 9.9909218 10.04041415 10.131140 10.7716994 40 19 9.8281619 9.858547 9.9998004 9.9909218 10.04041415 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.0404184 10.131140 10.7716994 40 10 9.8281619 9.868183 9.999818 10.040418 10.131140 10.1714141 10.1716994 40 10 9.8281819 9.868183 9.999818 10.040418 10.131140 10.1714141 10.1716994 40 10 9.8281819		9.8260715	9.8705179				1			
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1		9.8638917	2.9701624		10136108		59 58
2		9.8637737	99704157		1.0136226		
3		9.8636557	9-9706689		0.136344	10.1656754	57 56
4		9.8635376	9.9709221		10 136462		55
1 8	9.834459 7 9.8345948	9.8634194	2.9711754		10.1365800	10.1654052	54
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	9.8347297	9.8633011	9.9714286	10.0285714	10.1366989	10.1652703	53
7	0 .06.7	0.00	9.9716818	10.0283182	10.1368172	10.1651354	52
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1 5	200000	9.8629460	9.9721882	10.0278114	0.1370540		50
11	1 2 9 600	9 8528274	9.9724413	10.0275587	10.1371726	10.1647312	49.
1 ::		9.8627088	9.9726945	10.02730551	10.1372912	10.1645967	48
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1	9.8355378	9.8625902	9.9729477	10.0270523	10.1374098	10.1644622	47
1 12	9.8356722	9.8624714	9.9732008	10.0267792	10.1375286	10.1643278	46
i	9.8358066	9.8623526	9.9734539	10.0265461	10.1376474	10-1641934	45
10	/ I ' C ' ' A	9.8622338	9.9737571	10-0262929	10.1377662	10-16.1059	44
1	9.8350750	9.8621148	9.9739502	10.0260398	10.1378852	10.1639250	43
18	9 8 3 6 2 0 9 1	9.8619958	9-9742133	10.0257867	10-1380042	10.1637909	42
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2		0.4	9.9757318	10.0242682	10.1387197	10.1629879	37
2.	9.8370121	9.0012003	77777318		100,307.97		30
	9.8371456	9.8611608	9.9759840	10.0247151	10.1388392	10-1628541	35
2		9.8610412	9.9761379	10,0237621	10,1389588	10.1627209	34
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3	9.8379453	9.8604423	9.9775030	10.022497c	10-1395577		29
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3		9.5602022	9.9780090	10.0219910	10-139797	10.1617885	27
3	9.8383441	9.8600821	9.9782620	10.0217380	10-139917	10.1616559	26
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3	7 9.8387422		9.9790209	10.0209791	10.140278		23
3	8 9.0380747		9.97927 ₃ 8 9.9795263	10.0207262 10.0204732	10-140399		22
3	9.8390072		9.9795263	10.0204732	10-140640		21
4			9 9 300326	10.0199674	10-140140	1 1	10 19
4		1 6	y.9302356	10.0197144	10.140881		i8
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1	9.8395353	9.8589978	2 9805385	10.0194615	10-141002		17
1	1 0 270	9.8588770	807914 :	10.0192086	10.1411230	10.1603316	16
4		0 0	3.9810443	10.0184557	10.141243	10.1601995	15
4	, I a .	0 02	7.7812972	1.00187028	10-141364	10.1600677	14
1 3		9.8585141	29815501	1.00184499	10-141485	10.1599356	13
4	8. 9.8401959	ີ 1 . ດໍບໍ່	3.9318030		10.141607		12
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4	9 8403276	9.8582718	J'9820559		10.141728	10.1595724	:0
50	1 . 0	9 8581505	9.0823087		10.141849		11
5	9.8405908	9.8580292	9.9825616		10.141970	10.1594092	. 9 8
5	9.8407223	9.8579078	29828145		10.142092		
1 5	3 9.8408537		2.9830673		10.142213		
5.	9.8409850	9.8576648	9.9833202	10-0166798	10.142335	2 10.1590150	6
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5			3·9835730		10.142458	1	5
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5	9.8413785	9.8571779	9-984078 7	10.0159213	10.142822		; 2
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1_	L Co-Sin:	L. Sine.	L. Co-T.1n2.				147
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44 DEGREES.									
M	N. Sine	N.Co. Sine.	1	N. Tangent	N.Co.Tang.	ī	N. Secant.	V. Co-Secant .	
0	6946584	7193398		9656888	10355303	- 1	13901636	14395565	60
ī	6948676	7191377	9	662511	10343277	ſ	13905543	14391231	59
2	6950767	7189355		0668137	10343254	1	13909453	14386900	58
3	6952858	7187333		9673767	10337235	1	13913366	14382574	57
4	6954949 695 7 039	7185310		9679400 9685335	10331220	l	13917283	14378251	56
5	6959128	7181263		9690674	10319199	l	13925127	14373932 14369616	55 54
			13						
7	6961217	7179238		9696316	103 13195		13929054	14365305	53
8	6963305	7177213		9701962	10307194		13932985	14360997	52
9 10	6965392 6967 47 9	7175187		9 7 076 10 971326 2	10301196 10 2 95 2 03	. [13936918	14356693 14352393	51 50
10	6969565	7171134		9718917	10289212		13944796	14348097	49
12	6971651	7169106		9724575	10283226		13948740	14343805	48
			- 1					,	
13	6973736	7167078		9730236	10277243		13952688	14339516	47
14	6975821	7165049		973 59 05 9741569	10271263	ı	13956639 13960593	14335231 14330950	46
15	6979988	7160989		9747240	10259315		13964551	14326672	45 44
17	6982071	7158958		9752914	10253346		13968512	14322399	43
18	6984153	7156927		9758591	10247381		13972477	14318129	42
1	600/00	1	1	2564252			12036111	1407505	
19	6986234	7154895		9764272 9769956	10241419 10235461		13976445 139 8 0416	14313863	41
20	6990396	7150830		9709950	10235401		13984391	1430 9 600 1430534 2	40 39
22	6992476	7148796		9781333	10223455		13988369	14301087	38
23	6994555	7146763	ŀ	9787027	10217608		13992351	14296836	37
24	6996633	7144727		9792724	10211664		13996336	14292588	36
	6998711	714269I	ľ	9798424	10205723		14000325	14288344	
25 26	1	7140655	1	9804127	10199786		14004317	14284104	35 34
27	خدة الله	7138618	l	9809833	10193853		14008313	14279868	33
28	7004942	7136581		9815543	10187923		14012312	14275636	32
29		7134543		9821256	10181997		14016315	14271407	31
30	7009093	7132505	l	9826973	10176074		14020321	14267182	30
-	7011157	7130466) [9832692	10170155		14024330	14262961	29
31 32	7013241	7128426	1 1	9838415	10164239	1	14028343	14258743	28
33	17015314	7126385	1 1	9844141	10158326		14032360	14254929	27
34	7017387	7124344	1 1	9849871	10152417		1403638 0	14250319	26
35	7019459	7122302	1	98613 3 9	10146512		14040403 14044430	14246112	25
30	7021530	/120200		9001339	10140010		14044430	14241909	24
27	7023601	7118217		9867079	10134712		14048460	14237710	23
37 38	7025671.			9872821	10128817		14052494	14233514	23 22
39	7027741	7114130		9878567	10122925		14056532	14229323	2
40	7029010	7112086		9884316 9890 0 69	10117037		14060573	14225134	20
41	7031879	7107995		9895825	10105272		14068665	14220950	19 18
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43	7036014		[[9901584	100,9394	1	14072717	14212592	17
44	7038081	7103901		9907346	10093520	1	14076772	14208418	16
. 45	7040147 -] [991311 2 9918881	10087649	1	14080831 14084893	14204248	15
40	7042213	7099868		9924654	10075918	1	14088958	14195919	14
47	7046342	7095707		9930429	10070058	1	14093028	14191761	12
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49		7093657]	9936208	10064271	1	14097100	14187605	11
50		7089556	1 1	9941991 9947777	10058347 10052497	ı	14101177	14183454	10
51		7087504		9953566	10046651		14109340	14175161	8
53		7085451	1	9959358	10040807	i	14113427	14171020	7
54		7083398	1	9965154	10034968	1	14117517	14166883	б
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55	5 7060776: 5 7062835	7079291]	9970953 9976756	10023298	1	14121011	14162749	5 4
50		7077236	[]	9982562	10017469	ł	14129810	14154493	
57 158	7066953	7075180		9988371	10011642	1	14133915	14150370	3 2
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66	7071000	7071068		10000000	10000000		14142136	14142136	
1	N.Co.Sine	. N. Sine.		L.Co Tang.	N.Tangent.		N. Co-Secont	N. Secant.	M

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0 9.8417713 9.8569341 9.9848327 t0.0151628 10.1430559 1 9.8419021 9.8558121 9.9850900 10.0149100 10.1431879 2 9.8420328 9.8566900 9.9853428 10.0146572 10.1433100 3 9.8421634 9.566570 9.9855956 10.0144041 10.1434322 4 9.8422939 8.8564455 9.9861012 10.0141516 10.1435545 5 9.8424244 9.5563237 9.9863540 10.0136465 10.1437992 6 9.8425548 9.8562.08 9.9863540 10.0136465 10.1437992	10.1582287 10.1580979 10.15790672 10.1579366 10.1577061 10.1577576 10.1574452	50 59 58 57 56 55
1 9.8419021 9.8558121 9.9850900 10.0149100 10.1431879 2 9.8420328 9.8566900 9.9853428 10.0146572 10.1432100 3 9.8421634 9.5565570 9.8852484 10.0144041 10.143222 4 9.8422939 8 8564455 9.8858484 10.0144516 10.143545 10.1436768 10.1436768 10.1437992	10.1580979 10.1579672 10.15798366 10.1577961 10.1575756 10.1574452	59 58 57 56 55
2 9.8420328 9.8566900 9.9853428 10.0146572 10.1433100 10.1434322 10.0144041 10.0144516 10.0144516 10.0143516 10.0143516 10.0138988 10.0136768 10.0136768 10.0136768 10.0136769 10.0137992	10.1579672 10.1578366 10.1577061 10.1575755 10.1574452	58 57 56 55
3 9.8421634 9.565570 9.855956 10.0144041 10.0143322 10.1434322 10.0143516 9.8422939 8.8564455 9.8563232 9.862208 9.862208 9.863540 10.0136460 10.01437992	13 1578366 10,1577061 10,1575756 10,1574452	57 56 55
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1 0.8429456 0.8558232	10-1570544	51
1 .5 9.8420757 9.8557106 9.9872651 10.9120349 10.1442894	19.1569243	50
9,8432057 0,8555878 19,9870179 10,0123821 10,1444122	10.1567943	49
12 9.8433356 9.8554650 9.9878706 [D.0121294] 10.1445350	10.1566644	48
9.8434655 9.8553421 9.9851234 10.0113766 10.1146579	10.1565345	47
14 9.8435943 9.855219 (9.983370) 100110233	10.1564047	46
	10.1562750	45
1 1 6 7 6 7 1 6 7 6 7 6 7 6 7 6 7 6 7 6	10.1562158	44
	12.1558963	43
18 9.8441137 9.8547266 9.9893871 10.01:6129		72
19 9.8442432 9.8546333 9.9896399 10.010360 10.1453967	10.1557568	41
9.98443725 3.8511700 9.984826 10.0100014 10.1455201	10.1556275	40
20 3.8415018 3.8542561 9.9901453 10.7098547 10.1456436	10.1554982	39
9.8446310 3.8542310 9.9903981 10.0096019 10.1457671	10 1553690	38
1. 22 3.8447601 3.8541093 9.3900503 10.0093492 10.1450907	10-1552399	37
24 9.8448891 9.8539856 5.9909035 10.009076 10.1460144	10.1551109	36
	10.14.20	
	10-1549819	35
20 20 10 10 10 10 10 10 10 10 10 10 10 10 10	10.1548530	34
	10 1545955	33
1 - 1	10-1544668	32
29 1 20 1 20 1 20 1 20 1 20 1 20 1 20 1	10.1543382	30
30 7,7		
31 9.8457903 9.8531179 9.9926724 10.0073276 10.1468821	10.1542097	29
9 8450188 3.8520326 . 9.9924251 10.0070749 10-1470064	10.1540812	28
0.3031778 10.0008222 10.1471307 (10.1539519	27
24 9.8461754 9.8527449 9.9934305 10.0065695 10.1472551	10.1538246	26
	10-1536964	25
35 9-8403030 9 8526204 9.9930832 1000060541 10.1475041	10.1535685	24
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37. 9.846\(\sigma\) 9.85\(\sigma\) 9.99\(\sigma\) 1866 10.00\(\sigma\) 10.1476287 10.1477534	10,1534401	23
10.1478782	10.1531842	22 21
39 2 4.44 2 8 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	10-1530564	20
10.1481279 0.8618721 0.9051902 10.0048057 10.1481279	10.1529286	19
41 701482620	10.1528009	18
42 / 7/79 / 7/7/		
	10.1526733	17
44 9.8474543 3.8514969 9.9959573 10.004012, 10.1485031	10.1525457	16
45 9.8475817 9.8513717 9.9962103 10.503790 10.14.0203	10.1524183	15
46 9.3477091 9.8512465 9.9964627 13.0035373	10.1522309	14
47 9 8478 365 9.8511211 9.3967154 10.0632640 10.1469349	10.1521635	13
48 9.8479637 9.8509957 9.9969680 10.0030320 10.1490043	10.1520363	12
40 0.8180000 0.8508702 99972207 10.0027733 10.1491298	10-1519091	11
49 7 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	17.1517820	10
10077760 10002740 101402810	10.1516550	9
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	10.1515280	8
0 8486030 0 8602675 9,0082314 10,0017686 10,1496325	10.1514011	7
53 9.8485979 9.8503075 54 9.8487257 9.8502417 9.9984840 10.001516 10.1497583	10.1512743	6
74 70000		
55 9.8488524 9.8501157 9 9987367 10.0012633 10.1498843	10,1511476	5
66 9.8489791 9.8499897 9.9989893 10.0010107 10.1500103	10.1510209	4
57 3.8491057 9.8498637 9.9992420 10.0007580 10.1501303	10-1508943	3
58 7.8492322 9.8497375 9.9994947 10.3035073	10-1507678	2
50 9 8493586 9.8496113 9 9997473 10.0002527	10.1506414	
60 3.8494850 9.8494850	L. Secant.	$\frac{\circ}{M}$
Les one	L. Secunt.	I IV
45 DEGREES.		

Sines, Tangents, and Secants.

Zzzz 2

THE

Description and Use

THE

BLES

Natural and Artificial Sines, Tangents, and Secants.

Minute of the Quadrant. 1. And the first thing to be done is to

know how to take out the Sine, Tangent or Secant, whether Natural or Logarithmical,

of any Degrees, or Minutes

In order to which you will find, that the Natural Numbers are always in the Left-hand Page, and the Artificial or Logarithmical on the Righthand Pages: So that for every Degree and Minute of the Quadrant, you have before you, one right against the other, the Natural and Logarithmic Sines, Tangents and Secants, with their Complements placed by them.
2. If therefore the Number of the Degrees of

any Ark or Angle given be under 45°, you must look for it at the Head of the Table; but if it exceed 45°, you will find it at the Bottom or Foot; and as in the former Cale you find the Minutes under M increasing downwards on the Left-hand of the Page; so in the latter, they begin at the Bottom of the Page on the Right-hand of it and increase upward.

Thus, if you look for 23 Degrees 13 Minutes, you will find in Page 48 of the Tahles, and its Natural Sine will be 3942093, its Natural Tangent 4289449, &c. and in the Right-hand Page its Artificial Sine will be 9.5957268, and its Logarithalling, Aftronomy, &c. all Treatiles on those Submited Tangent 9 6224015.

mical Tangent 9.6324015, ec.

But if the Degrees given had been more than 45°, as suppose 61°. 25', then you turn till you come to those Degrees at the Foot of the Table; which you will find in Page 58. 59 and there Natural Sine will be 8781222, and the Natural easie for him, by considering the Course and Pro-Tangent will be 18353999; the Logarithmick Sine portion of the Ericrease or Decrease of the Num-will be 9.9435549, and the Logarithmick Tangent bers in the Tables, as they stand near that which

from 180 if it be less than it, or from 360 when

HESE are continued to every Degree and ['tis greater than 180 ; and then feek in the Tables' for the Sine, Tangent or Secant of the Remainder. Thus 123°. 11' substracted from 180° leaves 56°. 49° whose Sine, or Tangent must be sought in the Tables, as is shewn above.

4. And when this is understood, the Inverse

Practice of finding the Degrees and Minutes answering to any Sine, Tangent or Secant given,

will be easie.

Thus suppose you would have the Degrees and Minutes answering to 7027782, a Natural Sine: you must look amongst the Natural Sines, either downward or upward, till you find the Number given, and then on the Top or Bottom you will have the Degrees; and the Minutes on the Right or Left-hand in the Column marked M accordingly; and so you will find the Degrees and Minutes answering to the Natural Sine 7027782, to be 44 yet the nearest to it is 7027741; whose Deg. and Min. are 44°. 39'. and so you must always do when you cant find the Numbers exactly; which will most times be the case.

jects do acquaint us.

N.B. There hath very great Care been taken in the Correction of these Tables and those of the Logarithms, and I believe very few Faults have you will find (reckoning the 23 upwards in the been committed; but whenever the Calculator Right-hand Column of Minutes over M) that the finds Reason to suspect the Tables, it will be very will be 10.2637307; and so for the Secants, &c. he judges faulty, either above or below it, to find 3. If you want the Natural or Artificial Sine, out nearly what Figure is wrong, and how much Tangent or Secant of any Ark greater than 50° or how little; as Experience will soon 'teach as suppose of 123°, 11' you must first substract it him.

1-		.								<u></u>
Deg.	0, 1, 2, 3	•			O,	Natural Ve	rfed .			
M	N. o	N. 1	N. 2	N. 3	1	1 L. 0	L.	1 L. 2	L. 3	M
Ö	0000.000	0701.523	0006.09		ı			l		· I
					. [-			1
I	0000001	0001.574	0005.194	1013 857	l	2.6264222		6.7919482	7-1416791	1
2	.002	1.623	6.29¢	14.011	ı	3.2284822			7-1464636	2
3	.004	1.679	6.400	14.165	ı	3.5806647		6.8061860		3
4	007	1.733	6.575	14 320	ı	3.8305422	6.2387696	6.8132185	7.1559542	
5	•011	1.788	6.610	14.476	L	4-0243620	6.2522361	6.8201944	7-1606600	
6	.016	1.843	6.716	14.633	ı	4.1827246	6.26 54968	6.8271147		16
		l	<u> </u>		ı				734-5	
7	0000.022	0001.893	0006.823	0014.791	l	4.3166182	6.2785581	6.8339812	7.1693.984	1,
7 8	.028	. 1.956	6.931	14.95C	ı	4.4326020	6.2914259	6.8407920	7-1746297	7 8
	.035	2.014	7.040	15.100	ı	4.5349070	6.3041058	6.8475576	7.1792365	
9 10.		2.073	7.150		ı	4.6264219	6.3166033	6.8542572	7.1838189	9
	.043	2.0/5			ı		6.3289234	6.8609122	7 1800	10
11	.052	2.133	7.260	15.430	ı	4.7792072		6,8675167	7.1883773	11
12	•೧62	2.194	7.371	15.592		4.7847843	6.3410714	0,00/5107	7-1929118	12
			222.00		l	. 04 4400	6 - 100116	60-100-		
13	0000.073	0002.255	0007.483		1	4.8543084	6.3530516	6.8740712		13
14	.984	2.317	7.595	15.919	ı	4.9186777	6.3648689	6.8805768	7.2019104	14
15	.096	2. 380	. 7,701	16.083		4.9785040	6.3765275	6.8870338	7.2063750	15
16	.109	2.414	7 825	16.248	1	5.0346614	6.3880317	6.8934434	7.2108167	16
17	.123	2.509	7.940	16.414		5.0873192	6.3993855	6.8998058	7.2152358	17
18	.138	2.575	8.056	16.581	l	5-1369663	6.4105928		7.2196326	18
19	0000.154	(QQ2. 641	0008.173	0016.749	ŀ	5.1839282	6.4216574	5.9123926	7*2240071	19
20	.170	2.708	8.291	15.918	١.	5.2254810	6.4325826	6.9186183	7.2282407	20
21	.187	2.776	8.41C	17.088		5.2708594	6.4433603	6.9248004	7.2326006	20
22	-205	2.845	8.530	17.258			6.4540294		7 2370000	22
.23	.224	2.915	8.651	17.429		5.3498762	6.4645573		7.2412881	23
-	.244	2.986	8 772	17.601		5.3858430	6.4749592	6.9430837	7.2455551	
24	.244	2.930	3//2	17.001		3.3030430	0.4/49)92	0.943003/	7.2475551	24.
	2222.265	2000000	0008.894			5 4222000	6.48.0080	6.9490938	7.04000	
25	0000.265	0003.057		0017.774		5.4223002			7.2498013	25
26	.287	3.129	9.017	17 948				6.9550627	7.2540267	26
27	•309	3.202	9.141	18-123		5.4891474			7.2582317	27
28	-332	3.276	9.266	18.299				6.9668786	7.2624164	2 8 '
29	-356	3:351	9.392	18.475		5.5512156			7.2665810	29
30	.381	3.427	9.518	18.652		5.5806620	6.5348825	6.9785359	7.2707258	30
31	0000-407	0003.504	0009.645	0018.830		5.6091426		6.9843062	7.2748508	31,
32	-434	3.581	9.773	19.009	li	5.6367191	6 5539720	6.9900387	7.2789563	32
33	-461	3.659	9.920	19.189	Н		6.5633617	6.9957334	7.2830425	33
34	•489	3.738	10.032	19.36				7.0013911	7.2871095	34
35	.518	3.818	10.163	19.550	H		6.5818418	7.0369920	7.2911576	35
36	.548	3.899	10.294	19.732	П				7-2951869	36
		3.099				7-77-2-33	- 17. 3301		, = , , , , , , ,	30
27	0000.570	0003.081	2010.426	0010.624		5.7628214	6.5999368	7.0182460	7.2001075	37
37 38	.611	4.063	10.559	2C.099		5.7850850	6.6088450	7.0226600	7.3021807	38
30	.644	4.145	10.693	20.284	۱	5.8085468	6.6176626		7.3071636	30
39	.677	4.230	10.828	20.470		5.8305373			7.3111194	39.
40		4.315	10.964	20.470			6.6350337	7:0200046	7.3150572	40
41	-711		10.101	20.844		5.8729154			7.3189773	41
42	•746	4.401	-0-101	20,044		100/49174	45790/	7.0453719	1 3.03//3	42
1	0000 = 0 =	0004.490	0011.239	2021 022		5 8933534	6.6620640	201=	7.220870	
43	oooറ.782	0004.488		0021.032	ı	5 013225	6.6520642	7.0507160	7.3440/97	43
44	.819	4.576	11.377	21.221	ı	5.9133217	6.6604558		7.3267646	44
45	857	4.664	11.516	21.411			6.6687671	7.0613068	7.3300322	45
46	-896	4.753	11.656	21.602	ı	5.9519314	6.6769996	7.2665540	/-3344827	46
47	•935	. 4.843	11.797	21.793	Н			7-0717698		47 48
48	•975	4.934	11.939	21.985		5.9888977	6.6932340	7.0769544	7.3421327	48
			- 6			((0	200			[
49	0001.016		0012.082		IJ	6.0068070		7.0821082	7.3459326	49
50	1.058	5.119	12.225	22.372		6.0243546	0.7091706	7.0872316	7-3497159	50
51	1 101	5.213	12.369	22.567		6 04 15 546	6.7170304	7.0923238	7.3534828	51
52	1.145	5.207	12.514	22.763		6.0584206	6.7248199	7.0973885	7.3572334	.52
- 53	1.189	5.402	12.660	22.960		6.0749654	6.7325400	7.1024228	7.3609678	53
54.	1.234	5.498	12.807	23.157			6.7401921		7. 3646863	54
55.	0001.280	0005.595	0012.955	0023.355		6 1071284	6.7477774	7.1124044	7-3683888	55
56	1.327	5. 693	13.103	23 554		6.1227887	6.7552970	7.1172427	7.3720767	36
	1-375	5.792	13.252	23.754		6,1281620	6.7627520	7.1222728	7.2757460	
57 58	. I.424	5.891	13.402	23 955		6.1422670	6.7701436	7.1271669	7.2704024	57 58
59		5.991	13.402	24.157		6.1681166	6.7774728	7 1220202	7 2820427	
63	1.473	6.092			۱ ا	6.18.7127	6.7847406	7.1268680	7 286660	59 60
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1 6	55	00000:00	9.9923536	2 9845724	2.9765544		,82476		9476.64c	<u> </u>
	_	1.9938736								60
			9.9922250	9.9844417			9822.567		9473-735	59 58
		9.9997473	9.9920964	3.53.43.00	9.9763881	9994.182	2817.620	3045-191	9470/83c	58
	7	2.9991208	9.9919577	3.3741/29	9.9762548	5951.273	98,6,750	9542.284	9467.92	57
	56	19991944 19993679	2.991837	3.50.404.00	9.9761216	9933-304	9813.842	9039,337	9465.020	56
	55	1.9993019	9.9917103	3.3833179	9759333	y905.45¢	9810 934	96 3 0.47 0	9462.116	55
1	54	7.999444	7.9915816	7.9337309	2.4753550	3002.547	3808.025	9033.503	9459 211	54
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	53	3.9591148	9.9914528	9 9835550		5979.038	9805.117	9030.050	9456.306	.23
	52	2.9989882	9.9913240	9.9835248			9802.208		9453.402	52
	51	3 9988615	2.9911951	9.9833936	J-2754547	9973.820	9799.300	9024.842	9450.497	51
	50).99 ⁸ 7348) 5986081		9.9832524		9970.912	9790.392	9621.936		50
1 '	49		3.3909372	9.9831312		3968.333		\$619.029	9444.688	49
1	48	3.3381814	3.3503082	3.983ccoo	9/52541	2955.054	979°4575	9616.122	9441.784	48
-	_	2200114		-0-6404	2054000	246.18	-9-44	-	0.00	
	47	3.998354¢	J-9906792	9.9828686	3.9749205	9962.185			9438.8°c	47
	46	3.9982278	9-9995501		9.9747858		2734.759		9435.976	46
	45	7.9981009	9.9904210	9.9326059	2.374253T	9956.368	3781.851		5433.072	. 45
	44	3.997974¢	3.3902319	9.9824745	y·y/45194	9953-459		3604.495	9130.168	44
	43	3.9978470	3.9901527	9 9023431	9.9743856	9950.550		7601.583	9427.264	
	42	7.9477201	7.7900335	9.9822116	y y/42519	9947.541	9773,127	,598.6 82	9424.360	42
1-	_				10741-0	0011				
	41	2.95,75930	9.4739043	10:08250801	3.9741180	9914.732	9770.219		9421.456	
	40	2.9974660	9.98,7750	9.9819485	9.9735841		9767-311	9592.869		40
1	39	2.997338ç	9.9890456	9.6818169	3,9738502		9764.40			39
	38	2.9972118	9.9895153	8.981c823	9.9737162	19930.005	9701.495	9587.056		38
1.	37	9970846	3.0203260	9 9815536	9.9/35022	3333.C00	2758.587	9584.149	9409.840	37
- 1	36	2.9969574	9.9892575	2.9814219	9.973448	19930.187	9755.679	9581.243	9406.936	36
-	26	2 2068202	200000	2 28 . 2 . 2	3-02-21-1	2225070	2260 ===	2228 225		
- [35	3.9968302	3-90-1280	9.9812901	3.2733141		9752-771		9404.033	35
1.	34	y.9967029	9.9.89985	9.9811583	2.2722446	9924-970	9749.863			34
ł	33	3.9965756		9.9810265		2721.461		9572.524		33
1	32	9.9964483 9.9963209		9.9808946	3.9/29117	9918.552		9569.618	9395-322	32
t	30 31	7.9961935	3.9000097	9.9807627	2.9/2/774	2915.643		9566.712	9392.418	31
1_	30	3.9901937	9.9001001	9.9806308	9.9/20431	9912.735	9738.231	9563.806	9389.515	30
	29	2.9960660	0883503	9.9804988	10725588	9909.826	2726 202	9560.900	02646	- 20
1	28	2.9959385	3.0882206	9.9803668	-2722716	2906.917			9385.511	29 28
1	27	2.9958110		0.6802247	3.0722401		9732.415		9383.708	27
- 1	26	9956834		9.9801026	3.0721056		9726.599			26
	25	3.9355558		9.9799704	3.0710712	3898.191	9723.692		9377.901	25
1	21	3.9954282	9.0877012	9.9798383	0.0718267	9895.282	9720.784		9372.095	24
1-						707)1202	7,20.704	7,40.370	93/2.095	1 **
1	23	9.9953005	3.9875713	9.979706	J.9717021	0802.272	0717876	0542.464	9369.192	-22
-	22	3.9951728	2.9874414	9.9795738	2.9715675	2880.461	9711.068	3540 568	9366.289	23
ŀ	21	2.9950450	2.2873114	9.9794115	9.9714325	6886.444	9712.06D	2527-662	9363.386	21
-	20	2.9949172	99871813	9.9793092	y.9712982	6883.647	9700.152	0534.747	9360.483	20
	19	2.3947894	5.9870512	9.9791768	3.5711635	19880.725	9706.244	9521.841	9357.580	19
1	18	ÿ•3946615	9.9869211	9-9790444	2.9710286	19877.820	9703.227	9528 024	9354.677	18
1-	-									
	17	9,9945336	9.9867910	9.9789119	<i>3</i> .9738940	9874.921	9700.430	9526.030	935 i.774	17
	16	9-9944057	9.9866608	9.9787795	9.9707592	9872.012	9697.522	9527-124	9348.871	16
	15	9.9942777	2.9865305	9.9786466	9.9706247	9869.104	9694.615	9520.210	9345.969	15
	14	9.9941467	9.9854003	9.9785144	9 9704864	19860.195	9691.707	9517.313	9343.066	14
	13	3.9510216	2.9862700	9.9783817	9.9703545	9863,286	9688.800	9514.408	9340.162	13
- {	12	3.9938936	861396 و.ر	9.9782491	9.9702195	9860.378	9685.892	9511.502	9337.261	12
1-										
	11	9.9937654	9.9860092	9.9781164	9.9700845	19857.469	9682.985	9508.595	9334.358	11
1	10	3-9936373	9.9858788	9-9779837	9.9699494	19854.561	9680.070	9505.602	0331.456	10
1	8	9.9935791	9.9857484	9.9778509	9.9098143	19855.652	9677.170	9502.786	9328.553	
1.			9.9856179	9.9777182	9.9696792	9848.743	9674.263	9499.881	9325.651	9 8
1		9.9932526	9.9854873	9-9775853		19845.835	9671.355	9496,976	9322.749	7
	6	9.9931243	9.9853568	9-9774525	9-9094088	9842.926	9668.448	9494-071	9319.847	6
1-	7	0.000000	208-25-5	0.0555	2 4 4 2 2	0	- 44			
1	,	9-9923959	9.9852261	9.9773195	9-9092735	19840.018	9665.541	9491.166	9316.945	5
		0.003730	9.9850955	y-y/71800	9.9791382	9837-189	9002.633	9488.26c	9314.043	4
		9.9927391	9.9849648	9.9/70530	9.9090029	9034.201	7059.726	9485.355	9311.141	3
		9.9926106	9.9848341	9.9/09200	y.yuaaa75	9831.292	9050.819	9482.450	9308.239	2
		3.9944041	9.9847033	yy/07475	9.9007321	9828.384	9053-912	9479-545	₹305.337	1
ļ	<u></u>	v.yy-5750 l	9.9845725	-y /00544 I	9005907	19825.476	9051.005	9476.640	9302.435	0

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	Deg.	4, 5, 6, 7			A Table	n?	Natural Ve	rfra			
			A NY	T X		Ë			, 		<u>. —</u>
	M	N. 4	N. 5	N. 6	N. 7	l) L. 4	105	L. 6	L. 7	$^{-}$ M
	0	0024.360	2038 053	2054.78	074.539	1	7-3866683	7.5803891	7.7386303	7.8723800	
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- 1	1	0024.563	0038.307	0055.280	074.894	ı	7-3902785		7.7410375	7.8744436	1
	, 2	24.767	38.562	55.391	75.250		7.3938716	7.5861568	7.7434380	7.8765017	2
	3	24 972	38.817	55.697			17.2 74640	2 6800262	7.7458319	7.8785550	2
1						ľ	7 39/4740	7.709 7203	17.7430319	7.0705550	3
1	4	25.178	39.074	56.004	75.964	ľ	7.4010190	17.5918864	7.7482192	7.8806033	4
	5	25.385	39.331	56.212	76.322		7.4045706	7.5947322	77505999	7.8826469	
:	6	25.592	39.589		76.681	ı	7.4081071	7-5975783	7.7529742	7.8846846	5
- 1	U	-7,792	33.7.2	70.021	/0.001	ŀ	/.40010/1	1,.181,163	/*/ 7 * 9/4*	7.0040050	6
ı						l					<u> </u>
ł	7	0025.800	∞39 . 848	0056.931	0077.041		7.4116293	7.6004103	7.7553419	7.8867196	-
ı	Ŕ	26.009	40.108		77.681		7.4151372		7.7577031	7.8887487	7
'1								7.0032331	7.777032	7.030/40/	8
- 1	9	26.219	42.369		77.754		7.4186311	7.0000403	7.7600580	7.8907784	9.
	10	26.430	40.630	57.864	78.126		7.4221109	7.6088513	7.7624064	7.8927028	10
1	11	26.642	40.893	58.177	78.484		7-4255767	7.6116468	7.7647485	7.8048078	
1		26.855			78.853			7.67.4400			11
I	12	20.077	41.156	58.491	70.053		7 . 4297 2 88	7.6144333	7,7670843	1,0000181	12
ı											
4	13	JO27.069	0041.420	0058.806	2070.218		7.4324672	7.6172109	7.7694138	7.8988238	• •
ł	-		41.695			1		7.6372309			13
1	14	27.283		59.121	79.584		7-4358921	7.0199790	7.7717371	7.9008248	14
1	15	27.498	41.951	55.437	79.951		7.4393034	7.6227395	7.7740541	7.9028212	15
1	16	27.714	42.217	59-754	80.318		7.4417016	7.6254006	7.7763649	7-0048100	
J				60.00		-	777703	7 600	7 77 964	7.0040130	16
J	17	27.931	42.485	60,072	85.686				7.7786696		17
1	18	28.149	42.753	60-391	81.055		7.4494578	7.6309668	7.7809682	7.9087820	18
I										-	20
t		0000 00	0042.0-0	2000	000- :-	Į	7.4000	7960-4	= =0==4==	710.15=1	
1	. 19	0020-307	0043-022	JUJC-710	0001.425	1	7 4528163	7.0330920	7.7832607	7.0107610	19
ı	20	28.586	43.292	61:030	81.796	1	7.4561619	7 6364386	7.7855472	7.9127246	20
ı	21	28.806	43.503	61.351	82.168	1	7.4594946	7,6391167	7.7878276	7.0147020	
ı						1	7.7774740	7.0391107	11/0/02/0		12
1	22	29.027	43.835	61.673	82.541	ı	7.4028140	7.0418164	7-7901020	7 9100084	22
ı	23	29.249	44.107	61.996	82.914	- 1	7.4661219	7.6445078	7.7923705	7.9186268	23
1	24	29.472	44.380	62.320	83.288	- 1		7.6471008	7.7946331	7.0206844	- 1
. [-4	-9.4/-	740300		03.203	- 1	7-4-94-00	7:047.900	1.124022.	7.9207.44	24
1	· ·			- 1		ı					
1	25	0029.696	7044. 655	0962 645	0083,663	- 1	7.4726989	7-6498655	7.7968897	7-9225258	25
1	26	29-921	44.930	62.971	84.039	- 1	7.4750688	70626220	7.7991405	7.0244807	
. 1				63.297	04.039	1	7.47 79000	7.0727320	7.622.23	7.924402/	26
1	27	30.146	45.205	103.297	84.416	ı	7.4792265		7.8013855	7.9204253	27
è	28	30.372	45.482	63.624	84.794	١	7.4824719	7-6578404	7.8036246	7.9283636	28
•	29	30.599	45.760	63.952	85-172	ı	7.4857052	7.6684825	7.8058580	7.0202076	
4						1	7.40000		7000004	7.9302975	29
4	30	30-8-27	46.038	64.281	85.551	- 1	7.4889265	7-6631165	7.8080856	7.9322271	30
4						j					
1	31	0031.056	0246.217	0064.611	0085-021	- 1	7-4921359	7.66 = 7427	7.8103076	7.0241622	
1			46 407	64.942	0007.93.1	1	7 4040010	2 440 - 4-0	7 912 2227	7,77,723	31
i	32	31.285	46.597		86.312		/•4953353]	7 0093008	7.8123237	7.9300734	32
	33	31.515	46.878	65.273	86.694	1	7.4985193	7.6700711	7-8147343	7 9379901	33
Ħ	34	31.746	47-160	65.605	87.077		7.5016934	7.6726726	7.8169392	7.0200027	
Æ				65.938			7 (048:60	7 2 2 2 2 2 3 2 1	7.8191386	7 04 9	34
1	35	31.978	47.143	07.930			7.5040500	7.0/01002	7.0191300	7.9410110	35
u	36	32.211	47.726	66.272	87.844	1	7.5080071	7.6787550	7.8213323	7'9437151	35 36
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Н		10000.44-1	0048-010	0066 408	2200 22		7	40	7.8235205	70466	
1	37			200.000							37 38
H	38	, 32.68o	48.295	66.943	88.615		7 .51427 51	7.6839058	7.8257032	7.9475107	28
1	39	32.915	48.581	67.279			7.5173022	7.6854607	7.8278804	7.9494022	
1	40	33.151	48.868	67.616	82.00	-	7.6204082	7 480004	7.8300522	70613800	39
1		254.77			83.301		7-7-04934	1.00000200	7.0300722	1.2 2170AU	40
Ħ	41	33.388	49.156	67.954	8 9.7 79	.	7-5235930	7.6915749	7.8322185	/·95 317 32	41
#	42	.33.626	49-444	68.293	90.168	-	7.5266750	7.6941162	7.8343794	7.9550524	42
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il	4.0	0000 04-	2040 734	0060 4-	2000 : 6	- 1	7 (207400	4040		0.45	
11	43	0033.865		0068.633		1	7.5297498	7.6966502	7.8365349	1.9569276	43
1	44	33-405	50'024	68.974	90.949	1	7.5328119	7.6991767	7.8286851	7.9587988	44
Ħ	45	34-345	50.3.15	69.315	91.341	ı	7.5358632	7.7016060	7.8408299	7.9606663	
н				40.6			7 5 28 20 29	11.72.09,9	7.0400299	7.950,000	:45.
ı	46	34.586	50.607	69.657	91.734	1	7.5389038	7.7042078	7.8429695	7.9625290	46
11	47	34.828	50.900	70000	92-1:24	:	7.5419338	7.7067124	7.8451037	7.9643880	47
į	48	35.071	51.193	70-344	92,521	ı	7-5449532	7.7092098	1, 1, 7, 7, 1	7 966 2431	70
١.	70	,,,,,,	/ / / /	19.744	7-17-1	.	-, -, -, -, -, -, -, -, -, -, -, -, -, -	11 /-2-090	7-8472327	7. 2. 2. 43.1	48
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١,	.49	0035.315	9 0514487	0070-689	0092916	1	7.5479021	7.7117001	7.8493565	7.9080942	49
: 1	50	35,560	51.783	71.035	93.312	1	7.5509607		7.8514751	7.0600414	
•		35.806	52.079			1			1,23,44,31	7773.4	50
1	51			7.1.382			7.22 32402	17.7100592	7-8535885	1.9/1/040	5.1
: 1	52	36-052	52.375	71.729	94.107	1	7-5569268	7.7191281	7.8556268	[7 ·97 36239]	52
	53	136.299	52.673	72.077	94.506	1	7.5508946	7.7215000	7.8577999	7.0754502	
1								7	1.2377333	פערבר וכיים	53
! j	54	36.547	52.972	72.426	94.905	1	7.5628522	7.7240450	7.8598980	7.9772908	.54
ŀ						1	·	 	J		
1	55	0036.796	0052.271	9072.776	0005 205	1	7.5657997	7.7264930	7.8619910	2.0201-0.	,
: 1	12			70,00,00		1	1,000/32(1.7204930	1.0010010	7.7771104	5.5
	56	37.046	53.572	73.127	95.796	1	7.5687373	7.7209341	7.8640789	7 9509422	56
ı	57	37-297	53. 873	73-479	96.168	1	7.5716650	7.7213682	7.8661618	7.98276211	57
i	58	37.548	54.175	73.831	96.511	ı	7-5745828	722762	7.8682397	7 084 - 00	16
; 1						1		17.7357.73	7.008439/	7.7045702	58
1 1	59	. 37.800	54-477	. 7.4.184		1	7.5774903	7.7302104	7.8703126	7 .98639 05	159
ŧ.	6၁	38.053	54.781	74.539	97.319		7.5803801	7.7386202	17.8722806	7.9881990	60
ì	. }	/ 3		1		ı '	1	[[,,,5,5]	1, .,, -2000	, , , , ,	
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					-			221 700 000 100 100 100 100 100 100 100 10		-	

<u> </u>		Z		o L E U/	Maiura				
سنسند		d their Log	anthins					85, 84, 83	3, 82
	L. 85	Lo 84	ره سا	L. 52	N. 85	N. 84	N. 23	N, 82	1/1
6 0	9 968596;	9.9603967		9.9435591		9128.543	8954.715	8781,307	60
59	9.9684611	,,9632581	3.9519114	9.9434163		9125.54	9951.822	8778.420	52
' '	919683256 919681900	3.9601205 3.9595825	2.9517711	9.7432735		9122,647 9119,750	8948.929 8946.030	8775•533 87 72 .646	58
-57	9,9680544	9.9598445	9.95 0307	9.9431306 9.9429876	3290.828		8943.143	8769.759	57 56
56 55	9.9679188	9.9597068	3.7113497	9.9128446		9113,955	8940.251	8766.872	55
- 54	9.9677831	y 959568E	9.9512092	9 9427016		9111.057	8937.358	8763.985	54
		0.04 11.004			2282 .04	2208 160	9	0 - 1	
53	9.9676474	9-9594306		y•9425586		9108.160 9105.263	8934 . 466 8931 . 574	8761.099	53
52	9.9675116	9.9592925 9.959154	3.9509230	9.9424155		9102.366	8731.7/4	8758.212 875 5. 326	52 51
51 50			9.9506467	9.9421291		9099.469	8925.750	8752.440	50:
49	9.9671040	9.9588777	9.950\$ 359	9.9419859		y096.572	8922.898	8749.554	49
48	9.9669681	9.958739	9.9503654	9.9418426	267.619	9093.675	8920.006	8746.663	48
	2460221	9,9586010	0.0502242	9-3416993	9261718	9090.778	8917.114	8713.782	12
47	0.666661	9.9584626	J.0506825	9.941556		9007:381	8914.222	6740.856	47 46
40	0.0665601	19.9583241	9-9499426	9.9414125	9158.916	9784.984	8911.331	8738.010	45
44	0 0664240	19.9581857	9.3498016	9.9412691	9256.015	9082.787	8908.430	8735-124	44
43	13.0662879	19.9580471	9.9496606	9.9411256		9 ⁰ 79 · 191 9 ⁰ 76.294	8925.548	8732.239	43
. 42	9.9661517	9.957,086	9.9495196	9.9409822	9250.213		8902.656	8729.353	42
1.	0.0660155	9.9577699	2.0103784	9.9408385	924.7312	9073.398	8899.765	8726.468	41
41	9.9658702	9.9576313	9.9492375	9.9406949	9244412	9070.502	8896.874	8723.583	40
39	9.9657430	9.9574926	9.9497963	9.9405513	9241.511	9067.505	8893.983	8720.698	39
38	0.0656067	19-9573539	2.0489553	9.9404075	9238.611	9064.709	8891.092		38
37	9 9654703	9.9572151	9.9488139	9.9402638	9235.710	9058.017	8886.201	8714.928 8712.043	37
36	9.9053339	9.9570763	9.9400710	9.9401201	1				36
25	0.0651074	9.9569374	0.0485312	9.9399762	9229-910	9756.C21	8882.420	8705.159	35:
35 34	0.4650610	19.9567985	10-0783800	9.9398324	9227-209	9053.125	8879.529		34
33	9.9619214	<i> 9</i> ,9556596	9:9182485	9.9396885	9224-109	9050.229	8876.639	8703.390	33
32	9.9647879	9.9565205	9.9481071	9.9395445	9218.309		8873.748 8870.858	8700.505 8697.622	32
31	15.9640512	9.9563416 9.9562425	9.9479050	9.9394005	9215-109	9041.442	8867.968	8694.738	31
30	9.9047140		9.94/0241	3.9392303					30
20	9.6643779	y.9561034	9.9476825	9.9391224	9212.509		8865.078	8691.854	29
28	9.9642412	9.9559643	9.9475409	9.9389083	9209.609		8862.188	8688.970	28
27	9.9641044	3.9558251	9.9473993	9.9381241	9206.709		3859.298	8683.202	27
26	19.9039070	9 . 9556859	9.9472570	9.9386300		9027.066	8353.518	8680.319	26
25	0606000	9.9554073	0.0460741	9.9383914	9198.010		8850.628	8677-436	24
24	_'					<u> </u>		04	
23	9.9635570	9.9552680	9.9468323	9.9382411		9021.276	8847-739	86744553	23
22	9.9634200	9.9551286	9.9466904	9.9381027	3180,212	9018.381 9015.486	8841.960	8671-670 8568-787	22
21	19.9632830	9.9549891 9.9548497	19.9405485	9.9379583	9186.412	9012.592	8839.071	8665.904	21
20	9.9031400	9.9547102	0.0162646		9183.514	9009.607	8836.182		19;
19		9.9545706	9.9461126	9.9375248	9180.615	9006.802	8823.293	8660,138	18
					0177 7.4	2002 0=0	88	865-	<u> </u>
17		9.9544310	9.9459805	9.9373802		3003.908	8830.404 8827.515	865 7.25 6 8654.373	17
16	4 6 6 6 6	9.9542914 9.9541517		9.9372356		3998,119	8824.626		16
15	الم محمد الما	9.9540120		9.9363462	9169.019	8995.225	8821.737	8648.608	14
14	9 9621855	9.9538723	9.9454119	9.9368015	9166.120	1992.331	8818.849	8645-726	13
12	9.9620482	9 9537325	9.9452696	9.9366567	9103.222	8989.437	8815.960	8642.844	12
		0000000	245:25	9.9365118	9160.222	8985.543	8813-072	8639.962	
11	19.9019108	9.9535926	2.0440850		9157.424	8983.649	8810.184	8637.080	
10	0.3616248	9.9533128	6.C448424		9154.526	8980.755	8807.296	8634.198	
8	9.9614983	9.9531729	9.9447001	9.9360771		8977.861	8804.408	8631.317	8
7	10.9613607	9.9530329	0.9445576	9.9359321		3974.968	8801.520	8628.436	
6	9.9612232	9 9 9 2 8 9 2 9	9.9444151	9.9357870	1 9145.031	8972.074	8798.632	8625:554	6
	1	9.9527528	0.0442726	9.9356419	9142.933	8969.181	8796.745	8622.673	
5	19.9010055	9.9526127	0.0441200	9.9354968	9140.035				
4 2		9.9524725	14.9439873	9.9353150	9137'137	8963.394	8789.969	8616.911	3
3.	9.9606723	9.9523923	9.9438446	9.9352004	9134.239	8950.501	8787.082	8614.030	2
I	10.0005345	9.9521920	9.9437019	917350011	9131.341				_
Ö	19.5603967	13.9520518	9.9435591	9.9349158	9128-443	8954.715	8781.307	8608.269	0
J		1	Ι.	- ************************************	* 1	l	_	<u></u>	

			Jines, 1			23	117 C i			<u> </u>
Deg.	8, 9, 10,	II.	·		le	o Natura	Verled			M
M	N. 8	N. 9	N. 10	N. 11	1-	<u></u> 8	س ب	10 10	L. 11	
-0	0097.319	2123.117	0151.925	187.728	12	1.9881990	8.0903156	8.1816220	8.2641757	<u> </u>
-		0123.573	0152.428	0134-284		7.9900038	8.0919203	8.1830648	8.2054867	1
2	98.130	124.029	152-934	184.840	17		8.0935210	8.1845051	8.2667957	2
3	98.537	124.486	153.441	185.397	1	7.9935020	8,0951188	8.1859431	8.2681028 8.2694078	3
4	98.935	124.944	153.949	185.955	17	1.9953855	8.0983055	8.1873786 8.1888118	8.2707169	4
5	99-354	125.403	154450	186.514	1	7.9971853	8.0998944	8.1902426	8.2720119	5
6	99.763	125-863	154.968	187.074	1'	-9909713				
		01 26.323	0155.479	0187-624	8	3.0007537	8.1014804	8.1916710	8.2733111	7
7 8	0.000.73	126.784	155.990	188.195	8	3.0025325	8.1030535	3.1930971	8.2746082	7 8
	102.584	4	156.502	188.757	18	8-0043076	8.1046437	8.1945208	8.2759035	9
9 10	101.409		157.015	189.320	18	3.0060790	8.1063711	8.1959421	8.2771967	10
11	TO1.823	128.173	157.529	189.884			8.1077955	8.1973611	8 27848 8 0 8-2797774	11
12	102.238	128.638	158.044	192449	ľ	0.0090110	8.1093671	8.1987778	5.2/9///4	.2
					ķ	30112716	8.1109358	8.2001921	8.2810649	13
13	0102.653	0129-103		191.530	1	8.0121287	8.1125017	8.2056042	8.2823504	14
14	103.069	129.569 130°036	159.576	192.147			8.1140647	8,2030139	8.2836341	15
15	103.486		159.593	192.715	18	8 0166321	8-1156249	8.2044213	8.2849158	16
16	103.904		160-630	193.284			8.1171823	8.2058264	8.2861956	17
17	104-323	131.443	161.150	193.853			8.1187369	8.2072293	8.2874735	18
18	104.743				1				0.00-	
••	0105.163	0131.915	0161.671	0194.423		80218607	8-1202887	8.2086298	8.2887495	19
19	125.584	132.384	162 192	194.994		0.0235965	8.1218377	8.2100281	8-2900236	20
21	106.006	132.856	162.714	195.566		0.0253289	8.1233840	8-2114241		21
22	106.429	133.329		196.139	ł	8 02 705 78	8.1249274	8.2128179		22
23	106.853	133.003	163-761	196.713	١	0.0287833	8-1264681	8.2142094	8.2938346	23 24
24	107.277		164.286	197.288	1	8.0325053	8.1380001	8.2155987	0.29,1012	24
	-		24.0-		١	8.0322239	8.1295413	8.2169857	8.2963660	25
25	0107.702		0164.811	0197.803	١	8.0220201	8.1310738	8-2183705	10. 20	26
26	108.128		165.337		ı	8-0356508	8-1326036	8.2197531	0 000	27
27	108.555		165.864 166.392		П	80372502	8.1341307	8.2211334		28
28	108.98	1 2 22.				8.0390642	8.1356551	8.2225116		29
29	109.182						3.1371768			30
30	109.841	-5/	107.47	200./53					-	
1	7	0137.624	0167.981	0201-233	Н	8.0424642	8.1386958	8.2252613	8.3039156	
31		1 428 100	168.512	201-914	ı	8.0441592	8.1402121	8,2265329	8-3051075	32
32		1 20 0				8.0458505	8.1417258	8.228002	8.3064175	33
33		100000		203.079	l	8.0475393	8.1432368	8.229369	8.3076657	
34 35				203.663	ii	3.0492243	8-1447452		8.3101568	35 36
36	_		170.646		1	8.0509001	8-1462510	8.2320974	1 0.3101500	30
1		-			П	8 0005845	8.1477541	8.2334581	8.3113996	37
37	0112.87		0171.182	0204.832	ll	8.0542505	8.1492546	8.234816		
37 38	113.30	8 141.01			l	8.0540310	8.1507525	8.236173	00 0	39
39	113.74	141.49			ı	8.0576001	8.152247	8.237527	10	
40	114.18				H	8.0502662	8.153740	8.238879		
41	114.62					8.0600286	8.1552307	8-245229	'	
42	115.06	2 -42.90	73.07	207.772				.		-
	7	0143.45	0174.41	0208.362	H		8.1567182		8.3188189	
43			174.954	208.953	H	8.0641438	8.1582032	8.242923	8.3200493	
44		21			l		5 8.1596857	8.244267	3 8.3212779	
45		21 - 22 - 20			Н	8.067546	8.1611656	8.245608		
40		2 145.42	6 176.58	210.732		8.0591928	8-162643	8.246948		
47		-1				• .07 08362	8-1641178	8.248286	8.3249532	40_
				·	l	0.030:54	0 .4	8 04550	8.3261748	40
49	0118.16	2 0146.41		211-921			8.1655902		0	
50		9 146.91				8.0741130	5 8.1670600 5 8.1685273	8.250954		51
1 5	1 119.05		178.76			3.02727X	8.1699921		· ^ -	52
1 5:	2 119.50						8.171454		0	
5						8-082621	8.172914		110	
54	1 120-40	2 148.90	100.41	214-910			(-	1-	
1-	<u> </u>	0740-40	20180.06	30215.510		8.082252	1 8.174371	8.257590	6 8.333468	
5	5 0120'85	1				8.083871	8 8. 175826 [.]	7 8.258911	7 8.334077	8 56
5						8.085497	6 8.177279	8.260230	7 8.335885	
5	7 121.79	,,,	3 182.61			8.087100	2 8.178729	2 8.261547		
5						3.088709	9 8.180176	8 8.262862	6 8.338296	3 59
5			2 183.72			18.090316	6 8.181622	0 8.264175	7 8.339499	1)60
- (<u> </u>	7	<u></u>	1	1	<u> </u>				
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-			their Logari				Deg.	81, 80, 79	, 7ბ.
M	L. 81	L. 80	L. 79	L. 78	1 N. 81	N. 85.	N 79	N. 78	·M
. 6 0	9.9349155	9.9261188	9.9171650	9.9080510	8601.20	8,3 .16	8 263 518		_
59	9-9347705	9.9259709	2.9170144	9.9078977	8605.33				60
58	9.9346251	9.9258229	9.9168638		8602.50	8432,70.			59 58
57	9.6344756	9.9256749		9.9075911	3599.62			8086.200	58
56	9.9243342		9.9165624	9.9074377	8596.74	8427.039	3254.925	3083.345	. ,,
55	9.9341886	9.9253787	9.9164116		8593.867	7 3421.10		8080.490	56
54	2.9340431	3.9252376	9.9162609	9.4071307	8593.987			8077.635	55
I				7-7-307	7,93.93/	1412.416	3246.333	8074.780	54
-	9.9338975	9.9250823	0.0161100	9.9069771	3588.107	3415 54	3 3	0-	
53 52	3.4337520	9.9249341		9.9063236	3585.228	3415.547 8412.675	3243.469	8071.926	53
	9 9336661	9.9247858	0.0158082	9.9066559	8582.348			3063.072	52
51	9.9334604	9.9246375	9.9156572		\$579.459			8066.218	51
50	9.9333146			9.9063625	8576.593			8063.364	50
49 48	9.9331688	9.9243407	9.9153551	9.9062087	8573.711	3404.059		8060.510	7/
40	, , , ,	7.7-43407	77-1311.	7.900.007	3//30/11	3401.188	8229.153	8057.656	48
15	9.9330229	30247000	9.9152040	9.9060549	8570.832	3000 0.6	2		
47	9.9328771	9.9241922 9.9240437		9.9059611	8567.953				47
46	9.9327311	9.9238956	9.9150528		8565.074	8395.445	8223.427	8051.950	46
45	2.9325851		9.9143016		8562.195	3392-574	¥220.565	8049.097	45
44	7.9324391	9.9237466	9.9147504	9·9055932 9·9054392	8559.310	3389.703	8217.702	8046.244	44
43	3.9322930	9.9235979	9.9145991		8556.438	3386.832	8214.840		43
42	3.9322930	9.9234493	9-9144478	919470251	0))0.430	3303.902	8211.978	8040.53	42
1-	322216		0.014646	0.00	8550	3,,0.			<u> </u>
41	3,321469		9.9142964	9.9051310	8553.559	3381.091	8209-116	8037.686	41
40	9.9320007		9.9141450		8550.581	8378.221	8206-254	8034.834	40
39	9.9318545		9.9139935		8547.80;	3375.351	8 203.392	80,1,982	39
38	9.9317083		9.9138420		8544.925	3372-451	8200.531	8029.130	- 38
37	9.9315620		9.9136904	9.9045142	8542.047	8369.511	8197.669	8026.278	37
36	19.9314150	9.9225563	2.9135388	9.9043599	3539.169	365.741	3194.808	8023,426	36
				200.00	8626	2.6			
35	9.9312092	9-9224073		9.9042055	8536-292	3363.871		8020.575	35
34		9.9222583	9.9132355		8533-414	3361.001	8189.086	8017.724	34
33		9.9221092	9.9130837		8530.537	1350.132	8186.226	8014.873	33
32	9.9308299	y·9219601	9.9129319		8527.660	3355.262	3183.366	8012.022	32
31	9.9300033	9.9218109	9.9127801	9-9235876	8524.783	8352.393	8180.505	8009.171	.31
. 30	9.9305307	9.9216617	9.9126282	9.9034330	3521.906	8349.524	3177.645	8006.321	30
				-	3				
29		9.9215124	9.9124763	9-9032783	3519.029	3346.655	8174.785	8003.470	29
28		9.9213632	9.9123244		8516.152	3343,786	8171.925	8000.620	28
27			9.9121723		8513.276	340.918	8169.065	7997-770	27
26	9.9299499	2.9210641	9.9120203		35 10.399	3338.049	3166-205	7994.920	26
25		9.9209150	9.9118682	3.9026593	8507.52,	1932-191	3163.346	7992.070	25
24	9.9290503	9.9207656	9.9117161	9.9025044	3504.647	1334313	3160.487	7989.220	24
					0				
23	9.9295094	9.9206160	9.91150,0	9.90 23495	8501.77	3329.145	8157.628	7986.371	23
22	9.9293024	3.9204665	9.9114116	9.9021945	8498.895	3325.577	8154.769	7983.522	22
21	9.9292154	9.9203169	9.911259;	y.9020395	8496.019	3323.709	8151.910	7980.673	21
20	9.9290004	9.9201672			0493-143	8320.841	8149.051	7977.824	20
19	9.9209213	9.9200175		9.9017293	8490.267	8317-275	8146.192	7974.975	19
18	9.9207.743	9.9198678	9.9108022	3.9015742	8487.392	3315.106	8143.334	7972.126	18
					0.0				
17	9,9286271	9.9197180		9.9314190	8484.516	8312.239	3140.176	7909.278	. 17
16	9.9284799	9.9195682		9.9012638	8481.641	3309.372	8137.618	7965.430	15
. 15	9.9283326	9.9194183	9.9103447	9.9011085	8478.766	3306.505	8134.760	7062.482	15
14	9.9281854	9.9192684		9.9009531	8475.891	8303.638	8131.902	7960.734	14
13	9 .928 0380			9.9007977	8473.016	0300.771	8125.014	7957-886	13
772	3.9278907	9.9189685	9 .9 098868	9.9006423	8470,141	3297-925	8126:187	7955.038	12
11		9.9188184	9.9097341	9.9004868	8467.266	1295.038	8123.330	7952.191	11
10	3.9275958	9.9186683	9.9095813		8464.392	3292.172	×120.473	7949.244	10
8	9.9274483			9.9001758	3461.518	3489.306	8117.616.	7945.497	9
			9.9092756		8458.644	3286.440	8114.759	7943.650	8
7			9-9091227	9.8998645	8455.770	3233 574	8111.972	7940.803	7
6	9.9270055	9.9180675	9.9089697	9.5997088	8452.896	3280.708		7937-957	6
		-		_ '					
. 5		9-9179172	9•9088167	9-899553	8450.022	8277.843	8106.190	7935.111	5 !
	9.9267101	9.9177669	9.9080637	9.8993973	8447•145	3274.978	8102.334	7932.265	4
	9.9265624				8444.275	3272.113	3100.478	7929.419	3
2		9.9174660			8441.401	1267.245	3097.622	7926.573	2
	9.9262667	9.9173155	9.9082043	y. 5989296	8438.528	3266.383	3094.765	7923.728	1
. 0	9.9261188	99171050	9.9080510	1.8987736	8435.65=	3257.5.81		7920.853	0
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				A l'a		ic of Natu	ral Versed	A		
	2, 13, 14,	N. 13 \	N 14 1	N. 15	7	L. 12	4. 13	L. 14	L 15	M
M	N. 12				1		8.4087475	8.4728189	8.5324253	
<u> </u>	2218.524			2340.742	1			8,4738472	8.5333844	_
1 1				341.495	ı		3.4098556 3.4109622	8.4748742	8.5343423	1 2
2	219.735	257.611	298-152	342·249 343·004	ı		8.4120675	8.4759001	8.5352992	3
3	220.342	258-267 258-924	299,158 299.865	343.760	I	8.3442936	8.4121712		8.5362551	4
4	221.558	259.582	300.572	344.516	1	8,3454880	8.4142736	8-4779480	8.5372098	5
5	222.167	260,241	301.280	345-273	ı		8.4153746		8.5381635	6
					١				9	
7	0222.777	0260.901		0346.031	1			8-4799910	8.5391151	7 8
8	223.388	261.561	302.699	346.790	I	8.3490614	8.4175723	8.4810107	8.5400677 8 5410182	
9	224.000	262,222	303.410	347.550 348.311	١	8.3502492 8.3514354	8 4107644	8.4830464	8.5419676	9 10
10	224.613	262 884 263.547	304.121 304.833	349.073	١		8-4208583	8.4840625	8.5429160	11
12	225.227 225.841	264.211	305.546	349.835	١	8.3538029	3.4219508	8.4850773	8.5438633	12
					١					
13	0226.456		⊇ 3 ⊃6-260	0350.598	I	8.3549842	8.4230420	8.4860910	8.5448096	13
14	227-072	265.541	306.975	351.362	١	8.3561639	3.4241318	3.4871034	8.5457548	¥4
E 5	227.689	266.207	307.691	352.127	Ì	8.3573419	3.425228c	8.4881146 8.4891247	8.5466383	15
15	228.307	266.874	308.407	352.872	١	8.3585184 8.3596932	8 42203072	8.4901336	8.5476422 8.5485843	15
17	229 925	267.542 268.211	309-124	353.658 354.425		8.3608664	3.4284770		8.5495253	17 18
1-	229.544	200.211	309.042	7 /4-4-1	-					
19	0230.164	0268.830	0310.461	0355.193		8.3620380	3.4295600	8.4921477	8.5504654	19
20	230.785	269.550	311.281	355.962	I	8.3632081	8.4306414	8.4931530	8.5514044	20
21	231-407	270-221	312,002	356.732		8,3643765	3.4317216	8.4941572	8.5523423	21
22	232.030	270.893	312.723	357.502	ł	8.3655434	3.4328004	8.4951601 8.4961619	8.5532793 8.5542152	22
23	232.653	271.565		358.273	I	3-3667086	3.433 87 78 3.4349539		8.5551500	23
21	?32 .27 7	272.240	314.168	359.045	ł	3.30/0/23	3.4349539			24
25	222.000	0272.056	0314.892	0359.818	ł	3-3600344	8.4360286	8.4981619	8.5560839	25
25 26	233.902 234.528	273.59T	315.617	300,592	Ì	3-3701950	8.4271020	8.4791602	8.5570167	26
27	235.155	274.267		361.367	l	8-3713540	8.4381740	8.5001573	8.55794851	27
23	235.783	274.944	317.069	362.142	I	8.3725114	8.4392447	8.5011532	8.5588793	28
29	236.411	275.522		362.918	ı	8.3736672	8.4403141	8.5021480	8.5598091	29
. 30	257.040	276.301	318.524	363.695	١	5.3743215	8.4413821	8.5031416	8.5607379	30
ļ.——		2006.00		2244	١	8-3759743	8 44 24 4 8 8	8.5041341	8.5616656	31
31		0276.980		0364.473		8.3771255			8 5625924	32
32	238.301 238.933	277.660 273.341	319.983 320.713	365.252 366.031	١	8.3782751	8.4445743	5,5061136	8.5635181	33
33 34	239.565	279.023	321.444	366-311		8.3701232	8.4456410	10.5071040	8.5644429	34
35	240.198	279.706		367.592		8.3805698	8.4467024	8.5080925	8.5653666	35
35	240.832	280.390	322,000	368.374	H	8.3817149	8.4477625	8-5090792	8.5662894	36
1-						0 -0 -0 -0	0	3.5100648	8 ((7))	27
37	241.467	0281.074	0323.643		П	8 38 28 584	8 448 92 13 3.4498788		8.5672111 8.5681318	37 38
38	242.103	281,759					18 .45 09350		8.5690516	39
39 40	242.740 243.377		325.112			8.3862799	8,4519898	3.5130148	8.5699704	40
41	243.3//	0 0		372.296		8.3874174	8.4530434	3.5139959	8.5708881	41
42	241.654			373.083	ı		8.4540957	8.5149758	8 5718049	42
-	1 —		·		١	0 10 0	-	2	8.6727005	1
43	1245.294		0328.002			8-3796878	8-4551467		8,5727207 8,57 3 6355	43 44
44	245.935			374.659		3 30 10 622	8.4561964		8.5745494	45
45	246.577					8 3930822	8.4572448	8.5188844	8.5754622	46
46 47	247.219 247.862					8.3942107	8.4593378	8.5198588	8.5763741	47
48	243.506			377.821	I	9.3953377	8.4623824	8.5208320	8.5772850	48
		.	-	,	H			2 - 6 - 0	0.450=	
49	0249.151	0289.351	0332.510	0378.613	۱		8.4614257	8.5218042 8.5227752	8.5781949 8.5791039	4.9 50
50	249.797	290 046	333.254	379.406	1		8.4624677	0 -0004-7	8.5800119	51
51	250.442						8.4635085 8.4645480	3.5247140	8.5809189	52
52 53	251.090			380.995	١	8.4000406	8.4655863	8.5256817	8.5818250	53
54	251.738 252.387			^ ^	I	3.4320688	8.4666233	10	8.5827301	. 54
1/	-12.50	-92.035	330.239	50,007	I				0.0.	
55	2253.037	7293.534	0336.987	0283.384	١	19.473185	8.4676461	8.5276139	8.5836342	55
56	254.688		337•736	384.182	١	8.401200	18.468693	(18.5285784	8.5845374 8.5855396	56
57	254,34	294-935	338-486	384.981	١	18.405414	7 8-4097209	8.5295417		
58	255.99			385.781	١	3.400527	38 47 1780	7 8.53050 4 0 4 8.5314652		
49	255.64				ł	3.408747	S 8.472818	8.5324253		
00	255.300	29 7943	343.71.	* 50/.301	-	2 3 2 2	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			

ìòc	<u>. · · · · · · · · · · · · · · · · · · ·</u>		A	TABI	LE of	Natura	Verled		····
1	<u> </u>	Sinesan	d their Log						
M	L. 77	, L. 76	L. 75	L. 74	11 N. 77	N. 76	N. 75	· 77, 70, 7	5, 74.
60			9.8797 140	0.8600242	7920.88			-	M
59	2.8086176	0.8801702	0 8705525	0.8607506	7918.03		-		
58	10.8084615	0.8890114	12.8702006	0.8604040	7915.19		7577.959 7575.137		
57	19.8983054). 8888524	9.8702286	3.8604301	7912.34	7741.987	7572.315		. ,
56	9.8981492	9.8886935	9-8790668	9.8602652	7909.50	7739-153	7563.493		
55 54	9.8979930	19.8885344	9.8789048 9.8787429	9.8691004	7,906,658	1 , , , ,	7566.671	7397.764	55
74	9 09/030/	9 0003/54	9.0/07429	9.0009355	7903.81	7733.487	7563.850	7394.755	54
53	2.8976804	9.8882162	9.8785809	9.8687705	7900.970	7730.554	7561.029	7700 - 45	
52	0.8075241	lo. 8880<71	3.878A 18X	0.8686066	7898.126	7727.821	7558-208		
51	2.8973676	J-8878978	9.8782567	9.8684405 9.8682754	7.895.282	7724.988	7555-387		52 51
50	0.8972112	2.8877386	9-8780946	9.8682754	7892 438	7722.156	7552.566	7383.723	50
49 48	0.09/0547	0 8874100	9.8779323 9.8777701	0.8670450	7883.599 7886.752	7719-324		17380.916	49
1 =	9.090090		9.077701	9.00/9450	/380-/52	7716.492	7546 926	7378.109	48
47	2.8967416	9.8872604	9.8776078	9.8677707	7883.909	7713.660	7544.106	7274 224	-
46	13.8965850	39.887101 0	9.8774454	9.8676145	7881.066	7710.828	7541.286		
45	0.5964283	9,8869415	9.8772850	9.8674491	7878.222	7707.996			46
44	0.8962716	9.8867819	9.877120%	9.8672837	7875.38		7535.648		44
43	9.8901148	286440	9.8769581	9.8671182	7872.538		7532.829	7364.076	43
42	9.0979700	9.0804027	9.07955	9.8669527	7,869.696	7699.503	7530,010	7361,270	42
41	9.8058211	918863029	9.8766329	0.8667871	7866.854	7696.672	7507 101	-	-
40	0.8956442	9.8861432	9.8764702	9.8666216	7864.012	7693.841	7527.191 7 524. 372	7358.464	
39	0.8054872	19.8852824	0.8762076	0.8664cco	7861.170	7691.011	7521.554	7355.658	
38	9.8953302	9.8858236	9.8761449	9.8662902	7858-329	7683.181	7518-736	7350.048	39 38
3.7	9.8951731	28850037	9.8759821	9.8661244 9.8659586	7855-488	7685.351	7515.918	7347-243	37
36	9.0950101	9.0055030	9.0/58192	9.0059500	7852.647	7682.521	7513.100	7344-438	36
35	0.8048580	2.8853437	9.8756563	9.8657027	7849.800	7679.691	7510.283	`i	
34	9.8947017	19.8851827	9.8754034	0.8656260	7846.965	7676.862	7507.466	7341.634	, , ,
33	9.8945445	9.8850236	9.8753304	3.8654600	7844.124	7674.033	7504.649	7338.830	34
32	19.8943872	19. 8848625	K51578'9	1.8652040	17841.28	7671.204	7501.832	7333.223	33
31	9.0942298	9.8847033	9.8750043	9.8651288 9.8649627	7838.444	7668.375	7499-016	7330.420	31
,30	9.0943/25	9.0045431	9.0740412	9.0049027	7835.604	7665.545	7496.200	7327.617	30
20	9.8939150	9.8842828	0.8746780	9.8647965	7832.764	7662.718	7402 284		·
28	9.8037576	9.8842225	0.8745147	0.8646202	7829.924	7659.890	7493·384 7490·568	7324.814	29 28
27	9.8936200	9.8840621	9.8743514 9.8741881	9.8644641	7827-084	7657.062	7487.752	7319.208	20 27
26	9.8934425	9.8839017	9.8741881	0.8642978	1824-245		7484.936	7316.405	26
25	0-8031070	0 8837412	9.8740 24 7 9.8738613	9.8041314	7821.406	7651.406	7482-121	7313.603	25
24	9.0931272	9.3035007	9.0730613	9.0039050	78.18.567	7018.579	7479•306	7310.801	24
23	9.9929699	9.8834202	9.8736978	J.8637085	7815.728	7645.752	7476.491	-	
22	9.8928117	19.88₹2506	10.8725242	0.8636320	7812.889	7642 925	7473,676	7307.999 7305.198	23
21	9.8926539	9.8830989	9.8733707	9.8634655	7810.051	7640.008	7470-862	7302.397	22 21
	9.8924901	19.8829382	19-3732071	9.8032989	7807.213	7637.271	7468.048	7299.596	20
18	0.8021802	19.0027774 10.8826.4-	9 8730434 9.8728797	0.86206	7804-375	7634.445	7465.234	7296.795	19
					7861.537	7631.619	7462.420	7293-995	18
17	9.8920222	9.8824558	9 8727150	9.8627987	7798.700	7628.793	7459.607	700* :	
16	19.0918042	9.8822040	9.8725821	9.8626210	7795.863	7625.967	7456.794	7291-195 7288-395	17
15	9.0917001	9.8821339	9.8723882	9.8624650	7793-026	7623.141	7453.981	7285.595	15
14	0.8915480	90019730	9.8722243	9.8022981	7790.189		7451:168	7282.796	14
12	9.8913898 9 .8912 316	0.8810408	9.0720003	0.8610640	7787-352 7784-515	7617.491	7448.355	7279 997	13
				9.0019042	7/04.515	7614.666	7445.542	7277.198	12
11	9.8910733	9.8814897	9.8717322	8617971	781.678	7611.841	7442.730	7274 200	—
. 10	9.8009150	9 8813285	9.82126826	3.8616200	7778.842	7609.017	7439.918	7274.399 7271,600	71
9 1	9.8907566	9.8811672	9.871404ck	0.8614628 l	7776.006	7606-192	7437.106	7268.802	10
	9.8905982	048806444	9.0712398	8612956	7773.170	7603.368	7434.294	7266.004	8
7 6	9.8904397 9.8902812	0.8806833	2.87007.55	8600610	7770334	7600.544	7431.483	7263.206	7
أخسا				-ocodo to	7 7 67.498	7597.720	7428.672	7250.408	6
. 3	9.8901226	.88052189	· 87 27468k	.8607936	7764.963	7594.896	7425.861	7267 6	
4	7.8899640k	0.8803604	0.8705824lə	.8606262	7761.828	7592.073	7423.050	7257.611	5
3 1	9•88980546	0.8801988	-87041700	·8604587	7758.993	7589.250	7420.240	7252.017	4 3
2	9.8896467 9.8894879	0.8708044	0702534D	860:25	7756 158	7586.427	7417-430	7249.220	2
	.8802201	87071461	2600043	8400465	7753.323	7583.604	7414.020	7246.423	1 }

10-	26 in 19			A T.	_	la a Nama	1 Mariford	-			7
	16, 17, 18	, 19	- NY - 0-1		0	le o Natura			· · · · ·		ı
M	N. 16	N. 17.	N. 18	N. 19		1_L. 16_	1 4 17	L. 18	L. 19	M	ı
0	0387'383	0436 952	0489.435	0544.814		3.5881406	8.6404342	8.6896949	8.7362485	0	I
1	0388.185	0437.803	0400-324	0545.762		8.5890390	3.541279	8.6904921	8.7370030		ł
I	388.988	438.655	491.234			8.5899365		8.6912886	8:73777	1	ı
2	389.792	439.508	492-135	547.659	'	0. 7 099 305	8.6429663	8.6920844	8.7377570	2	ı
3		440.361	493.037			0.5900330	9 6429003		8.7385102	3	ı
4	?90.597					8.5917280	8.6438037	8.6928794	8.7392628	4	۱
5	391.402	441.215	493-939	549-559		8.5926232		8 6936736	3.7400147	5	ı
6	392.208	442.070	494.843	550.511		8.5935170	8.6454909	8.6944672	3.740 76 59	6	ł
											ł
7	0393-015	7442.926		0551.463		8.5944097	8.6463308	8.6952599	8.7415165	.7	ı
8	393.833	443.782	496 652	552.416		3 5953016	8.6471628	3.6960520	8.7422664	.7 8	ł
9	394.632	444.639	497.557	553.370	-	8.5961925	8.5479880	8.6968432	8.7430156	\ g	ı
. 10	395-441	445.498	498.464	554.325		8.5970824	8.6488454	8.6976336	8.7437642	10	ı
. 11	396.251	446.357	499-371	555.580		8.5979715	8.6496820	8.6984236	3.7445121	11	ı
	397.062	447.216	500,279	556.236		8.5988596	8.6505177	8.6992127	3.7452593	12	ł
12			-			30,900,90	7-7-77		777-793	• •	ı
	0397.874	0448-077	0501.188	0557.193	٠	8.5997468	8.6513526	8.7000010	8.7460059	*2	ľ
2	398.687	448.938	502.098			3.6006330	8.6521867	8 7000010	8.7467518	13 -	ı
14		449.801	503.009	559-110		3 0000330	8.6530200	8.7007886	8740/510	14	ı
15	399.501	450.664	503.920		.]	8.6015184	8.44-8	8.7015755	8.7474971	15	ı
16	400,315			560.069		8.6024028	8.6538524	8.7023617	8.7482417	16	ı
17	401.130	451-527	504.832	561.029		3.6032763	8.6546841	8-7031471	8.7489857	17	١
18	401.946	452.392	505.745	561.990		8.604168	8.6655149	8.7030318	8.749729	18	١
		0450055	0006 6	h-(2)			9.6.4		0 -		ı
19	0402.763	453.257		0562.952		8.6050505	8.6563449	8 7047158	8.7504716	19	۱
20	403.581	454.124	507.574			8.6059313	8.6571741	8.7054990	8.7512136	20	١
21	424.400	454-991	508.489	564.878		8.6068112	8.6582025	8.7062815	8.7519540	21	ı
22	405.219	455.859		565.843		8.6076901	8.6588301	8.7070633	8.7526956	22	1
23	406.039	456.727	510-322	566.808		8.6085681	8.6596569	8-7078411	3.7534357	23	ı
_	406.860	457-597	511.240			8.6094453	8.0604829	8.7086247	8.7541751	24	ı
24								3/30024/	7774-731	-4	ı
	0407.682	0458-467	0512.158	0568.740		8.6133215	8.6613081	8.7094044	8.7549138	95	ı
25	408.202	459.338	513.078			8.6111968	8.6621324	8.7101833	8.7556519	25	ı
26		460.210	513.998		-	8.5121900	8.6629560	8.7101033	8 7560	26	ı
27	479.328	461.083				8.6120712			8.7563894	27	ł
, 28	410-152	461.956	515.841			8.6129448			8.7571262	28	ŧ
29	410-977	462.833		572.614	- 1	8.6138174	8.6646008	8.7125157	8.7578623	29	ı
30	411.803	462.830	516.763	573.585		8.6146891	8.6654220	8.7132918	8.7585979	30	ł
1		0460 506	0417.68-	200			9.444		0		ł
, 31	0412.629		0517.687			8.6155600	8.6662424	8.7142671	8.7593327	31	ı
. 32	413.456	464-582	518.611	575 ·5 29	1	8.6164299	8-4670520	8.7148418	8.7600670	32	Ł
: 33	414.284	465.458	519.536	576.502		8.6172990	8.0678808	8.7156157	8.7608006	33	ı
34	415.113	466.336	520.462			8,6181672	8.66 86988	8,7163889	8.7615336	34	ł
35	415-947	467*214	521.388	578.450		8.5190345	8.6695160	8.7171614	0.7622550	35	ı
36	416.774	468.093	522-316	579.425		8.6199009	8.6703324	8.7179332	8.7629976	36	ı
											ı
27	0417.605	468-973	0523.244	0580.402		9.6207664	8.6711481	8.7187044	8.7637286	37	ı
37 38	418.437	469.854	524.173			3.6216331	8.6719630	8.7194748	8.7644591	38	ı
	419.270	470.736	525.103		-	3.6224948	8.6727771	8.7202445	8.7651889	39	ł
. 39	420-104	471.618	526.034	583.335	. !	8.6233577	8.6735904	8.7210135	8.7659180	40	ı
; 40	420.039	472.501	526.965			3.6242197	8.6744029	8.7217818	8.7666466	41	ı
41		473-385	527.897			3.6250809	8.6752147	8-7225494	8.7673745	42	ı
42	421.775					~~~~	-//	- /227494		7-	ı
4.0	0422.611	0474.270	0528.830	0586.276		3.6259112	8.6760256	8.7233163	8.7681018	43	ı
, 43		475-156			- 1	8.6268	8.6768358		8.7688284		ĺ
44	423'448			588.240		8.627.1951	8.6776453	8.7240825	8.7695544	44	ı
45	424.286	1-6				0.02/1951	8 679		8.7702798	45	ı
46	425.125	40		. , 1		0.0205108	8.6784539			46	ı
47	425.964	477.817			1		8.6792618	8.7263770	8-7710046	47	ı
48	426.804	478.706	533-507	591-192	1	3.6302295	8.6800689	8.7271404	8.7717288	48	ı
1		0470 404	0524455	0400 550			9 40 - 0		9	-	t
49	0427.645	4/20190	0534-445		1	3.6310846	8.6808753	8.7279032	8.7724523	49	ı
50	428.487	480.486	535.384		.]	Ĭ₹ ∙ 0310388	8.6816809	8.7286653	8.7731752	50	ı
51	429.330	481.377					8.6824857		8.7738975	51	1
52	430,174	482.269				3.6336447	8.6832897	8.7301874	8.7746192	5:2)
. 53	431.018	483.162				3.6344964	8.6840930	8.7329474	8,7753402	53	1
54	431.863	484.056	539-146	597.119		3 6352472	8.6848956	8.9317067	8.7760607	54	1
									-		ŀ
. 55	0432.709			0598.109		3.6361971	8.6856973	8.7324654	8.7767825	55	ĺ
56	433.556	485.846	541 032			3.6370462	3.6864984	8.7332233	8.7774997	56	İ
57	434.404	486.742	541.977	600.093		3.6278346	8.6872986	8.7339806	8-7782183	57	ĺ
26	435.253	487.639	542.922	601.086		3.6387419		8.7347373	8.7789363	58	1
			1 / 5.0		1		10 (800				
58		488.526	542.868	602.079		1 5•0205884	18.08880000	10.7254027	13 770062771	.50 =	
59	436.102					3.6395884 3.6101342			8.7796537	59 60	
			543.868 544.814			1.0395884 1.6104342		8.7362485	3.7803 7 05	60	ļ

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}	Sines, a	nd their Log	a: ithms			9.220	Deg.	73, 72, 71	, 70
M	L. 73	La 72	L. 71	L. 70	N. 73	N. 72	N: 71	N. 70	171
1							·		60
		9.8498052	9.8394674	9.8289381	7243.627	7676.283		67445318	-03
	9.8597883	9.8496344	9.8392934	9,8287609	7240.831	7073.501	0907,064	6741.568	59
- c8 l	9.8596206	9.8494636	9.8391195	9.8285837	7238.035	7070.720	4 224.298	5738.828	58
57	9.8594529	9.8492928	9.8389455	9.8284065	7235.239	7067.939	5901.532	6736.069	57
.56	0.8592851	9.8491219	9.8387714	9.8282292	7432-444	7065.158	68 98-76 6	6733.319	56
55	9.8591171	9.8489509	9.8385973	9.8280518	7229.649	7062.377	689 6- 001	6739 570	55
54	9:8589492	y.8487799	9.8384233	9.8278744	7226.854	7059-597	6893.236	6727.821	54
1					+				
62	9;8587812	9.8486088	9.8282489	9.8276969	7224-059	7056.817	6890.471	6725.073	53
53 52	0.8586132	9.8484397	0.8380746	9.8275194	7221265	7054-037	5837.706	6722.325	52
	9.8584451	9.8482665	0.8370003	9.8273418	7218.471	7051.257		6719.577	51
-51	0.8582770	9.8480953	9.8377259	9.8271642	7215.677	7048-477	6382.178	6716.829	50
50	0.8581088	9.8479240		9.8269865	7212.883	7045.698	5979.414	6714.082	49
49	0.84 70406	9.8477527	0.8372770	.9 8263088	7210089	7042.919	6876.651	6711.335	48
40	310,777		37377						
	0 8 5 7 7 7 2 2	9.8475813	0.8272024	9.8266310	7207-206	7040.140	6873.888	6708,488	47
47	0.8576040	9.8474099	0.8270278	9.8264532	7204.503		6871.125	6704.841	46
46	2.8674246	9.8472384	0.8368431	9.8262753	720/-710	7034.584	6868.362	6703.094	•
45	9 95/4350	9.5472304	20300331		7108 018	7031.806	6865.600	6700.348	45
44	9.8572072	9.8470659	9.0300705	9.8260973			4040 900		44
43	19:55,70987	9.8468953	19.0305037	9.8259193	7196,126	7026.250	6862.838	0697.602	43
42	19.0569302	9 8467237	12.0303285	9.8257412	7193.334	1/220.250	6862.076	6694.856	42
<u> </u>	1-	0	0.1			7022 45	6802	6600	
41	19.8567619	9.8465520	19-9301540	9.8255631		7023.473	6857-314	6698.111	41
40	19.8565925	9.8463802	9.8359/91	9.8153849		7020.695	4054.552	6689.366	40
39	9.8564242	9.8462084	9.8358041	9.8252067		7017-919	6851.791	6586.621	39
38	9.8562555	9.8460366	9.8356791	9.8250284		7015.143	6849.030		√38
	0.8560867	9.8458647	9.8354540	9.8248501		7012367	6846.269		37
37	0.8550179	9.8456927	0.8352789	9.8246717	7176.586	7009.591	6843.509	6678.389	36
36	300 777								
-	10.8557480	9.8455207	0.8251027	9.8244932	7173,796	7005.815	6840.749	6675.645	35
35	08664800	9.8453487	0.8240285	9.8243147		7004.040	4837.989	6672.902	34
34	19.07777000	9.8451765	10.8047631	9.8241361		7001,26;	6835.230	6670.159	33
33	3,033441	9.0471707	19.034/73			6998,495	5832-471	6667.415	
32	19.0552420	9.8450044	19.0345//0	9.8239576			6829.712	6664-673	32
31	19.8550728	9.8448322	9.5344024	9.8237785		6995-716	62 06 012	6661.931	31
. 30	19.8549037	9.8446599	9.8342209	9.8236002	7159-347	6992,912	5826.953	0001.931	30
-						6.00	40-	4640.00	-
29	9.8547349	9.8444876	9.8340514	9.8234213		6990.168	6824-195	6659.189	29
28	9.854565	9.8443152	9.8338759	9.8231425		6987.394	6821.437	0556.447	28
27	19.8543959	9.8441428	6.8337002	9.8230536		6934,620	6828.679	6653.706	27
26	0.8542260	5 0.8439703	9.8335246	9.8225847	7148-622	5981.847	6815-921	6650.965	26
	0.8540572	9 8437978	0.8333488	9.8227257	7145.904	6979.074	6813.103	6648.224	25
, 25	0.8538877	9.8436252	0.8331731	9.8225266		5976 301	6310.406	6645.484	24
24									
	0.8527182	9.8434526	0.8320072	9.8223475	7140.328	6973.528	6807.649	6642.744	23
23	In Quantable	9.8432799	3.8228213	9.8221684	7137541	6270-756	6824.892	6640'004	22
22	9.0333400	9.8431071	0.0226464	9.8219891		6967.981	6802.126	6637.264	21
21	1.0	9.8429344	0.8224604	9.8218099		6965-212	4799.380	6634.525	20
20	101853000	9.8427615	12.8229022	9.8216305	7120.181	6962-441	6796.625		19
19	0.0230300	9.8425886	12.8222 -2		7126 205	6959.670.	6793.870		18
18	9.0520099	9.0423000	P.0321172	9.8234511	1	7 17.0/1).	-		
 	9	842456	0.83.04	08010315	7102 600	Sock Par	6791.115	6626.309	17
117	19.0527000	9.8424156	9.0319411	9.8212717	7.23.009	5956.899		6623.571	16
16	19.0525302	9.8422427	y 0317049	9.8210922		6954.128	6785.605	6620.833	
115		9.8420696	A 6312889	9.8209126	7118.037				15
114	9.8521903	9.8418965	9.3314123	9.8207330	17115-252	6948.587	6782.850		14
13	J9.8520202	9.8417233	P-8315320	9.8205533	7112467	6945 817	6780.096	6615.358	13
12	19.8518502	9.8415501	9·8310 5 95	9.8203736	7100.632	5913.747	6777-342	6612.621	12
		.			-		600 -00	6609.884	
it	19.8516800	9.8413768	9.8308830	9.8201938	7106497	6310,524	6774.588		11
10	19.8515099	9.8412035	9.8307064	9.8200140		5,37,508	6771.835	6607.148	10
9	0 8512306	9.8410301	3.8305298	9.8198341		6934-739	6769.082	6604.412	9
8	0.8411602	9.8408567	2.8302622	9.8196542	7098.544	6931.970	6766.329	6601.676	•
_	0.850000	9.8406834	0.830176	0.8194741	17095.760	6929,202	5763.577	6598940	7
7 6	0.8508284	9.8405097	2.3200007	9.8192941	70-2.077	6926.434	6760.825	6596.205	6
1		1	7777		11				
	O Reades.	9.8403361	0.8208220	9.8191140	7000-104	6923-666	6758.073	6593.470	5
5	19.070070	9.8401625	0.823640	9.8189338	7087 411	6920.898		6590-735	4
	19.0504077	9.040.025	8004401				6752.570	6588.001	3
3	19.0503171	9.8399887	y.0 294 091	9-8187536	7084.639			6585.267	2
1 ^	19.8501405	9.8398150	9.0292922	9.8185733		6915.364	6749.819	6582-533	ī
1	19.8499759	9.8396412	9.0291151	9.8183930		6912.597	6747.068	1	0
0	19.8498052	9.8394674	9.8239381	9.8182126	7070.283	69 09. 830	6744.318	6579-799	~ 1
1	I .	I	•		11.				

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Deg.	8, 9, 10,	11.		A Tab	le	or Natural	Verled .			
MI	N. 20	N. 21	N. 22	N. 23	Г	1 L. 20	L. 21	L. 22	L. 23	M
					l					1/1
0	0603.074	2664.196	0728.161	2794.951	l	8.7803705	8.8222961	8.8622277	8.9003406	0
1	0604.069	0665.239	0729.251	3790.008	ı	8.7810863	8.8229772	8.8628771	8.9009611	
2	605.065	666.282		797.226		8:28:8022	8.8236582	8.8633265	8.9015816	1
	606.062	667.327		798.365		8 70 - 5 40	8.8213382	8.8641749	0.9013010	2
3		660 000				0./025100	0.0213302	0.0641/49		3
4	607.060		732.526		١.	0.7032314	8.8250182	8.8648233	8.9020207	4
5	6 08 .05 8	669.418	733.619	803-644		8.7839499	8.8256970	8.8654707	8.9034393	5
¹ 6	609.057	670.465	734.713	801.785		8.7846583	8.8253750	8.8661181	8.9040579	6
7	0610058	0671.512	0735.808	0802.027	ĺ	8.7853705	8.8270537	8.8667645	8.9046757	
7 8	611.059	672.561	736 904	804-265	i	8.7860827	8.827733/	8.8674109	8.9052934	7
	612.060	673.610	738.300	805.515		8.7867937	8 8 2 0 4 3 1 4	8.8680563	8 0012934	8
9		673 660	730.300			0.700/937	0.0204781	0.000503	8.9059102	9
10	613.062	674.660		806-356	1	8.7875047	290848	8.8687018	8 9065270	10
11	614.066	675.710	740.195	807.501		8.7882146	8.8297604	8.8693462	8.9071429	11
12	615.070	676.762	741.294	808.647		8.7889244	8.8304360	8.8699906	8.9077588	12
					ı				-	
13	0616.075	0677.814	0742.394	0809.793		8.7896330	8.8211106	8.8706340	8.9083738	• •
	617.080	678.867	743-494	810.94		8.7002416	8.831785C	8 97700345	8.9089887	13
14			744-595	812.088	1	8.7910491	8 8 3 1 / 0 5 0	8.8712774	8 00050-0	14
15	618.087	679.921				19.7910491	324584	8.8719198	8.9096028	15
16	619.094	680.976	745.697	813.237	ľ	8.7917565	8.8331313	8.8725623	8.9102169	16
17	620.102		746.800	814.386		8-7924627	8.8338541	8.8732037	8.9108301	17
18	621.111	683.0§8	747.903	815.520		8.7931695	8.8344765	8.8738452	8.9114432	18
								. , , , , ,		
19	0622.120	0684:145	0745,007	0 816 .687		8.7938740	8.826142-	8 8744856	8.9120555	,,
20	623.131	685,203		817.839		8.7945791	8.8268	8.8751261	8.9126678	19
			751.218	818.991	ľ	8.7952830	8 826.0	887-71201	8.07.20-20	20
. 21	624.142		. ,	820.145		8 707 2030	0 0 2 - 4892	8.8757656	8.9132792	21
22	625.154	687.321	752 324			8.7959869	2.6371594	8.8764051	8.9138905	22
.23	626.167	688.381	753-431	821.299	. !	8.7956896	8-8378285	8:8770436	8.9145010	23
24	627.180	689.442	754-539	822.454		8-7973923	8 8 3 8 4 9 7 6	8.8776821	8.9151115	24
					ŀ					
25	0628.194	0690.504	0755.648	0823.600		8.7980938	8.8391657	8.8783196	8.9157211	25
26	629.210		756.758	824 765		8.7987953	8-8398337	8.8739571	8.9163306	26
27	630,226			825.923		8.7994957	8.8405027	8.8795937	8.9169393	
			/5/.009		1	8.800	8.8411677	6.6/97937	0.9109393	27
28	631.242			827.081		8 8001901	0.0411077	8.8808303	8.9175480	28
29	632.260			828.240	l	8.8008953	8-8418337	8.8808659	8.9181558	29
30	633.278	695.824	761.205	829.399	l	8.8015945	3.8424996	8.8815014	8.9187636	30
					l					
31	a634. 2 97	0696.891	0762.318	0830.56 0		8.8022025	8.8431645	8.8821361	8.9193706	31
32	625.317	697.958	763.432	831.721		8.8029906	8.8438294	8,8827707	8.9199775	-
33	636.338		764.547	832.882	١	8.8036874	8.8444932	8.8834044	8.9205835	32
	637.350	700.095	764.747		l	8 8040844	8.8451570	0.0034044	8.9211895	33
34			765.663	834.045	1	\$ 8043043	0.0451573	8.8840390	3 921 1095	34
35	638.382	701.165	766.780	835.209	ı	0.0050001	8.8458198	8.8846707	8.9217947	35
36	639.405	702.235	767.897	836.373		0.8057758	8.8464826	8.8853734	8.9223999	36
								•		
37	0540.429	0703.306	0769.015	o83 7• 538		8.8064704	8.8471443	8.8859352	8.9230041	37
38	641.453	704.378				8.8071640	8.8478060	8.8865669	8.9236.84	38
39	642.479			839.870		8.8078484	8.8484667	8.8871977	8.9242118	39
40	643-505			841.037		8.808 2 2 2	8.8491274	8.8878285	8.9248152	
•	644.532			842.205		8.800244-	8.8497870	8.8884584	8.9254177	40
41					ı	8.8000=4	8 8 9 7 9 70	8-8890882	8.9250202	41
42	645.560	708.6 7 4	774.618	843.374		8.8099364	V·0504407	3-0090002	0.9 200202	42
	416 190					004	0 0	0 00	9	
43	0646.588			0544.544		0.0100276	8.8511053	8.8897171	8.9266219	43
44	647.618		/	845.714		0.8113187	8.8517639	8.8903460	8.9272235	44
45	648.648	711.904	777.990			8.8120087	18.8524215	8.8909739	8.9278243	45
46	649.679			/	ı	8.8126988	8.8520700	8.8916019	8-9284251	46
47	650-711					8.8133876	8.8537356	8,8922289	8.9290250	
48	651.743					8.814076	8.8543921	8.8928559	8.9296249	
4.0	-)/43	7-7-74	75.509	5,0403	ľ		0745921		7-7-49	4"
	0640 ===	0776 222	0780 456	0841		0 814545	8 845-55	8.8934820	8 0000045	
49	0652.777		0782.496			18.014/043	8.8550476		8.9302240	1 '' 1
50	653.811	717.304				0.0154521	8.8557032	8.8941080	8-9308231	50
51	654.846	718.386		853-928		8.8101387	8.8563576	8.8947331	8.9314212	51
52	655.851	719.409	785.883	855.105		8.8168253	8.8570121	8.8953583	8.9320194	52
53	656.918	720.553		856.282		8.8175108	8.8576656	8.8959825	8-9326168	53
54	657 955	721.637	788.145	857.460	'	8.8181061	8.8583191	8.8966366	8.9332141	54
,,,	-)/ 9/)		, , , , ,						7,7,5.4.	74
	0668 050	0722.722	0789.277	0858.539		8 8 1 8 2 2 0	8.8589715	8.8972299	8 0008:04	
55		723.809				0 8 10 10 10	0.0709715	0.09/2299	8.9338106	
56	660.032	L ' ' ^ 'I		859.819		10.0195052	8.8596240	8.8978532	8 9344070	56
57	661.072			8 60. 999	ı	8.0202484	8.8602754	8.8984755	8.9350027	
58	662.112			862.181	ľ	8.8209317	8.8609268		8.9355983	58
59	66 3.154			863.363		8.8216139	8.8615773	8:89)7192	8-9361930	59
60	664.196	728.161			1	18.8222961	8.8622277	8.9073406	8.9367878	65
1) {	, -	I :'''	1	1	ι "	1	1	•
					-					

A TABLE of Natural Versed

104	•	•	A	TABL	E of I	Natural	Ver/ed		
		Sinesan	d their Log					69, 68, 67,	
M	L. 69	L. 68	L. 67	L. 66	N. 69	N. 68	N. 67	N. 66	_M
60	9.8182126				6579.799	6416.321	6253,934	6092.689	_60
59 58	9.8180321 9.8178516	9.8071022 9.8060182	5.7959059 5.7057786	9.7840181 0.7844271	5577.006 5574.333	6413.605	6251.237	6090 . 011 6087 . 334	59
57	9.8176711	9.8267343	9.7955911	9.7842361	6571.600	6408.175	6245.844	6084.657	57
56	2.8174905	9.8065503	9.7954037	9.7840450	2568.867	6405,460	6243.148	6081.980	56
55	9.8173098 9.8171301	9.0003032	9.7952101 3.7050285	9.783662 7	5566.13<	6402.746	6240,452 6237 .7 57	6079·304 6076.628	55 54
\ <u>'</u>									
53	9.8169483	7.8059979	9.7948408	9.7834714	6560.671	6397.318	6235.062	6073.952	53
52 51	2.8165865	13.805620	0.794053	9.7832801	6557*94¢ 6555.205	6391.892	6232.367	6068.602	52 51
50	9.8164056	9.805445	9.794277	9.7828973	5552.478	6389.179	6226.973	6265.928	50
49	9.8162246	9.805260	9.794089	59.7827058 59.7825143	6549.747	6386.467	6224.285	6063.254	49
48	9.010043	9.005070	9.793951	9.7025143	6547.017	0303./55	6221.592	0000.580	48
47	9.815862	9.804891	69.793713	59.7823226	5544.287		6218.899	6057.907	47
. 46	2815681	9.804707	9.793525	49.7821309	5541.558	6378-331	6216 206	6055.234	46
45	0.8153182	9.804337	79.793337 79.703140	19.7817474	6538.829 6536.100	6375.620 63 72. 909	6213.514 6210.822	6052.561	45 44
43	9.8151373	9.804152	9.792960	80.7815555	6533.371	6370.198	6208.130	6047.216	43
42	2.8149560	2.803968	9.792772	59.7813636	6530.643	6367.488	6205.438	6044.544	42
41	2.814774	9.803783	9.792584	19.7811716	6527.915	6364.778	6202.747	6041.872	41
40	9.8145930	9.803598	9.792395	69.7809796	6525.178	6362-068	6200.056	6039.201	40
38		2.802228	39.792207	19.7807874 79.7805953	6522.460 6519 733	6359 358	619 7 .365	6036.530	39
38	2.814048	19. 803043	19.791829	9.7804030	6517.006		6191.984	6031.190	38 37
36	9.813866	.802858	9.791641	39.7802108	6514.279		6189.296	6028.520	36
	2 812684	3.802672	70.701452	50.7800184	6511.553	6348.524	6186-607	6025.851	
34	2.813502	7.802487	5 7.791263	79.7798260	5500.027		6183.918	6023.182	35 34
3	2.813320	802302	1 7.791074	89.7796335	5506,101	6343.108	6181.220	6020.513	33
3	0	513.802110 513.801021	719 .7 90885	99·7794410 99·7792484	5503-376	6340.401	6178.541	6017.845	32
31	1 0	3.80:745	2.790507	99.7790558	6497.925		6173.166	6012.509	30
	_		-						
2	3 3.812410	4).801274	213.790318 60.700120	8 <i>9</i> •7788630 7 <i>9</i> •7786703	5495.201		6167.792	6009.841	29 28
2	, [].812228	. }∙βΩ1188	\$12.780040	49.7784774	5489.753		6165.105	6004.507	27
2	5 3.812045	\$ 3.801003	9.789751	29.7782845 89.7780915	5487.029	6324.165	6166.419	6001.841	26
2 2	5 13-011003	10.800631	:13.709501 513.780272	519•7780915 519•7778985	5484.306	6321.459	6159.733	5999·1 7 5 5996.509	25
1	-1	.		-	.		0137.047	77901709	
2	3 7.811498	(1).800445	59.789183	c 9.7777054	5478.860	6316.049	6154.362	5993.844	23
2 2	1 13.8111310	43.800072	149.78°993	5 9.7775123 9 9.7773191	5476.138 6473.416		6148-992	5988.514	22 21
2	0 3.810950	43.799887	5 2.788614	.3 9.7771258	5470-694	6307.938	6146.308	5985.850	20
1	9 9.810768	29.799701	788424	59 .7 769325 8 9. 7767391	6467-973		6143.624	5983.186	19
1 !	_		-		5465.252	6302.532	6140.940	5980.522	18
1	9.810402	67.799328	788049	9.7765456			6138.257	5977.859	17
1	6 19.810219	7799142	112.78785	19.7763521 23.7761585	6457.090		6135.574	5975-196	16
l i	4 3.809853	1. 7.798769	7 2.787479	29.7759649	5454.370	6291.724	6130.209	5972.533 5969.870	15
1	2 3.800670	2.798583	1 2.787284	19.7757712	6451.650	6289.023	6127-527	5967.208	13
1	2 9.809487	7.798390	787099	9.7755775	5448-930	6286.322	6124.845	5964.546	12
1				89.7753836			6122.163	5951.885	10
1	0 3.809121	798023	786714	69.7751898	5443-492	6280.920	6119.482	5959-224	11
	9 13.808938 8 13.808754	79.797640	2.786224	3 9.774 9958 09. 77 48 018	5410.773 5438.059		6116.801	5956.563	8
	7 2.808571	2 2.797462	5 2.786143	5 9.7746077	15435.337	6272.820	6111.440	5951.243	7
	5 3.808387	2.797276	C 2.785953	19.7744136	5432.620	6270.122	6108.760	5948.584	6
	3.808204	2.797089	2-785762	59.7742194	6429.90	6267.423	6106.081	5945.925	
1 4	1).808020	7.796902	C 2.785572	09.7740252	6427.186	6264.725	6103,402	5943-266	5 4
	3 13.807837	2).796714	512-785381 612-785381	39.7738308	6424.469		6100.723		3
1	807469	89.796340	5.784999	9.7736365 89.7734420	6419 03		6095.367	5937-950 5935-292	2
	2.807286	2.796153	4 3.784809	9.7732475	6416.32		6092.689		0
J			1	1				<u></u>	

	Sines,	and their L	ogarithms						De	g. 53, 52, 5	2, 50,
Ni	N. 24	٠٩. 25	N 20	N. 27	1 -	L. 24	L. 2		Ln 26	1 27	(N)
	0804.545	09,5.072	101 2.060	1089.935	-	·9367878			9.0052061	9.0374005	0
1	865.729	0938.152	1013.335	1091.256	8	9373817	8.972	2729	9,0057529	9.0374264	1
2	856.913	939.382	1014613	1092.577		·9379756			9.0062997 9.05 6 8458	9.038 45 22 9.0389774	2
3	868.098		1015.388	1093.900		.9391618			9.0073920	9.0395026	3 4
4	869.284 8 70.4 71	1 :0	1018.445	1096.547	8	-9397540	8-974	5476	9.0079344	9.0 400272	5
- 6	871.558		1019,724	1297.972	8	-940 3462	8.975	1155	9-0084827	9-0405517	6
				1000 100	g	.9409376	8-075	6826	9-0090274	9.0410755	
7	2872.846		1021.004	1099,197		9415290			9.0095721	9-0415944	7 8
8	874.035 875.225		1023.567	1101.851	8	.9421195	8.976	8161	0:0101160	9-0421226	9
9	875.416		1024.849	1103.178	8	9427101	8.977	3824	9-0106600	9.2426458	10
11	877.607	950.491	1026.132	1104.507	l l g	•9432998 •9438895	8-078		9.0112032 9.0117465	9.0431 <i>6</i> 83 9.0436908	11 1
12	878.799	951.729	1027.416	1105.836]	7750077				7,50,00	
	2870.003	0952.968	1028.701	1107.166					9.0122890	9.0442127	13
13 14	381.185	954.208		1108.497	8	.9450672	3,979	6431	9-0128315	9.0447345	14
15	882.380	955-449	1031-273	1107.829	l lo	5.9456552	8.980	2071	9.0133733 3.0139154	9•0452557; 9•0457769	15
16	883.575	950.090	1032,560	1111.161	8	-046820s	8.081	22/1	9.0139154	9.0462975	16
17	884-771			1112.494	8	-9474177	8.981	8976	9.0149973	9.0463180	.17 18
18	885.967	7)7.77	1035.136		11	-					
19	9387.165	09:0.418		1115.162	8	9480040	8.982	4601	9.0155377	9.0473379	19
20	888.363	901,002	1037.715	1116.497	٥	9185904	18.983	7220	9.0160781	9-0478578	20
21	889,562	962.907	1039.006	1117.834		,,491759 3.9497617	8.084	1460	9.01661 7 7 9.0171574	9.0483770 9.0488 9 62	21
22	890.762	904.153	1040.297		S	3,9503462	3 984	7070	9.0176,64		22 23
23	891.952	1 -4-4-	1041.580	1120.306	8	3.9509309	3,985	2679	9.0182353	9.0499333	24
2‡	873.163	70.00			11		-				
25	3894.355	0967,899			Ш	8.9515148	8.985	8281	9.0187736	9.0504512	25
26	895.568	909-144		1124.525					9.0193119 9.0198494	9.0509691	26
27	896.771				113	8.0522648	8.087	5072	9.0203870	9.0514864 9.0520036	27 28
28	897.976	971-644			111	8.9528471	18.088	30659	9.0209238	9.0525202	29
29 30	899.181				П	8.9544294	18.988	6246	9.0214507	9.0530368	30
1	900.30	-			11	8 0440-0	-		0.0010060	0.0535508	
31	0901.594	0975.400			Ш	8.25550100	8 8	1825	9.0219969 9.0225330	9.0535528	31
32	902.80				П	8.95 517 20	18.00	7/404 12036	9.0230685	9-0545840	32 33
33	904-019	070 16				8.956753	8-000	18448	19.0230039	9.0550993	34
34	905.219	1 000 41			H	8.057 222	28.00	14112	9.0241387	9.0555140	35
36	907.639		5 1058.45		Ш	8.957913	18991	19675	9.0246735	9.0561286	36
1	•	-			11	8.058402	18.00	25222	0.0258076	6.0566426	37
37	2908.85	0	2 1059.70 2 1061.06	4 1140.661	П	8.050071	18700	20700	9.0257410	6.0571566	38
38	910.06		9 1062.36		п	8.050640	2 18.0 2	252.20	19.0202750	10.0576700	39
40	912.48	986.70	8 1063.67		п	8.960227	518.00.	41888	9.0200004	. 0° 0581833	1 '
41	913.70	3 987.90		9 1144.712	Н	8.960854 8.96138 2	5K.38	47 4 30	9-0273411 9-0278738	6.0586961	
42	914.91	989.23	0 1066.28	6 1146-064		0.901302		<u> </u>		7,92008	42
1 42	22.5.2	4 0030.40	2 (067.59	4 1147-416	1	8.961958	98.90	58506	9.0284058	6.0597209	43
43	917.35	1 001.76	4 1068.90	2 1148.770		8.962535	5 8.00	64741	19.028937 8	660602329	44
45	918.56	8 993.01	8 1070-21	1 1150.124	Ш	8.963111	28.99	69568	9-0294691		
45	919.78	61 994-20	2 1071.52			8-963687	00.99	75095	9-0300004		
47	921.00	5 995.84	7 1072.83			8.964837	00.00	86124	9.0305310	6.0617666 5.0622774	
48	922.22	5 7,000	12 1074-14	2 1154.191			- 0.77			•	1
49	2923-44	6 0,98.07	19 1075.49	4 1155.54	7	8.965412					
50		7 999.34	1076-76	6 1156.90	. 1	18.06508	48.00	07158	9.0321219	9.0632977	50
51	925.89	0 1000 0	14 1078.08			18.96655	300.00	20266	9.0326508	9.0638073	51 52
52			33 1079.39			8.06770	1810~	200150 200151	9.033180	5 9.054825	
53			52 1080.70 22 1082.02			8.96827	74 3.00	21016	9.034237	2 9.0653346	
54	929.50				-	·	~		 	-	ن <i>ــ</i> ي
55	0930.7	85 1205.69	94 1083.3.			8.96884	92/2.00	02465	9.034765	1 9.065842	
56	932.0	11 1006.9	65 1084.6	58 1165.06		8.96942	10 9.00	03014	4 9.035293	0 9.0663 5 1 2: 9.066858	1 56
57	933.2	38 1008.2	37 1085.9	76 1166:43	•	8.07056	2013-0	03502	6 9. 0358 2 0 9 0. 03634 7		
55	934.4		11 1087.2 85 1088.6	95 1167.79 15 1169.15		8.07112	32 3.0	04648	5 9.036874		31 59
59			60 1080.0	35 1170.52	4	8.97170	34 2.0	05206	1 9.03740		
1 0	_1_7,0,9	, , , , , , , , , ,		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	`.	Phi					

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	47			le e+ Natu					54, 64, 61,	
	_	6. 65	L. 64	L. 63	1 2. 02	1000	N. 04	14. 34	N. 62	M
17					1 307272002	5932.054	57,73.817	5010,268	<467.095	50
1	59 9.	7732525	7.7612547	9 749247	29.7309942		5/74 181	5013.674	545.5.703	59 1
	c 8 10	.7728573	9.761066	9.749944	59.7357878		5768.545	5611.060	5454.912	58
	57 13	.7720030	9.7908971 St 76 0663	20.742042	6 3.73 65814 2 3.7363750		5765.910 5763.275	5608.446 5605.833	5449.730	57
	56 19 55 12	7722741	9.7604 7 0	70.748437	737361686		5763.640	5603.220	5447.140	55
	54 6	7720792	2760272	19.748239	29.7359641		5758.006	5600.608	5444.550	54
1-	҉.				_					
1	53).7718842 . 7716802	2.760073	319.748032	169.7357554	5914.040	5755-372	5597.990 5595.304	5439.372	53
1).//10093). 77 1494.	9•/59°74 5.75d675	70.747623	99.73554 ⁸⁸ 129.73534 2 1	503.731	5752.738 5750.105	5592.773	5436.784	52
1	51	9.7712931	9.759476	50,9.74742	149 735 1353	59 .6 077	5747-472	5590.162	5434.196	50
	40	9.7711039	lo 753277	7919-74722	15 9.7349284	5903.42	5744.839	5587.551	5431.608	49
1	48	3.7709087	9.759078	35 3.7 4701	BC 9.7347215	5,00.706	5742.207	5584.941	5429.021	48
1.		0.7707133	0.7:8870	070.74681	502.7315145	5898.110	5739-575	5582.331	5426.434	47
ł	12.1	0.7705 I 83	10.753630	DOM:74601	2619. 73430 7 4	5825.45	5736.944	5579.722	5423.847	46
1	45	9. <i>77</i> 0322°	7.758481	13 19.746 49	94 9.734 1003	5892.811	5734-313	5577.113	5421.261	45
١	44	9.770127	119.758282	2112.74020	03 9.7333931	58,0.159	5731.082	5574-504	5418.675	44
1	43	9.7099311	12.75008:	2/13./4000	309.7336858 -79.7334785	5837·527 5884.856	5729.051	5571-896 5569-288	5416.089 5413.504	43
1							5720 421	7,75,200	7775104	
1	41	9.769540	29.75768	38 9.7 1559	632.7332711	5882-205	5723.794	5566.680	5410.919	41
	40	3.700344	419.75748	43 19•7 4539	2819.7330030	5879-554	5721.162	5564.073	5408.335	40
1		9.703148	010.75728. 810.75728.	4019-74518	939.7328560 574.732648 5	5870.904	5718.533	5561.466 5558.860	5405.751 5403.167	38
1	,	0.768756	80.75688	520.71478	219.7324408	5871.605		5556-254	5400.584	38 37
1	37 36	9.768500	8 9 75668	549.74457	849.7322331	58682956		5553.048	5398.001	36
- {.		<u> </u>		-	<u> </u>	-				
	35	9.708304	79.75618	55 9.74437	45 9.7320252	15866.307	5708.021	5551.043	5395-419	35
- 1	, ,	9.700100	10.75020	3 c 6 2 . 7 4 2 c l	70; 9.7318174 55: 9.7316094	5853.656 5861.011		5 5 48.43 8 554 5 .833	5,92.837 5390-256	34
1	,,	9.707776	20.75588	569.7437	526 3.7314014	15858.353		5543.229		33 32
١	21	9.767579	9.75568	35419 74359	587 [3.731193 3	5855.715	5097.515	5540.625	5385-094	31.
ı	30	9.767383	59.75548	353 3.74 33	547 9.730 9852	5853.068	5694.889	5538.022	5382.514	30
ŀ		0.767182	75538	366 27421	50, 9.7307769	6850 421	5692.264	5535-419	5379-933	30
	29 28	9.766999	06 9.75508	847 9.7429	462 2.7305686	5847-774	5689.639	5532.816	5377-354	29 28
	27	9.766794	09.75488	845,9.7427	415/7.7303603	5845.128	5687.014	,5530-214		27
- 1	26	9.766597	4.9.75468	835 9.7425	17:4 9 -7301519	. 5842.482	5684-390	5527.612	5372.195	26
1	25	0.700400	7544	83 819.742 3	331 917 299433	3339.837		5525-010		25.
-1	24	9-7002 12	-1	52° 9.7421	281 9.7297318		-	15522.409	5367.040	24
I	23	9-76600	719.7540	8219.7419	24: 3.7295261	\$834.547	5676.519	5519.808	5364-462	23
ı	22	9.765810	39.75381	814 9.7417	49,7293175	1 4931.903	5073.890	. 5517-203		22
- 1	21	10 46 4 4 4 4	319 7536	500 9.741 \$	146 9.729 : 087	\$825.259 \$826.515		5514.608		21
- 1	20	10 36 401	210.7534	/909./453 7802 7418	ayy 9.7288999 a 509.7 286909	823 972		5509-409		20
J	18				0019-7284820					19
		<u> </u>		-	···	-				
	17	19.70482	199.7528	7699 7436	9519.7282729	1818.687	5660.783	5504.212		17
- }	16	10 36444	7 /19 75 20; 04 10 7 c 24 :	/ 5014-7404 746 6. 7 402	90 9 7280638 844 9-7278546	816 045	5658• 1 67			16
. }	15	9.76423	309.7522	7349,7400	795 9 727 6454	1810.76	5652-927	5496-418	1, 1,	15
	13	9.76403	5 9.7520	721 7398	7459.7274360	14808-120	5650.307	5493,821	5338-707	13'
1	12	9.76383	16.1218	70k 2·7396	6929.7272267	111	5617-688	5491.224	5336.134	12
		0.76264	250 25 6	692 3.7391	638 9.7270172	802.83	5645.029	5488.628	5333.561	
	10	9.76344	299 75140	6743.132	584 9.7268077	1800.10	(' ' ' '	5486.032		10
- 1	9	9.76324	519.75120	66 a l 3.7 390	528 2.7265981	1 3797.558	5639.833	5483-437	5328.416	9
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1175-993	•		1250.025	1342.050	1431.325	1	0.0603088	0.00000057	9.1279649	9.1557382	
5 177,301 1262,278 1249,240 1437,327 1437,321 1249,247			1259.450	345.570	1434.326	١	9.0704046	9-1001809	0.1280062	9.1566177	
7 1180,102 1261,693 1349,945 1448,332 0.0719193 0.1016414 0.1305 159 0.1580100 7.1016414 0.1305 159 0.1780100 12786 1205,109 17314100 1205,109 17314100 1.1016114 0.1305 159 0.158260 0.158260 1	5					ı	9.0709097	9•1c06679	9.1293763	9.157 1720	
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8 1184.473 1265,109 1351.405 1440.336 1450.336 1318.4218 1266,742 1354.828 1264,745 1352.866 1481.351 1269,360 1269,360 1269,742 1354.821 1446.357 1443.341 1180.000 1272.109 1357.752 1446.357 1443.341 1269.761 1272.109 1357.752 1446.357 1446.357 1473.619 1360.180 149.377 1473.619 1360.180 149.377 149.341 149.777 1276.620 1361.645 149.377 149.341 149.777 1276.620 1361.645 149.377 1473.619 1473.619 1473	7		1263.693	1349,945	1438.832	ĺ	9.0719193	9-1016414	9.1303 159	9.1580100	7
10 1184218 1267-942 1354-327 1443-315 10-0734316 10-103005 10-137425 10-159220 11 1185-965 1270-779 1357-25 1446-157 10-074438 10-130107 10-132605 10-159220 11 12 1186-965 1272-799 1358-25 1446-157 10-074438 10-130107 10-132605 10-159220 11 1181-1591 1275-040 1366-168 145-355 10-074438 10-130107 10-132605 10-159275 11 1191-091 1275-040 1366-168 145-355 10-074438 10-159220 11-0505 10-15925 11-1593-16 1275-040 1366-168 145-351 10-074438 10-159220 11-1593-16 1275-040 1366-168 145-351 10-074438 10-159220 11-1593-16 1280-16 1360-16 119-16 1280-16 1360-16 119-16 1280-16 1360-16 1280-731 1365-16 1280-731 1365-16 1280-731 1365-16 1280-731 1370-431 145-931 10-074438 10-159230 11-1593-16 1283-16 1368-98 11-1593-16 128	8		1265.109	1351-405		l	2.0724238	9-1021278	9.1307855	9.1584637	8
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14 1189,716 1273,619 1360,880 14:07377 15 1191-039 1275,040 1361.645 1361.545 1365.381 16 1192470 1276462 1363.111 1352.391 1.050.794372 1.050.7948 9:134.593 9:146.383 16 17 119348 1277.897 1366.044 1455.131 1.050.794372 1.050.7948 9:134.593 9:163.381 16 18 1195.220 1279.397 1366.044 1455.131 1.050.794372 1.050.7949 9:134.593 9:163.381 16 19 1196.600 1280.731 1367.512 1456.923 9.0779510 1074578 9:135.931 9:163.8373 20 1197.980 1283.156 1368.881 1458.136 9.0784818 9:108.935 9:163.8373 20 1199.367 1283.156 1370.451 1454.971 9:108.966 9:138.932 9:104.873 22 1200.745 1285.050 1371.921 1464.052 9:0794512 0:108.966 9:1372.290 9:164.873 22 1204.898 129.2990 1377.899 1465.038 9:08.4431 9:108.896 9:138.792 9:165.873 22 1204.898 129.2990 1377.899 1465.038 9:08.4431 9:108.898 9:165.873 22 1204.4988 129.2990 1377.899 1465.938 9:08.4431 9:108.898 9:165.873 22 1204.411 1295.111 138.232 1473.0790 9:08.4431 9:108.898 9:165.854 22 1214.411 1295.111 138.232 1473.0790 9:08.4431 9:108.898 9:165.854 22 1214.606 1299.290 1386.603 1473.098 9:08.4431 9:111.793 9:140777 9:1688268 31 1213.217 137.787 138.718 1475.160 9:38.7438 9:144.797 9:1688268 31 1213.217 130.906 1395.901 138.833 9:08.44316 9:114.915 9:144.733 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.915 9:144.733 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.739 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.913 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.913 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247	12	1186.965	1270.779	1357-252	1446-357	١	9.07.44381	9.1040701	9.1326605	9.1602756	
14 1189,716 1273,619 1360,880 14:07377 15 1191-039 1275,040 1361.645 1361.545 1365.381 16 1192470 1276462 1363.111 1352.391 1.050.794372 1.050.7948 9:134.593 9:146.383 16 17 119348 1277.897 1366.044 1455.131 1.050.794372 1.050.7948 9:134.593 9:163.381 16 18 1195.220 1279.397 1366.044 1455.131 1.050.794372 1.050.7949 9:134.593 9:163.381 16 19 1196.600 1280.731 1367.512 1456.923 9.0779510 1074578 9:135.931 9:163.8373 20 1197.980 1283.156 1368.881 1458.136 9.0784818 9:108.935 9:163.8373 20 1199.367 1283.156 1370.451 1454.971 9:108.966 9:138.932 9:104.873 22 1200.745 1285.050 1371.921 1464.052 9:0794512 0:108.966 9:1372.290 9:164.873 22 1204.898 129.2990 1377.899 1465.038 9:08.4431 9:108.896 9:138.792 9:165.873 22 1204.898 129.2990 1377.899 1465.038 9:08.4431 9:108.898 9:165.873 22 1204.4988 129.2990 1377.899 1465.938 9:08.4431 9:108.898 9:165.873 22 1204.411 1295.111 138.232 1473.0790 9:08.4431 9:108.898 9:165.854 22 1214.411 1295.111 138.232 1473.0790 9:08.4431 9:108.898 9:165.854 22 1214.606 1299.290 1386.603 1473.098 9:08.4431 9:111.793 9:140777 9:1688268 31 1213.217 137.787 138.718 1475.160 9:38.7438 9:144.797 9:1688268 31 1213.217 130.906 1395.901 138.833 9:08.44316 9:114.915 9:144.733 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.915 9:144.733 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.739 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.913 9:169.7247 33 1213.178 130.6438 1394.061 1394.938 9:08.44316 9:144.916 9:149.913 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247 33 9:169.7247	12	1188.340	1272.100	1358.716	1147,865	1	6,0740407	21045548	0.1201084	0.1607278	
15 1191-393 1475-040 1301-045 [1450-331]		1189.716	1273.619	1360,180		Ì	6.0754434	9.1045546	2.1331264		- /
17					4	l	0.0759454	0.1055226	9-1240627		
18						l	6.0763488	9.1060078	9.1345311	9.1626247	
19							6.0774502	2.1069749	9-1354648	9.1629859	17
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21							9.0779510	9-1074578	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
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24							9.0794521	9.1089056	0.1373200	9-1647876	
26 1204.898 12°9.200 1376.336 1456.038 26 1206.283 1290.719 1377.809 1467.525 27 1207.665 1292*149 1379.283 1469.042 28 1209.54 1293.54 1295.54 1293.54 1295.54 1293.54 1295.54 1293.54 1293.54 1295.54 1293.54 1293.54 1295.54 1293.54 1295.54 1293.54 1295.54 1293.5	-		1287-862	1373.392			0.0804512	3.1008603	9.1317943		
26 1206.283 1290.719 1377.809 1467.525 27 1207.688 1292.149 2379.283 1469.042 20 9.0814491 9.1103318 9.1391889 9.1655844 26 1207.688 1209.754 1293.586 1380.757 1470.560 27 1113125 9.1430.531 9.1676341 27 1210.441 1295.011 1382.3232 1472.079 9.0824448 9.1117932 9.1407482 28 1213.291 1296.443 1383.708 1473.598 9.0824448 9.1117932 9.1407480 9.1683791 30 1211.829 1296.443 1383.708 1473.598 9.0834413 9.1127534 9.1410446 9.1683791 30 1211.829 1296.443 1383.708 1473.598 9.0834413 9.1127534 9.1410446 9.1683791 30 1211.596 1300.744 1388.141 1478.161 9.084331 9.0844356 9.1137234 9.1410446 9.1683791 32 1215.906 1300.744 1388.141 1478.161 9.084331 9.0844356 9.1137236 9.149708 9.1692745 32 9.0844356 9.1140757 9.1443434 9.1692745 32 9.0844356 9.1140757 9.1443434 9.1692745 32 9.0864204 9.1156374 9.143380 9.1701689 34 1222.070 1305.051 1392.580 1482.731 9.0864204 9.1156374 9.143380 9.1701682 36 1222.097 1307.926 1397.543 1485.735 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156374 9.143380 9.1701682 36 9.0864204 9.1156377 9.145636 6.1715084 41 1227.746 1310.804 13397.025 1485737 9.0878049 9.1701682 36 9.0878049 9.1701682 36 9.1701682 36 9.0878049 9.1701682 36 9.0878049 9.1701682 36 9.0878049 9.1701682 36 9.0878049 9.1701682 36 9.0889387 9.1180149 9.1401616 6.171508 37 9.0878049 9.1701682 36 9.0889387 9.1180149 9.1401616 6.171508 37 9.0889387 9.1180149 9.1401616 6.171508 44 1227.142 1314.244 1405.90 1405.444 1405						H			9.1382595	9.1050070	24
28 1299-154 1299-159 1399-263 1409-042 29 1211-829 1211-829 1296-141 1382-372 1472-079 9.0829416 9.112733 9.140173 9.1674328 28 1211-829 1296-443 1383-708 4473-1598 9.0834413 9.1127534 9.140146 9.1683791 30 1211-829 1299-309 1386-663 1475-619 9.0834413 9.1127534 9.1410446 9.1683791 30 1211-879 1300-744 1388-141 1478-161 9.0834435 9.1127334 9.1410446 9.1683791 30 1211-879 1300-744 1388-141 1478-161 9.0834938 9.1127323 9.1417077 9.1688268 31 9.121-8778 1302-179 1389-620 1479-684 9.08549249 9.1149705 9.142762 32 9.08549249 9.1149705 9.1688268 31 9.121-8778 1303-161 1391-109 1481-207 9.08549249 9.1156274 9.1433580 9.1701689 34 9.08549249 9.1156274 9.1433580 9.1701685 34 9.122-975 1309-364 1399-154 1485-731 9.08649249 9.1165831 9.1447431 9.147623 36 1222-957 1309-364 1399-761 1485-731 9.0893847 9.186651 6.1715085 37 6.1715085 1222-958 1313-865 1401-477 1491-889 9.0893847 9.184912 9.1467866 6.1732913 41 1227-142 1312-244 1404-01 1491-859 9.0893847 9.1184912 9.1467866 6.1732913 41 1228-538 1313-685 1401-477 1491-889 9.0893847 9.1184912 9.1467866 6.1732913 41 4221-323 1318-012 1409-035 1491-118 6.0993788 9.1184912 9.1467866 6.175070 45 6.0993788 9.1123449 9.1497664 6.175070 45 6.0993789 9.122349 9.1498010 9.1768451 49 1238-335 1322-345 1410-401 1501-073 6.0933829 9.122349 9.1505294 9.1773883 50 4248-555 1331-033 1419-351 150-283 6.0973789 9.1224667 9.153808 9.1795002 55 9.1773883 50 4248-555 1331-033 1419-351 150-283 6.0973789 9.122349 9.150324 9.1795002 55 9.1795002 55 9.123803 1339-746 428.337 1510-388 6.097279 9.1236079 9.1539161 9.180824 58 9.1225991 9.180382 57 9.180383 9.1226079 9.153910 9.1808245 58 9.1226079 9.153910 9.1808245 58						Н	9.08 295 02	9-1103506	9.1387242	9.1661362	29
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1225-746	38	1222.957	1307.926	₹395°543	1485.781	П	9.3874111	0.1165831	0.1447421		37
1227.142 1312.244 1399.993 1490.361 1491.889 9.0888940 9.180145 9.1461266 6.1732913 41 1228.538 1313.685 1401.477 1491.889 9.0893887 9.1184912 9.1465861 6.1737365 42 12181.334 1316.569 1404.449 1494.947 6.090.3778 9.1194932 9.1465861 6.1737365 42 1232.732 1318.012 1405.936 1496.478 6.090.3778 9.1194932 9.1470465 6.1741812 43 6.1732732 1318.012 1405.936 1496.478 6.090.3778 9.1194932 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.3687 9.11919192 9.1479654 6.175070 45 6.090.33768 9.1191413 9.148838 7 6.175014 46 6.090.33768 9.1191413 9.148838 7 6.175014 46 6.090.33768 9.1191413 9.1493426 6.1764018 48 6.175014 11326.686 1414.373 1501.073 6.090.33297 9.1222939 9.1502594 9.1768451 49 6.090.33768 9.12227679 9.1502594 9.1768451 49 6.090.33768 9.12227679 9.1502594 9.1772883 50 6.090.33297 9.1222939 9.1502594 9.1772883 50 6.090.33297 9.1222939 9.1502594 9.1772883 50 6.090.33297 9.12323419 9.1501751 9.1777311 51 6.094.3120 9.1232419 9.1511751 9.177311 51 6.094.3120 9.1232419 9.1511751 9.1781738 52 6.096.2931 9.1241887 9.1520898 9.1790584 54 6.096.2931 9.1241887 9.1520898 9.1790584 54 6.096.2931 9.1241887 9.1520.349 9.1790584 54 6.096.2931 9.1241887 9.1520.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.1790584 54 6.096.2931 9.1241887 9.1530.349 9.179		1224.351	1309.364	1397.025		П	9.08790581	011170604	C.1442041	6.1724004	
42 1228.538 1313.685 1401.477 1491.839 9.0893887 9.1184912 9.1465861 6.1737365 42 43 1229.936 1315,126 1402.963 1493.118 6.0893822 9.1189674 9.1470.165 6.1741812 43 44 1231.334 1316.569 1404.449 1494.947 45 1232.732 1315.012 1405.936 1496.478 6.09.08687 9.119493 9.1479654 6.1750701 45 46 1234.132 1319.456 1407.424 1493.009 47 1235.532 1320.900 1408.912 1409.541 1501.073 6.09185139 9.1208699 9.1488837 6.1759781 47 48 1236.933 1322.345 1410.401 1501.073 6.0923462 9.1213194 9.1493426 6.1764018 48 49 1238.335 1323.791 1411.891 1502.566 6.0938269 9.1213194 9.1493426 6.1764018 48 49 1238.335 1323.791 1411.891 1502.566 6.0938269 9.1213194 9.1493426 6.1764018 48 50 1239.737 1325.238 1413.381 1504.140 6.0933297 9.1222399 9.15028594 9.172883 50 51 1242.545 1328.134 1416.365 1507.210 6.0943129 9.1232419 9.1502772 9.1777311 51 52 1242.545 1328.134 1416.365 1507.210 6.0943129 9.1232419 9.151751 9.1781738 52 53 1243.949 1329.583 1417.857 1508.746 6.0952831 9.1241887 9.1520898 9.1790584 54 55 1246.761 1332.483 1420.845 1511.821 6.0957830 9.1246815 9.1525466 9.1795084 54 56 1248.168 1333'934 1422.340 1513'348 6.0957830 9.1241887 9.1520898 9.1790584 54 57 1240.575 1333.386 1422.380 1514.898 6.0957830 9.1253344 9.1530034 9.1790584 54 56 1248.168 1333'934 1422.380 1514.898 6.0957830 9.1253349 9.1534597 9.180832 57 57 1240.575 1336.389 1422.380 1516.438 6.0957830 9.1253394 9.1539169 9.180832 57 58 1252.392 1338.292 1426.829 1517.978 6.0977405 9.1256507 9.1534597 9.180832 57 59 1252.393 1339.746 1428.327 1519.510 1519.510 1510.		1227.143	1312.244	1300.003		П	0.0888040	9.1175377	9.1456651	61728461	
1229.936		1228.538	1313.685	1401.477		П	9.0893887	9.1184912	9.1465861	6.1737365	
45 1232-732 1318-012 1405-936 1496-478 6.09086879.1199192 9.1479654 6.1750701 45 46 1234-132 1319-456 1407-424 1498-009 6.0913616 9.1203945 9.1484248 6.1755144 46 1235-532 1320-900 1408-912 1499-541 1501-073 6.0923462 9.1213449 9.14984248 6.175584 47 1236-933 1322-345 1410-401 1501-073 6.0923462 9.1218194 9.1498010 9.1768451 49 1239-737 1325-238 1413-381 1504-140 6.0923297 9.1222939 9.1502594 9.1772883 50 1239-737 1325-238 1413-381 1504-140 6.0933297 9.1222939 9.1502594 9.1772883 50 1241-141 1326-686 1414-373 1505-675 6.0938208 9.1227679 9.1507172 9.1777311 51 1242-545 1328-134 1416-365 1507-210 6.0943120 9.1232419 9.151751 9.1781738 52 1243-949 1329-583 1417-857 1508-746 6.0943120 9.1232419 9.151751 9.1781738 52 1246-761 1332-483 1420-845 1510-283 6.0952931 9.1241887 9.1520898 9.1790584 54 1246-761 1332-483 1420-845 1510-283 6.0962730 9.1251344 9.1530034 9.1790584 54 1249-575 1335-386 1423-836 1514-898 6.0962730 9.1251344 9.1530034 9.1790584 54 1249-575 1335-386 1423-839 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1535079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1536079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1536079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1536079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1536079 9.1534597 9.1808245 58 1250-984 1336-339 1425-339 1516-438 6.0967780 9.1536079 9.1534597 9.1808245 58 1250-984 1336-984 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 1420-884 142	42	1220 026	1216 106	1400 055		۱	-				_
45 1232-732 1318-012 1405-936 1496-478 6.0908687 9.1199192 9.1479654 6.1750701 45 1234-132 1319-456 1407-424 1498-009 1408-912 1408-912 1409-541 1501.073 6.0913616 9.1203945 9.1488837 6.1755144 46 6.0918539 9.1208699 9.1488837 6.1759581 47 6.0923462 9.1213449 9.1498010 9.1768451 49 6.0923462 9.1213449 9.1498010 9.1768451 49 6.0923462 9.1213449 9.1498010 9.1768451 49 6.0933297 9.1502594 9.1772883 50 6.0933297 9.1502594 9.1772883 50 6.0938208 9.1227679 9.1507172 9.177311 51 6.0943120 9.1232419 9.1507172 9.177311 51 6.0943120 9.1232419 9.15016324 9.1781738 52 6.094325 9.1237153 9.1516324 9.1786161 53 6.0952931 9.1241887 9.1520898 9.1790584 54 6.0952931 9.1241887 9.1530034 9.1790584 54 6.0952931 9.1241887 9.1530034 9.1799419 56 6.09627309 9.1251751 9.1530034 9.1799419 56 6.09627309 9.1251751 9.1530034 9.1799419 56 6.09627309 9.1250079 9.153159 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.09672517 9.126079 9.1531501 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.0977405 9.1256057 9.1531507 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.0977405 9.126079 9.1539161 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.0977405 9.126079 9.1539161 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.0977405 9.126079 9.1539161 9.1808245 58 1250.984 1336.939 1426.839 1516.438 6.0977405 9.126079 9.1539161 9.1808245 58 1250.984 1339.746 1428.337 1519.510 1510.826 0.0977405 9.1265507 9.15345719 9.1808245 58 1250.984 1339.746 1428.337 1519.510 1510.826 0.0977405 9.1265507 9.1543719 9.1808245 58 1250.984 1339.746 1428.337 1519.510 1510.826 0.0977405 9.1265507 9.1543719 9.1808245 58 1250.984 1339.746 1428.337 1519.510 1510.826 0.0977405 9.1265507 9.1543719 9.1808245		1231,324	1316.560	1402.903			0.0093822	9.118 96 74	9-1470165		
47	4.5	1232,732	1312.012	1405.936		H	,0.0900007	9.1199192	0.1470664	6.1750701	
48 1236.933 1322'345 1410.401 1501.073 6.0923462 0.1213449 9.1493426 6.1764018 48 1 49 1238.335 1323.791 1411.891 1502.566 1239.737 1325.238 1413.381 1504.140 0.0923462 0.1218194 9.1498010 9.1768451 49 0.0933297 9.1222939 9.1502594 9.1772883 50 0.0938208 9.1227679 9.1507172 9.1777311 51 0.0943120 9.1232419 9.1511751 9.1781738 52 1243.949 1329.583 1417.857 1508.746 1345.355 1331.033 1419.351 1510.283 6.0943120 9.1237153 9.1516324 9.1786161 53 0.0952931 9.1241887 9.1520898 9.1790584 54 1246.761 1332.483 1420.845 1511.821 0.0952931 9.1241887 9.1520898 9.1790584 54 1249.575 1335.386 1423.836 1514.898 6.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.125134507 9.1808245 58 1250.984 1336.339 1426.332 1516.438 6.0962730 9.1256057 9.1534507 9.1808245 58 1252.393 1338.992 1426829 1517.978 6.0977405 9.1265507 9.1534571 9.1808245 58 1252.393 1338.792 1426829 1517.978 6.0977405 9.1265507 9.1543719 9.1812653 59 1253 803 1339.746 1428.327 1519.510		1234.132	1319.456	1407-424	1494.009	ł	0.0013010	9.I2U2Q4E	0.1484248	6.1755144	46
49 1238.335 1323.791 1411.891 1502.506 1239.737 1325.238 1413.381 1504.145 0.0933297 9.1222939 9.1502594 9.1772883 50 1241.141 1326.686 1414.373 1505.675 0.0938208 9.1227679 9.1507172 9.1777311 51 1242.545 1328.134 1416.365 1507.210 0.0943120 9.1232419 9.1511751 9.1781738 52 1243.949 1329.583 1417.857 1508.746 1345.355 1331.033 1419.351 1510.283 0.0952931 9.1241887 9.1520898 9.1790584 54 1246.761 1332.483 1420.845 1511.821 0.0952931 9.1241887 9.1520898 9.1790584 54 1249.575 1335.386 1423.836 1514.898 0.0962730 9.1256057 9.1534597 9.1803832 57 1249.575 1335.386 1423.836 1514.898 0.0962730 9.1256057 9.1534597 9.1803832 57 1250.984 1336.339 1425.332 1516.438 0.0967251 9.1256057 9.1534597 9.1808245 58 1252.393 1338.992 1426829 1517.978 0.0977405 9.1265507 9.1534519 9.1808245 58 1252.393 1339.746 1428.327 1519.510 0.0982023 9.1270225 0.1548719 9.1812653 59 1253 0.0982023 0.1270225 0.1548776 0.1817061 60 1253 0.0982023 0.1270225 0.1548776 0.1817061 0.0982023 0.1270225 0.1548776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1248776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1848776 0.1817061 0.0982023 0.1270225 0.1818	48					۱۱	6.0022460	9.1208699	9.1488837		47
50 1239.737 1325.238 1413.381 1504.145 0.0933297 9.1222939 9.1502594 9.1772883 50 1241.141 1326.686 1414.373 1505.675 0.0933208 9.1227679 9.1507172 9.177281 51 1242.545 1328.134 1416.365 1507.210 0.0943120 9.1232419 9.1511751 9.1781738 52 1243.949 1329.583 1417.857 1508.746 1345.355 1331.033 1419.351 1510.283 0.0952931 9.1241887 9.1520898 9.1790584 54 1246.761 1332.483 1420.845 1511.821 0.0952931 9.1241887 9.1520898 9.1790584 54 1249.575 1335.386 1422.340 1513.348 0.0962730 9.1246615 9.1525466 9.1795002 55 1249.575 1335.386 1423.836 1514.898 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1251344 9.1530034 9.1799419 56 0.0962730 9.1256057 9.1534597 9.1803832 57 0.0967625 9.1256057 9.1534597 9.1808245 58 0.0967625 9.1256057 9.1534597 9.1808245 9.1808245 9.1808245 9.1808245 9.1808245 9.1808245 9.1808245 9.1808245 9.1808245 9.					75.10/3	1				C-1/04018	401
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52		1241.141	1326.686				4.0933297	9.12229391	9.1502504	0.1772882	
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2	1522.60	1616.464	1712.879	1811.318	ı	2.1825868	9.2085661	9.2337267	9:2581145	1 :	
. 3		1618.050	1714-507	1813-188	ı	9.183026	9.2089919	9.2341392		1	
4	1		1716 130	1815-159	ı	9 183466	9.2094177	9.2345518	9.2589147		
5		1621.225			ı	3.1822050	9.2098431	9.2349639			
6			1719.397		ı		2.2102684		9.2593143		
	1				١	501045472		9.2353761	9.2597140	6	
7	1530.327	1624.402	1721.028	1820-178	l	0.184784	9.2106933	9.2357878	200	-	-
8		1625-001	1722 660	1821.810	ı	3.1863330	9.2111182		9.2601132		
	1522.421	1627.582	1724.202	1823-524	ı	13 18 6661	9.2115427		9.2605125	8	
9	1534.970			1825.199	ı	3.1862068	9.2119671	9-2366108	9.2609113	9	
10	1526.510	1630.764			ı	9.1865377	19 2119071	9.2370221	9.2613102		
11	0	1632.357	1720.101	1828.651	ŀ	9.186073//	9.2123911	9-2374329	9 261 7086	11	
12	7,30.000	-35377	- 7 - 3 - 5 - 7		l	9-1009/50	5.2128151	9.2378438	9.2621071	12	
1	11420 610	1633-950	1720-820	1830.228		202422	(0 0 0 0 0 0	- 0.0-1		<u> </u>	_
13	1539.619	1625 514		1831-906	1	9.10/4131	9.2132387	9.2382542		13	
14	4541.170	1635.544				19.1070505	9.2136622	9.2385647		14	
15	1542.722	1637.138	1735.740	1835.361		9.1002075	9.2140853	9.2390747		15	
16	1544.274	1030-734	1923 276	1826.204		9.1887245	9.2545084	9.2394847	9.2636985	16	
17	11545.828	1640.330	1/3/-378	1828 42	l. l	9.1891010	9.2149310	9-2398943	9.2640957	17	
18	11547.382	1641,926	1/39.017	.050.024	Н	y.1895974	9.2153537	9-2403038	9.2614929	18	
1-	-		17101	1042							
19	1548.936		1740.657	1040.305	H	9.1900335	9.2157759	9.2107130	9.2648898	19	1
20	1550.492		1742.297	1941.987	H	9 1904695	9.2161981		9-2658266	20	
21	1552.048		1743.933		ı	9.1909050	9.2166198	9-2415309	9.2656831	21	
22	1553.605		1745.580	1345.353		9.1913406	9-2170116	9.2419396	3.2660795	22	1
23	1555.162	1649.920	1747-222	1847.037		P1917756	9.2174520	9.2123480	9.2664756		1
24	1556.721		1748.365	1848-722		21922107	9.2178842	9-2427563	9.2668716	23	
1					l					24	.]
25	1558.280	1653.123	1750-509	1850407		9.1926453	9-2183051	9.2431642	9.2672673		•
26	1559.839	1654.725	1752.153	1852.094	l	9-1920790	9-2187259	9.2435721	9.2676729	25	
27	1551.400	1056-328	1753.795	1853.780		9.1935140	9-2191463	9.2439796		26	1
28	1562.961	1657 932	1755.414	1855.465	H	3.1030475	9-2195668	9.2439790	9.2684534	27	1
29	1564-523	1659.537	1757.001	1857-156		3.1342418	912199867		0 2680 .0	28	
30	1566.086		1758.738	1858.845		9.104812	9.2204067	9.2441941	9.2688483	29	
30	1.,55.656	——				70-945155	71-2-74007	9.2452012	9.2692431	30	
21	1567.649	1662.74	1760.386	1850.534		0.1052487	9-2208262	2456228	2646-4	_	٦
31		1.44	1762.035	1862.224		3:1056X10	9:2212458	9.2456078	9.2696376	31	
32	1569.213	1.46	1763.684	1863.216		9.196(146	0.2216640	9.2460145		32	
33	1570-778	1.460	1765.334	1865.607		9.1965473	9 2210019	9-2464207		33	ı
34	1572.343		1765.985	1867.200		3.1905473	0.00000	9.2468269		34	1
35	1573.909	1.630.504	1763.636	1868.002		9.1959795	0.200000	9-2472327	9-2712139	3-5	1
36	1575-476	.5/3./58	1/03.030			9.1974118	9-2229212	9 2476385	9.2716075	36	1
		1672 208	1770.288	1870.486	,	2222				_	-
37	1577.044		1770.200	2872 280		9.1978436	92233395	9.2480139		37	ı
38	1578.612		1771-941	1874 004		9.1982754	9.2237577	9.2484493	9.2723941	38	ı
39	1580.181		1773-595	1875075	ı	9.1937067	9.2241754	9.2488543	9-2727870	39	
40	1581.751		1775-219		1	9.1991380	9:2245932	9.2492593	9-2731700	40	ı
41	1583.321		1776.901		J),13 32 683	9,2250105	9-2496619	9-2735724	41	ŧ
42	1584.892	1080.459	17784563	10/8.102	ŀ	J.1993 9 97	9-2254279	9-2500584	9.2739640	42	ł
	1 —	- (0,		10000	ļ			-		T -	1
43	1586.464	1682.073				3.2004301		9-2504725	9.2743570	43	ı
44	1588-037				1	3.2 0086555	912262617	9.2508767	9-2747491	43 44	I
45	1589.610		1783.531	18841265		9 2012 304	9-2266781	9.2512805	2.2751408	45	ı
4 6	1591.184	1686.920	1785.189	1885-965	1	2.2017234	9 2270946	9.2516842	9 2755325		ı
47	1592.759		1786.848		1	9.2321498	9.2275 106		9-2759238	46	ı
48	1534-334	1690.155	1788.508	1889.362		2025793			9.2763151	47 48	f
			· ——							40	J
49	1595.010	1691.774	1790.168	1891-054	1	2 330083	9.2283422	9.2528938	9.2767061	42	Ĭ
50	1597•487	1693.393	1791 83C	1892.765	1	D.2334373			9.2770970	49	ľ
-51	1999.064	1695 013	1793.491	1891.470	1	2038659	9.2201720		9.2774875	50	ı
52	1600.643	1696.634	1795,154	1896.174		2042914			9:2778787	51	I
53	1602.222	1698.255	1796 817	1897.878	Į.	.2047225	9.2322028	1	9.2782683	52	ı
54	1603.801	1699.877				.2051506			9.2786584	53	ı
, T					1			7-	2.2/00/04	54	ı
55	1606.580	1701.500	800.146	1031/203	1	0.2055782	2.208218	0.2663056	0:0700100		ı
56	1606.062	1703.123	1831.8	1002.036	ľ	2060058	0.9212461	9.2553376		55	I
57	1628-646	1704.748	1802.477	1004.704	1	9.2054330	2275600		9 2794380	56	ı
38		1706-372			ŀ	9.2068602	3.522220		9.2798273	57	ı
	1611.712	1707.998	1806.8	1008-101	ł). 2000002). 20728	9.6523738			58	ı
· 59 60	1612:204	1709.624	1828.482	1909.830		2072869		9.2569127	9.2000057	59	ı
~	-0-5-294	יייערייעריי	: 555.455	ارد مالادر	1).2077 # 36	y.¥ 529037	9,2573136	×. 4456844	60	l
					L		,				J
-				-							-

Deg. 5	7, 56, 55,	54•		A Table	of Natural	Versed,			
M	L. 57	Ln 56	L. 55	L. 54	N· 57	N. 56	N. 55	N. 54	M
60		9.6583558	9.6442486	9.6298412	4700-808	4553.510	4408.07	4264,236	60
	9.6719445			9.6295984	4698-341		1405.000	4261.853	59
59	0.6717165	9.6578903	9.6437732	9.6293557	4695-875	4548.732	1403.249	4259-471	58
57	0.6714883	19.0576574	9.6435354	9.6291127	4693.409	4546.293		4257.089	57
1 56	0.6712602	9.6574245	9.6432975	9 6288598	4692-944	4543.855		1254.708	56
55	9.0710319	9.6571914	2.6430595	9.6286267	4688.479	4541.417		4252.328	55
54	9.6708036	9,0509583	9.6428215	9.6283836	4686.015	4538.980	4393.610	4249.948	- 54
	- 40000	9.6567251	26425822	9.6281403	4683.551	45 26.542	4391.202	4247.563	6.2
53	9.0705751	9.6564918	0.6122162	9.6278970	4581.087		4388.794	4245.189	53 52
52	0.6703407	0.6562584	9.6421068	9.5276535		1531.672	4386.386	1242.810	51
51	0.6608805	9.6560250	9.5418685	9.6274101	4676.161		43 ⁸ 3-9 7 9	4210.422	50
50 49	3.6606607	19.6557915	9.6416299	9.6271664	4673.699		4381.573	1238.054	49
48	9.6694319	9.6555579	9.6413914	9 6269228	4671.237	4524.368	4379-167	4235.677	48
\						4500 004	1276 761		
47	9,6692030	9.6553242	9.6411527	9.6266790	1008 770	4521.934	1376.761		47
46	9.6689741	9.055050	9.0409141	9.6264352	14000.315	4519,501	1271-051	4230-924 4228.548	46
45	9.6687450	9.0540500	9.6406752	9.6261912	14003.055	4517.065 4 514.6 36	1250.547	4226.173	45
44	9.6685159	9.0540227	9.6404364	9.5259473		+512-204	1367-142	4223.798	44
43	9.6682867	0.0543000	9.6401973	9.6257031	4656.476	\$509.772	4361.740	4221.424	43
42	9.6680574	9.054154	9.6399583	9.6254539	49,0.470		13-40/40		42
-	9.6678280	0.652020	3.6307101	9.6252146	4554.017	↓5 07.341	1362.337	1219.050	41
41	10 667c086	19.052030	17.0301200	9.6249703		4501.910	4359-934	4216676	40
40	A 6672601	19.0534510	10.0377400	9.6247258		4502.480	4357-532	4214-303	39
39	0.6671204	19.0532174	H3ro3330013	9.6244813	4646.645	4503-050	4355.131	4211.931	38
38	1- 6660 20 G	10.0529020	11.0487017	0.6242366		1497-621	4352 .73 0	4209.553	37
37	0.6666801	9.652748	9.6385222	9.6239919	4541.732	4495'192	4350.330	4207-108	36
36			-				10.00	100 6 0	
35	9.6664502	9.6525130	9.6382825	9.6237471	4639-276	1492.764	+347.930	4204-817	35
34	0 6662202	19.052270	9.6380428	9.6235022		1490.330	7345.531	4202.447	34
33	9.6659903	19.0520449	2.6378030	9.6232572		1487.929		42 >0.077	33
32	9.6657603	19.051 009	49.0375033	9.6230122		1485.482	1343,734	4197.708	32
31	0.6665201	19.051574	9.6373231	9.6227673	4626.458			4195-339	31
30	9.6652989	19.051339	9.6370830	9.6225218	\$627-004	1480.630	1333 330	4192-970	30
,		0611036	6-69-03	0.6000=64	4624.551	1438 000	4333.541	4190.602	
29	9.6650095	6 660868	9.6368428	9.6222764	4622. 98	4478.205 447 5. 780	4331.144	4188.234	29 28
28	19.6648392	0.650622	3.6363623 3.6363623	9.6217855	1610.646	1473·355	4328,748	4185.867	27
27	0.0040007	0.6532080	9.6361219		1617.101	1470.931	4326.352	4183.501	26
26	9.6643781	19.650162	9-6358813	9.6212942	4614.741	1468.507	4323-957	4181.135	25
25	0.6620168	9.649926	9,6356408	9.6210485	4612.291	1465.084	1348.502	4178.770	24
24	•				l i				
22	0.6636863	9.649691	0.6354001	9,9208026	14605.841	4463.652	4319.168	4176.405	23
23	In 6614559), Y•~4Y477°	ないの イントといむ	1 3.0 TO 1201		4461.240		4174-041	22
21	6622242	10.019219	19.0340165	1 3.9333100		4458.818		4171,677	€21
20	0.6600000	10.0409039	/JJ.0340770	1 0.020 1045.		445 4.397	1311.988	4169.313	20
19	0.6627620	10.010747	0.6377390	9.0138183		4153.970		4166.950	19
18	9.6625309	10.6485118	9.6341955	9.6195720	4597-597	1451.556	1307-201	77-50	18
-				0.6100055	1	4410	1304.812	4162.226	1.2
17	9.662299	0.6:8020	9.6339543	9.6193256	14997-140	4449.1 36 444 6. 717	4302.122	4159.364	17
16	9.0020003	D.6478021	9.6337131	9.6190792		4440.717 4441.295	4330,322	4157.5 -3	15
15	9-0018308	0.647566	9.6332303	9.6185860		4441.886		4155,144	14
14	D. 6610053	0.647220	9 6 2 2 9 8 8 7	9.6183392		4432.452		41,52.732	13
13	0.661149	0.647093	9.6327472	9.6180924	4582.918	1437.014	10000		12
12					13 ·				<u>{</u>
11	0.6600102	9.6468570	0.6325054	9.6178454	4580.473	4134.627		4148.063	11
10	12 6606286	19.0400204	10.0322027	9.0175985	4578 028	4432.21	4288.088	4145.705	10
9	0.6604466	19:0403839	Jy.6320218	9.6173513	 	4419.79	1285.701		9 8
F: 8	0.6602146	19.0401409	9.6317799	9.6171042	4573 141	4427-378	1283.314		
7	0-6600826	10.0459097	10.0315378	9.6168569	11570.098	44 24 - 26		4138.633	. 7
6	9.6597504	9.6456726	9.6312957	9.6166096	114508.255	4422.548	1278.542	4136.276	6
 					1		1006 116	4122.020	
5	19.6595181	9.0454355	9.6310535	9.6163621	114505.813	4420.134	4270-150	4133-920	5
4	19.6592858	19.045198	9.5308112	9.6161146	1 4503.371	4417.72	44/3-7/1	4131-564	4
3	19-6590534	19.0449005	2.6305688	9.6158669	1500-330	4415-307	1260 402	4129.200	3
2	9.6588210	9.0447230	9.6303264	9.6156192	4559-490	4410.482		4124.501	2
1	90585884	9.0444801	3.6300838	9.6153714	14770.050	4408 071		4122.148	0
10	19.0583558	3.0442400	9.6298412	9.6151235	1147735010	7700 0/1	14	1	ľ
1	1		1	-				W. C. C.	•

1 7	g. 3	5, 37, 38	. 30.		Sines a	no	their Log	arithms.		7	
	M	N 36	IN. 37	N. 38	N. 39 1	. 1	L. 30	L. 37 1	L. 30	L. 39	M
1-			2213 645		2228.54	1	9.1809617		9.3263135	9.348 205	0
-				2121.884	2233.371		9.2413833		9.3265805	9.3483771	1
1		1913.251			2232.203	1	9.2817720	943047376	9.3270473	9.3487337	2
l				2125.268	2224.035	1	9.2821602	9,3051147	9.3274136	9.3490899	3
l	ál	1916.675	2020'653	2127.061	2235.868	ŀ	9 2825484	9.3054917	9.327780	9.3494462	4
1	5	1918.388	2022406	2128.855	2237.702			943058633	9.3281450	9.3498021	5
	6	1920.101	2024-161	2130-650	2239.536	1	9.2833241	2.3062450	9.3285121	9.3501280	6
1-	}	100.0.	2224.0.6	1120 446	2012 07	1	0.00	0.2066213	9-3288778	2	
1			23 2 5.916 2027 .6 71	2132.445			9.2837116 9.2840 9 90		5-3292434	9-3505136	7 8
1		1923.530	2029.128			1	9.2344761	2.3073735	9.3296088	9.3508692	
	9 10	1926 962	2031.185	2137.335	2216.87			3077494	9.3299741	9.3515798	9
j			2032.942	2139.633			9.2852599		9.3303391	9.3519347	11
l	12	1930.397	2034.701	2141431		. }	9.2356456	3.3085006	9.3307042	9.3522897	12
 _	_										
l	13	1932-115	2036.46	2143.230	2252.39;			9.3088758	9.3310688	9 35 26443	13
l	14	1933.834	2338.220	214 ,.030	2254.23			9-3092510	9-3314334	9.3529989	14
1		1935-554	2039.980	2146.831	2256.074			3.3095258	9.3317977	9.3533532	15
1		1937.274		2143.632	2257.914	ı	9.23/1911	9.316.0007 9.3163572	9.3321620 9.3325260	9-3537075	16
1	-,	1938.995	2043.265	2150 434 2152 236				9:3107495	9.332390	9-3540614 9-3544454	17
1	18	1940-717				Į		7:3:0/490		9.3744474	18
1-		1942-140	2047.028	2154.039	2263.441	1	9.2883474	9.3111238	9.3332536	9-3547690	19
1	19 20	1944,163	2018.792	4155.843	2 265.284	1	9 2837326	9.3114979	9.3336172	9.3551227	20
1	21	1945.887	2050.556	2157 048	2 467.128	١	9.2891174	9.3118716	9.3339805	9.3554760	21
ı	22	1947.611		2159.453			3.2835022	3122454	9-33+3439	9.3558293	22
1	23	1949.336	.054.087	,,,	2273.818	1		3.3125188	9-3347067	9.3561823	23
l	24	1951.062	2255.854	2103.005	2272.654	1	J-2902711	9.3129)21	9-3350597	9.3565353	24
-			2057.621	216.0-	2074411		2 2026	012122662	9.3354323	224904	
ı	25	1952.789		2166 680	2274.511		0.2930331	9.3137383	9.3357949	9.3568880	25
ł	26	1954.516	2061.157	2168.480	2278.206	1	0.2314220	9.3141110		9.3572406 9.3575930	25
i	27 28	1957.912	2062.926		2280.055		9.2018065	19.3144837	9-3368194	9.3579453	27 28
	29	1959.701		2172.103	2181-004		9.2921898	9.3148551	9.3368813	9.3582973	29
ı	30	1961.431	20 66. 467	2173.918	2283.754		9.1925731	9.3152284	9-3372432	9.3585494	30
1_	,,,	·							l ———		
ł	31	1963.164	2068.238		2285.605	H	9.2929563	9.3156004	9.3376048		31
1	32	1904.893	2073.318	2177-451	2237.450		9-2933397	9-3159724	9.3379664		32
	33	1966.625		2179.534	2289.308		9.2937215	9.3163440	9.3383277		33
ł	34	1968.358	2073'555		2291.160		9.2941041	9.3167156	9.3389889		34.
ł	35	1970-091	2075.329	2152.981	1293.014	Ħ	9.2944802	9.3170869	9-3390498		35
1	36	1971.825	2077-104	-164./97	2294-868	ŀ	9.2340004	9.3174582	9-3594107	9.3607576	36
} -		1072'560	2078.870	2156 610	2296.722		0.3053503	0.2178201	9-3397713	9.3611081	
•	37 38	1975.295	2050.655	2188.126	1298-577	١	0.2056320	9.3182000	9.3491319		37 38
J	39	1977.031	1 0 -		2300.433		0.2000135	9.3185706	9.3404921		39
	40	1978.76	2084-208	12192.063	2302 29-		2.2063049	9.3189413	9.3408524	9.3621599	40
4	41.	1980-505	2085.986	2193.577	2304 147		9.296776	9.3193113	9-3412123	9.3625100	41
	42	1982-241	2087.765	2195.595	2306.004	ľ	9.2971570	9.3195815	9.3415722	9.3628601	42
1 -		-00-	2080 511		04	١.,			0.24::22:0	20611	1
1	43	1983.982	2001.22	12197-515	2307.853	١.		9.3200511			43
3	44	1985.722		2201.166	2309.722	1	9.49/918	9.3204213		1 / 2 /////	44
1	45	1987 · 462 1989.203			2313,42			9.3207908			45
1	46	1990-944	///		2315.303	1		9.3215291		9.3646078	
,	47	1992.686		2206.620	2317.165	;		9.3218986			47
٠ -											1
![49	1994-129	2100.233	22.8.14	2313-027	ŀ		9.3222674			49
1	50	1996.173		2210.267	7 2 3 20 . 8 9	ŀ		3.3226352		9.3656546	50
11	51	1997-917		,	2322.754			9.3230047			51
! [52	1999.662			2324.618			9.3233771			
1	53	2001.407			2326·483 2328·348	ŀ		1 9-3237412			1 '-
	54,	2003-154		1221/1909	25 200340		9.301/14	9.3241094	1	9-3670480	54
11-	55	2001.000	2110 946	2219.306	2330.215	1	0.302002	7 9.3244771	9-3462346	9.3673959	100
1	37. 56,	2006.618	2112.734	2 221 .22	2332.082	ŀ		9.3248449			55
11	57		2114.523	2223.051	12333.945	L		3 9.3252123		9.3680913	
	. 58,	2010-145	2116.312	2224.830	2335,817		9.303227	4 9.3255797	9.3473067		
:1	59	2011.895	2118,102	1226.710	2337.686	ı.	9.303605	1 9.3259468	9.3476636	9.3687861	59
	60	2013.645	2119.892	2228.540	2339.556	1	9.303982	9-3263138	9,348020	9.3591334	60
11_		`	<u> </u>	1	1	T	1		<u> </u>		1

Deg. 2	24, 25, 26,	27.		A Table	of Natural	Versed.			
M	L· 53	L 52	L. 51	L. 50	N. 53	N. 52	N. 51	N. 50	M
60	9.6151235		2.5847129	9.5689987	4122.148	3981.850	3943.385	T	6)
	9.6148755			9.5687337	4119.795			3706,796	;
	9.6146275			9.5684688	4117-442	3972.527 3977.204	3841 093 3838.802	3704.536 3702.2 7 6	59
57	9.6143793	9.5993243	9.5839364	9.5682036	4115.090	3974.882	3830-211	3700.017	58 57
56	9.6141311 9.0138827	9.5990706	9.5836771	9.5679385	4112.738		3834.220	3697.758	56
55	9.0138827	9.5988168	3.5834176	9.5675731	4110-387	3970-110	3831.930	3695.499	55
54	9.0130343	9.5985625	312831281	9.5674078	4108-036	3967.920	3829.641	3693.241	54
-	0.6122857	9.5983089	3.5828084	9.5671422	4105.686	3965.600	3827.352	3690.284	10
53 52	9.6121272	9.5982545	0.5826287	9.5668766	4103.336		3825.051	3688.727	53 52
3	9.6128884	9.5978007	9.5823788	9.5666109	4100.987	3960.962	3822.776	3686.471	51
50	9.6126397	9.5975464	9.5821190	9.5663451		3953.643	3820.488	3684.216	50
49	9.6123907	9.5972920	0.2818280	9.5660792	4096.291	3956.325	3818.201	3681.961	49
48	9.0121410	9-5970376	9.5015980	9.5658132	4093-944	3954.008	3815.915	3679.707	48
47	0,6118927	9.5967831	9.5813385	9.5655471	4091.597	3951.691	3813.629	3677-453	47
16	9.6116436	9.5955285	9.5810783	9.5652804	4089.250	3949-375	3811.344	3675.200	46
45	9.6113943	9.5962737	9.5808178	9.5659564	4086.904	3947.050	3809.060	2672.047	45
44	9.6111451	9.5960189	9.5805574	9.5647482	4084.558	3944.745	38:6.776	130/0.095	44
43	9.0100950	9.5957640	9.5802907	9.5644817	4082.213	394 2.4 30 394 0. 116	3804.492 3802.209	3668.443	43
42	9.0100401	9.5955090	9,7000301	9.5642151				3666.192	42
41	9.6103965	9.5952539	9.5797752	9.5639484	4077.524		3799:926	3663.941	41
40	9.6131469	9.5949987	9-5795144	9.5636816		3935.489	3797.544	3661.690	40
39	9.6098970	9.5947434	9.5792533	9.5634147	4072.837		3795-362		39
38	9.6090472	9.5944881	3-5789923	9.5631477	14070.495	3930.864 3928.552	3793.081	3657.191	38
37	0.6001472	9.5942325 9.5939 7 70	0.5784608	9.5628805 9.5626134	4065.811	3926.241	3790.801 3788,521	3654.942	37
36	91009147=	7.17.3711-	7 17 04090	91,0202,4				3652.694	36
		9.5937213		9.5623450		3923.931	3786.242	3650.447	35
24	9.6086468	9.5934656	9.5779470	9.5620787		3921.621	3783.963	3648.200	34
	9.6083965	9.5932097	9.5776854	9.5618111	4055.709	3919,312	3781.685	3645.95	33
-	0.0001401	9.5929538 9.5926977	9.5774237	9 .5 615436 9 . 561 27 58		39 17.00 3 3914.694	3779•407 3777•130	3643.7-8	32
1 2	9.6076450			9.5610080		3912.386	3774.854	3641.46	31
30	7.007.470							3639-238	30
	9.6273943			9.5607401	4049-434		3772.578	3636.974	29
28	9.6071346	9.5919291	9.5763761	9.5604721	4047.090	, , , -	3770.302	3634.730	28
	9.6068927	9.5910727	9.5701139	9.5602040	4044 759	3905.464	3768.027	3632.487	27
	9.6066417 9.6063907			9.559 9 358 9.55966 7 4	4040.036	3903.158 3903.158	3765.752 3763.478	3630.244	26
25 24	9.6061396	9.5970029	0.5753260	9.5593991	4037.750	3898.548	3761.204		25 24
					i			30-23-779	
23	9.6058883	9.5906461	9.5750643	9,5591305	4035.415	3 ⁸ 9 6.24 1	3758.931	3623.518	23
22	9.0050370	9.5903893	9.5748417	9.5588619	4033.081	3893-940	3756.058 3754.386	3621,278	22
			y 5745389 9.5 7 42761	9.5585932	403°•747	3891 . 636 3889.333	3752.115	13019.030	21
20 19	0.6048824	9.5806180	9.5740131	9.5583444		3887.030	3749-844	3616.799	20 19
18	9.6046308	9.5893608	9.5737502	9.5577864	4023.749	3884.728	8747.574	3614.560 361 2. 322	
-									-
- /.	0.6043790	9.5891034	9.5734870	9.5575173	4021-417	3882-127	3745-304	3610.084	17
	0.6041272	0.5886884	9.5732218 9.5729604	9.5572481	4016-764	3880-127 3877-827	2740.76	3607.847 3605.610	16
	9.6036232	0.5883308	U.5726070	9.5569787 9.5567093	4014.422	3875.527	3738-497	3603·374	15
12	9.6033710	9.5880730	0.5724335	9.5564397	4012-093	1873.278	3736-229	3601-128	13
12	9.6031188	9.5878153	9.5721699	9.5561701	4009.763	3870.929	3733-962	3598-903	12
	-60:044								-
31	9.6028564	9.5075573	9.5719051 9.5716423	9.5559004		3868.631		359 6.6 58	11
10	9.6023615	9.5870412	0.5712784	9.5556306 9.5553606	4002.778	3864.035	3727.162	3592-201	10
8	9-6021090	9.5867830	9.5711144	9.5550906	400.451	3861.739		3589-958	9
. 7	9.6018562	9.5865247	y 5708502		3998.124	3859,443	3722.532	3587.736	7
6	9.6016035	9.5852663	9.5705851	9-5545502	3995.798	3857-147	3720.368	3585.5.34	Ċ
		0.00000		0.45.40==0	1222	284.0	.=.0 -	0.0	
	9.6013506	0.5000078	9.5703217 9.57 0 05 7 3	9.5542798	3993.472	3854.852	3718.175 3715.842	3583.272	4
	0.6008446	9.5854005	9.5697928	9·5540094 9· 5 537388	3038.821	3850.264	3713.580	2578.811	4
3 2	9.6005014	9.5852318	9.5695282	9.5534681	3986.498	3847.070	3711.318	3576.581	3 2
1 1	9.6003382	9.5849728	9.5692635	9.5531973	3984.174	3845.5 7 7	3709.057	3574.352	ī
0,	9.6000849	9.5847139	9.5689987	9.5529265	3981.850	3843.385		3572.124	(
1 1			1		<u>.l</u> ; [Į.	l

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`er. 4	40, 41, 42	43.			and t	beir Loga		1 1 1	L. 43	M
N. I	N. 4 ²	N. 41	N. 42	<u>N. 43</u>	<i> </i>	L. 43	41	9.4096883	9.4201808	0
0	2339.556	1452.904	2508.55				9.38263 3			
-	2241-425	2454.813	2570.49	2588.447	٦.	3094303	9.33 2183	9.4100173	9.4295015	2
2	2212-296	2456.722	2572.44	2690.43	9.	3038272	9.3903561 9.3906935		9.4301424	3
3	2345.168	2458.032	2574.394	269 2 417 2694.403	19.	2705205	9.3910309	9.4110036	9.4304646	4
4	2347.040	2460°543 2462.454	2578.292	2696-390	lo.	27086 6 81	3.3013081	9 41 13 2 20	9.4307827	5
5	2348.913	2461.366		2698.377	9.	3712111	9.3917052	9.4116623	9.4311026	
0							0-2020421	9-1119885	9-4314224	7
7	2352.660	2466.279		2700.364	9.	2710051	9.3920421 9.3923789	9.4123166	9.4317423	8
8	2354.535	2400.192	2504.14	2702.354 2704.343	lo.	2722508	1913927155	9.4120434	9.4320617	9
9	2356-410	2470 .06 2472.020	2588.04	7 27 06.332	19.	2725064	19.3 930520	9.4129/22	9-4323811	10
10 11	2350.200	124/3935	2592.000	0 2708.32 3	19.	2729418	19.3933002	9-4173990	9.4327004	11
12	2362.04	2475.851	2571 95	4 2710-314	19.	3732872	9-3937245	9.4130-73	34730193	
			2402.00	8 7712.305	0	2726223	9.3940604	9.4139546	9-4333385	13
13	2363.918	12/170-05/	2 05.86	3 2714.297	9	3739773	19.3943904	9.4142818	9.4336574	14
14	2305.290	2181.602	250/.01	91-/2007	19.	3743221	19-3947310	9.4140000	9.4339761	16
15	12260-550	< 13403.250	ハーンタメ・//	71-7-0-207	9	.3746668	9.395067	9.4149357 1 9.4152625	9.4342948 9.4346132	
17	2371.430	5 2435.439	2301.73	2 2720.278	9	.3750113	9.395408 9.395738		9.43493 6	17 18
18	2373.31	7 2487.359	19:3.03	9 2722.273	11-		.	•		
-	10000	8 2489.27	2605.64	7 2724.26	9	.3756998	3.396273	5 9.4159155	9.4352497	19
19	100== 00	1 240 1, 200	2607.6 0	5 2726.26	4 19	2760440	9.390408	5 9.4162419	9.4355678	20 21
20 21	2378.96	4 2433.12	1 2009.50	5 2728.26	1 19	.276287	3 9.396743 5 9.397078	3 9.4105081	9.4358857	22
22	12282.84	3 249 5.04		2730.25 2732.25	7 19	.3707310	1 9.397412	5 9.4172199	9.4365212	23
23	1 0.2.	2 2496.96 - 3108 88	01.2013.49	2734-25	3 13	0.3774180	6 9.397747	0 9.4175458		24
24	238461	1	• i		-		_	~ — ——		
-	2386.50	2500.81	3 2617.40	08 2736.25	2 9).37 7 761	8 9.398581	2 9.4178715	9.4371561	25 26
25	434	2502.73	8 2510.3	7112738.25	21 10	9.378105	0 9.39841	34 9.4181970 34 9.4185223		
27	2390.27	10 - 504.00	74 1 40 4 1 1 3	34 2748.25 97 2742.25	-1 1	9·3/944/ 9·3/8793	8 9.39908	1 9.418847	9.4381075	28
28		2000800	6 2625.2	62 2744-29	4	0-270123	419.399410	71 9.419172	5 9.4384243	29
29			, 2627.2	27 2746.29	6	9.379476	0 9.39975	9.419497	9.4387410	30
30		· [_	-	- I. I	2.22.8.0	3 9.40008	36 9.419822	9.4392576	31
3	I 2397.8	30 2512.3	71 2629.1	92 2748.29	9	9.379°E°	6 9 40041	59 9.120147		
3	2 2399.7	2C 2514-29	99 2031.1	58 2750 26 25 2752•26	(61 I	രാദരശേദ	25 19-40074	yy 9·4 2 047 i	4 9.4390904	
3	- 1	2518.1	58 2635.0	2754.27	711	0.280844	LS 19.40103	49 9.420795	8 9.4400066	
3		04 1 25 20.0	031/2/03/		16	9.381186	2 9.4 3141)/ 9-42 112 0	F	
3	6 2407.2	87 25220	19 2639.0	29 2758.28	⁵¹ [9.381527	9 9.40104	9.421444	2 7 4400,00	
1-		. :	2640-0	08 2760-28	18	0.28 860	9.40208	08 9.421768	1 9.4409543	37
3		2525.8	82 2612.6	98 2760.28 68 2762.29	וואכ	0.282210	2612.40241	32 9.422091	9.4412700	
	04 2.0	SC 12527.8	1512014.9	331470139	02	0.284551	1619.40274	53 9.422415		
	2 104148	261 2620.7	40 12646.5	10 2760.3	0	0.28280	2 7 9 •40307	75 9 422739		
	10416	•Ku1253∶°6	831,2048.	3212700.3	191.	9.383 23	35 9·40340 42 9 4·3374	12 9.423385		42
	2 2418.0	557 2533.6	1012050	354 2770.3	[]	9-3035/			I	-
-	1 24:00	2626.6	54 2652.	827 2772.3	39	9.38391.	47 9.40407	27 9.423708		43
	1 34900	125 7 4	10:12054.	501127743	471	0 38135	51 19:40470	43 9.424031		, .
	3424.5	2630.4	12012550.	77512770.3	00	9 38459	53 3.4047	55 9.424354 68 9.424677	77	
	2 2426	210 254 103	304 2658.	75012773.3	721	9.35493	54 9.40506 53 9.40535	78 9.425000	7.	3 47
1 .	47 2428.	149 2543	240 2662	725 2780.3 701 2782.3		0.38561	51 9.4757	37 9.425322	T - 4444	
1 4			-		~				0.444703	1-
-	49 2431.	2547	179 2564	678 2784.4	.11	9.38595	47 9.4060	94 9.425644 01 9.425966		
		2 - A 2540e	11912000	05512/004		9.38629	4x 3.4063 34 9.4067	205 9.42628		
1	51 2435	7-412551.º	U5 01:2 000	03314/000	++ • •	3 38607	12713 4070	509 9.42661	08 9.415675	2 52
1	10430	-4.12551.	01212072	612 2797.4	•/ * 1	10.48731	16 9.4073	310 7.42093	2 ; 9.445983	8 \$3
1	53 2439	465 2556.	855 2674	57.1 3794.	8: 1	9.38769	506 944077	111 9.42725	41 9.446302	4 54
1_					,			409 2.42757	55 9.446615	7 5.5
1	55 2443	370 2558.	827 2676	.551 2795.	500	19.38798	892 944380 278 914383	708 9.42789		
1	56 2445	2500	771112070	.533 2798. .514 2800	7441	3.1856	562 914087	003 9-12821		22 57
1	2440	.08012504	,000 1268 2	.497 2302.	502	3.3893	04491403	298 9.42853	91 9.447559	2 58
1	58 2449 59 2450	000 2504	. 0 00 2684	.479 2004.	502	9.3893	425 7109	3491 9.42886		30 59 38 60
. 1	60 2452	.904 2568	.552 2686	5.46; 1806.	.602	. >•3 896	806 7439	5883 9,42918	308 6 44818	" "
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Deg. 4	9, 48, 47,	46.		A Table	of Natura	l Versed,			
M	L. 49	48 جا .	L. 47	L. 45	N· 49	N. 48	N. 47	N. 46	M
60	9.5529265	9.5364839	9.5196566	9.5024293	3572.124	3439.410	3308.694	3180,016	60
59	9.5526555	9.5362066	9.5193727	9.5021388	3566.896	3437.215	3406.532	3177.889	
58	9.5523845	9.5359293	9.5190889	9.5018480	3567.669	3435.021	3304.371	2175.753	58
57	9.5521132	0.5242742	9.5188048	9.5015572	3505.442	3432.827 3430.633	3302.211	3173.637	5.7
56	9.5515706	9.5350965	9.5182364	9.5009751	3560.989	3428.440	3300.051 3207.802	3171.511	55 55
54	9.5512992	5.5348187	9.517952	9.5006840	3558.764		3295.733	3167.262	54
		0.5345408		2 4000007	2556 520		1002 45		-
53	9.5510275 9.5507559	9.5347400	0.5170070	9.5003927	3556.539 3554•315		3293·573 3291·418	3165.139	53
5 ²	9.5504840	9.5339846	9.5170984	9.4998097	3552.091		3289.251	3160.873	52 51
50	9.5502122	9.5337065	9.5168136		3549.868	3417.481	3287.105	3158.791	50
	9.5499401	9.5334281	9.516528	9.4992263 9 4989345	3547.645		3284.949 3282.794		49
48	9.5496681	77331491	9.5102430	9 49 9 34 7	3545.423	3413.106	3202./94	3154.529	48
47	9.5493958	9.5328711	9.5159585	9.4986425	3543'201		3280.639	3152.409	47
46	9,5491236	9.5325925	9.5156732	9.4983504	3540-980		3278.485	3150.289	46
,	9.5488511	9.5323137	9-5153879	9.4980581 9.4977658	3538•760 353 6 •540		3276.332	3148.170	45
44 43	0.5483050	9.5317558	0.5148168	9,4974733	3534.321	2404.355 3402.169	3274 1/9	3 1 4 3 . 9 3 4	44 43
42	9.5480333	9.5314768	9:5145311	9.4971808	3532-102	3399.984	3269.875	3141.816	42
—				0.406900-	2520 99		<u> </u>		
41	9.5477604 9.5474875	9.5311975	9.5142453	9.496888 <i>1</i> 9.4965953	3529.884 3527.667			3139.700 3137.584	41
40 39	9.5474075	9.5306388	9.5136722	9.4963023	3525.450	3393.430		3135.468	4≏ 39
28	9 5469413	9.5303593	9-5133872	9.4950093	3523.234	3391-24/		3133.353	38
37	9.5466680	9.5300797	9.5131009	9.4957161	3521.018	3389.064	3259.125	3131.239	37
36	9-5463947	9.5298000	9.5128146	9.4954229	3518-802	3386.882	3256.976	3129.124	34
35	9.5461212	9.5295201	9.5125280	9.4951295	3516.587	3384.700	3254.828	3127.012	35
34	9.5458477	9-5292402	9.5122415	9.4948360		3382.519	3252.681	3124.899	34
33	9.5455740	9.5289601	9.5119547	9.4945424	3512.158	3380.339	3250.535	3122.787	33
	9.5453002	9.5283996	9-5116679	9.4942486 9.4939547	3507.732	3378.159 3375 .9 79	3248.389	3120.675	32
30	9.5447524	9.5281195	0.5113010	9.4936607	3505.520	3373.8 0 0	3246 .24 3 3244.098	3118.565 3116.454	30
29	9°54447 ⁸ 3	9-5278387	9.5108068	9.4933666		3371.621 3362 : 443	3241.954	3114-345	29
•	9.5442041	0.5272774	9.5105195	9.4930724 9.4927780	13403.886	3367.260	3239.310 3237.567	3112.236	28
27 26	9.5536554	9.5269966	0.5099446	9.4924836		3365.089	3235.524	3110.127	27 26
25	9.5433809	9.5267156	9.5096569	9.4921890		3362.913	3233.382	3105.911	25
24	9.5431063	9.5264346	9.5093692	9.4918914	3492.258	3360.737	3231.240	3103.805	24
	9.5428315	9.5261524	0.5000813	9.4915995	3490.050	3358.562	3220.000	3101.698	23
22	0.5425568	9.5258722	9.5087934	9.4913046	3487.842	3356.388	3220.959	3099:593	22
21	9.5422818	9-5255908	9.5 085053	9.4910095	3485.635		3224.819	3097:488	21
	9.5420068 9.5417316	9-5253094	9.5082172	9·4907144 9·4904191	3483.428 3481.222		3222.680 3220.541	3095.383	20
19	9.5414564	9.5247461	9.5076404	9.4901237	3479.016		3218.402	3093.279 3091 17 6	18
			~ 						
17	9.5411810	9.5244642	9.5073519	9.4898281	3476.811		3216.266	3089073	17
16	9.5409056 9.540630 0	9.5241823	9.506774	9.4895325 9.4892361	3474.606 3472.402		3214.129 3211.993	3084.869	16
E IÁ	9.5403544	9.5236182	9.5064856	9.4889409	3470.199	3339.013	3209.857	3082.768	14
12	9.5400786	9.5233358	9.5061966	9.4886448	3467.996	3336.844	3 207.722	3080.608	13
12	9-5398027	9-5230535	9.5059075	9.4883488	3465.794	3334-075	3205.587	3078.568	12
11	9.5395267	0.5227710	2.5056182	9.4880525	3463.592	333 2. 507	3203.453	3076.469	11
10	9.5392507	9.5224885	9.5053290	9.4877562	3461.391	3330.336	3201.319	3074·37°	10
	0.5385744	9.5222057	y.5050395	9.4874597	3459-191	33±8.17±	3199.187	3072.272	9
. 8	9*5386982 9*5384217	9.5219230	y.5047500	9.4871631 9.4868663	3456 991 3454.792	3323.84 0	3197.054	3070.175	
7 6	9.5304217	9.521357C	9.5041705	9.4865695	3452.593	3321.674	3192.791	3068.078 3065.982	. 6
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5	9.5378686	9.5210739	9.5038805	9.4862726		3319.509			5
	9:53 7 5919 9:53 73 150	9.5207907	3.502200r	9•4 ⁸ 59 75 5 9.4856783		3317.845 3315.182	3186.531	3061.791 3059.696	4
3 2	9.5373150	9.5202220	9.5030102	9.4853810	3443.802		3184.272	3057.602	2
11 1	05367610	9.5199402	y 5027198	9.4850835	3441.606	3310.856	3182.144	3055.509	1 1
. 0	9.5364839	9.5196566	J·5024293	9.4847860	3439.410	3308.694	3180,016	3053.416	0.
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Deg. 44, 45, 44, 45. Sines and their Logarithus.													
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1	0	2806.602	2928.432	3 4480X08	9-4667093	9.4847860	9.4067093	3053,416	2928.932	.0			
1	I,	2805.623	2930.989		9.4670142	9.4844853	9.4064042	3051,324	2926 876] 1			
1	2			y.4488059		9.4841905	9.4660991	3049.233	2924.82C	2			
ı	3	2812.667	2935.106	2.4491182	9.4676237	9.4838926	9.4557937	3047-142	2922.764	3			
1	4	2814.650	2937-105	2.4494305	9.4679283	9.4 935949	9.4654883	3045.051	2920.709	1 4 1			
1	5	2816.713	2939.224	9 4497426	9.4082320	9.4832964 9.4829681	9.4651828	3042.961 3040.872	2918.655	5			
1	6	2513.737	2941.254	9.4500546	9.4065370	9.4329901	9.4648771	3040-072	2916.602				
ľ		2820.762	20420245	9.4503664	0.4688411	9.4826997	9.4645713	3038.783	2914.549	7			
1	7 8	2822.787	2045.406	9.4506781	0.4601452	9.4824012	9.4642654	3036.595	2912.496	8			
1	9	2824.813	2017.468	9.4509896	9.4604491	9.4821025	9.4639593	3034608	291c-114	9			
1	10	2826.839	2949.531	9.4513011	9.4697536	9.4818038	9.4636531	3032.521	2908.393	10			
1	11	2828-866	2051.594	9.4516123	9.4700566	9.4815049	9.4633468	3030.435	2906.343	11			
	12	2830.894	2953.6 5 8	9.4519236	9-4703602	9.4812059	9.4630404	3028.349	2904.293	12			
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1	13	2832.922	2955.722	9.4522346	9.4700636	9.4809067	9.4627338	30 26. 264	2902.243	13			
ı	14	2834.951	2957.78/	9.4525456	9-4709069	9.4806075	9.4624271	3024.179	2900.194	14.			
- 1	15	2830.901	2959.053	9.4528563	9.4712700	9.4803081	9.4621202 9.4618133	3020.012	2898.146 2896.099	15 16			
.	16	28/11-041	2062.086	0.4524775	0.4718760	9.4797090	9.4615062	3017.929	2894.052	17			
- 1	17 18	2843.073	2066-052	9.4537879	0.4721780	0-4794003	9.4611991	3015.347	2892,005	18			
	10				7 17 - 17 09								
	19	2845-105	2068.121	9.4547982	9.4724815	9.4791094	9.4608917	3013.766	2885.959	19			
- 1	20	2847-137	2970.189	9 4544084	9.4727841	9.4788095	9.4605843	3011.685	2887.914	20			
	21	2849-170	2972.259	9-4547184	9-4730865	9.4785093	9.4602767	3009 604	2885.870	31			
ł	22	2851.204	2974.328	9.4550283	9-4733889	94782091	9.4599611	3007.524	2883.826	22			
- 1	23	2853.238	2976.399	9.4553380	9.4736910	9.4779088	9-4593532	3005.445	2881.782	23			
-1	24	2855.272	2978.469	9.4550470	9.4739931	9.4776083	9.4593532	3003.367	2879.740	24			
ŀ		045000	1080 44	0.2550571	0.4742041	0.4772077	0.4400461	2001.000	00-26-	~			
- 1	25	2857.309	12900.541	0-4562665	0.4745051	9·4773077 9 4770070	9.4590451 9.4587369		2877.697	25 26			
	26	2861 282	2084.686	0.4565758	0.4748084	9.4767062	9.4584285	2007.124	2875.656 2873.615	27			
- 1	27 28					9 4764052	9.4581201	2005.058	2871.574	28			
- [20	2865.457	2088.832	2.4571038	0.4755016	9.4761041	9.4578114		2869.535	29			
	30	2867.406	2990.007	9.4575027	9.4758020	19.4758029	9 4575027	2890.907	2867.496	30			
Ļ	30	50 / 490	1-77-19-7										

The End of the TABLE of Versed Sines, &c.

The

The Use of the Table of Versed SINES.

THE Uses of the Table of Ver/ed Sines are too numerous to be here all treated of: I shall now only shew how by them more easily to solve some of the most useful Cases of Spherical Triangles, which alone is enough to merit their Publication. It has been a long time the Votes and Desires of many able Men in the Mathematicks, that such a Table might be collected and published, but especially of that ingenious and ancient Student Mr. John Collins, who has expressed his desire thereof more than once in his elaborate pieces, and from whom I had the Loan of some Foreign Tables, which did assist much towards the composing of these.

Prop. 1. Two sides of an Oblique Spherical Triangle, with the Angle comprehended, being given, to

find the 3d de.

As the Cube of the Radius: Is to the Restangle of the Sines of the comprehended sides, :: So is the Square of the Sine of half the contained Angle,: To half the Difference of the Versed Sines of the 3d side, And of the Arch of Difference between the two including sides.

Which is thus, double the Log Sine of half the Angle given, and thereto add the Log. Sines of the contained fides, and from the left hand of the Sum, dash out 3 for the Cube of the Radius, so rests the Leg of half the difference of those two Versed Sines.

Log. of half the difference of those two Versed Sines.

Which half difference doubled, and added to the Versed Sine of the difference of the Legs or containing sides, gives the Versed Sine of the side sought.

taining fides, gives the Versed Sine of the fide sought.

Exam. 1. In the Triangle BP L, let

Figure 5. there be given the fide BP 77° 00 l,

the fide PL 40° 00', and the contained Angle BPL 52° 30 l, to find the fide B, L

The Log. Sine 40° 00' 9.8880675

The Log. Sine of 77° 00' 9.9887239

The Log. Sine of 26° 15' _______ 19.2914116
doubled.
The Natural Sine against:: ______ 39.0882030

Is 1227355, whose double is: 2454710

Toe Natural Ver. Sine of 37° 00' 2013645

she dif. of the two sides is

The Natural Sine of 57° 53° 4468355

The Versed Sine of 57° 53 - 4468355 she fide sought.

THE Uses of the Table of Versed Sines are too numberous to be hereall treated of: I shall now only shew how by them more easily to solve some of the Complement of the contained Angle to 180 Degrees, you will find the half difference of the Wessed Sines of the two including sides to be doubled, and subbeen a long time the Votes and Desires of many attracted from the Versed Sine of the said Sum.

But instead of the second Term be taken into the Proportion, the double of the Rectangle of the Sines of the containing sides, that is, if the Log. of the Number 2 be added to the Log. of the other middle Terms, you will have the Log. of the whole difference in the last place 5 having found it, take the Natural Sine that stands against it, and add it to the Natural Versid Sine of the difference of the Legs, and the Sum is the Natural Versed Sine of the side sought.

Exam. 2. Let the two containing fides be 38° 30' and 66° 30', and the containing Angle be 20° 00'.

The log. Sine of 38° 30′ 9.7941456
The log Sine of 66° 30′ 9.5623978
The log. of the Number 2 0.3010300
The log. Sine of 15° 00′ doubled is 18.8259924

The nearest Nat. Sine against 38.8835698
660 30′ Is 77009E
38 30 W bich taken from the Nat. 1170524

Versed Sine of 28° 00′
28 00 There remains 300432

The Nat. Versed Sine of 53° 10.

and the conthe fide B, L.

9.8c80675

9.9887259

19.2914116

39.0882030

2454710

2013645

This Prop. is of great Use to Calculate the Distances of Places on the Earth, according to the Arch of a great Circle by their Long, and Latit.

9.9887259

Declinations and Right Ascensions, or Longitudes and Latitudes given, by means whereof the Altitudes of two Stars, or of the Sun with the Difference of Time or Azimush being observed at any time off the Meridian, the Latitude may be found.

A TABLE of Difference of Latitude and Departure to every Degree and Quarter-Point of the Compass, for the exact working of a Traverse, when the Distance Run exceeds not (the Radius) 10000.

	Lat.	Dep.	ī	Lat.	Dep.		Lat.	Dep.		ı, at.	Dep.	_	Lat.	Lep	טוול.
I Line	ı D	89 D	1	2 D	88 D	_	0 p4	7 P 4	_	3 D	87 D		4 D	86 D	=
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1	1.9997	2.0349	ł	1.9988	0.0698	3	1.9976	0.0981	7d	1.9973	0.1047		1.9951	0.1395	2
2	2.9995	.0524	1	2 9982	0.1047	45	2.9964	0.1472	ęģ.	2.9959	0.1570		2.9927	0.2053	3
3	3.9994	2.0668	1	3.9976	0.130	.£	3.9952	0 1963	=	3.9945	0.2093		3-9903	0.2790	-;
4	1.9992	2.0872		4.5970	0.1745	8m	4.9940	0.2453	min.	4.9931	0.2617			0.3488	5
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15	5.9734	2.6101	·	5.9663		w	69517	0.7317		6.9478	(.8531		6.9319	0 9742	7
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	8.2658		١٣	8.9567	0.8822	5.	8.9507	0.9408		8.9327	1.0968	_	8.9124	1.2536	c
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	3	-	2.8246	1.0107	۾	<u> </u>	1.0201		2.8017	1.0751		2 7816	1.1238		2.7716	0.76 ₅₄	3	3
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	56 7 8		5,5230			5.4813	2.3337	1	4-5315 5,4678	2.1131. 2.5357	œ	1 51 99 5•4239	2.1378	4111	4.4940	2.1919		5
١	7		5-1435	2.7351		6,3948	2.5472		6,3442	2.95×3	بر طور طور	6.3279	2.7929	min.	5.3928	2,6302 3.0686	1	6 7
1	8		1.3640	3.1258		7.3084	3.2539		7,2505	3.3809	ğ	7-2315	3.4201	7	7.1904	3.0080		8
	2	-	1.2445 1)ep	3.5165	_	8.2219		-	3.1459	3.8036	2	8.1359	3.848c	-	8.0891	3-9453		2
ļ			A.9	1 1 30		Dep.	Lat	1	Dep.	1.st.	L	Den	Lat		Pen.	Lat		

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A Table of Difference Latitude and Departure to every Degree, &c.																
	Lat 1	Dep			Dep.	1	Lat	Dep.	1	Lat.	Dep.	<u>B</u>	Lat.	Dep.		ē
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4	3.5640 1.4550	1.8160			8779 3474		3-5277 4.4096	2.3570	2	3·4y85 4·373I	1.9392 2.4240		3.164 4.3301	2'5000		
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8	7.1280	3.6319			3•7558	∞ '	7.0554	3 7712 4 2426		6.997 0 7.8716	3.8785		6.9282 7.7942	4 .500 0	П	8
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30 deg.	6.8618				3.6052 4.1203		5.9 363 6.7 843	3.7091 4.2394		5.8707 6.7094	3.8125 4.3571	33		3.8890 4.4446	*	8
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_3	3.152			3.1086	2.5173		3.0920	2.5376	E E	3.0642	2.5712	1	3.0188	1.9082 2.6242	l	3
4 5	3.940	1 3.0783		3.8857	3.1466		3.8650	3-1720	15	3.8302	3.2139		3.7736	3.2803	1	4 5
6	4.728	1 3.6940		4.66	3.7759	8 22	4.6381	3.8064		4.5002			4.5283	3.9363	•	5 6
5 6 7 8	5.516			5.4 4 00 6.2172	4.4052 5.0346	39 deg	5.4111 6.1841	4.4408 5.075 I	so deg.	5.3623 6.1284	4.4995 5.1423	1	5.2830 6.0377	4 5924		7 8
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5	3.715	7 3,3457		3.7 048	3.3578	15	3.0500	3 4100 4.0920		3.5967	3·4733 4.1679		3.5355	3.5355		5 6
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la	Dep	Lat	1	Dep	Lat	1	Dep.	Lat.		Dep	Lat	Ĺ	Dep	Lat		
																The

The Nature, Construction, and Use of the TABLE of Difference of Latitude and Departure.

HE Table of Difference of Latitude and | From the dif. of Lat. answering to 800 Departure, is designed principally for the more exact and expeditious working of Traverses, but may be applied to the Solution of the several Cases of Plane Sailing.

It shews by Inspection the Alteration of the Latitude and Departure to every Degree, Point, and Quarter point of the Compass, for any Distance not exceeding 10000, and may be made to serve for. any greater Distance, provided it be first divided into Parts, not exceeding the Limits of the Table.

In the uprermost Rank are placed the Courses and their Complements from one Degree to 45, including the Points, Half-points, and Quarter points, which are plac'd in their properColumns between their next greatest and least Degree, and in the right and Left hand Columns are the Miles of Distance, and in the common Area the corresponding Difference of Latitude and Departure, and which are found from the Course and Distance by the Subsequent Proportion.

For the Difference of Latitude.

As the Radius, to the Sine of the Course 1.2.3. & Deg. sois the Distance run 1.2.3. & c. Miles the Difference of Latitude.

For the Departure.

As the Radius to the Co-sine of the Course 1. 2.3. &c Degrees, so is the Distance run 1. 2. 3. er. Miles to the Departure

By the Tables thus formed, no more is requisite to find the Alteration of Latitude and Departure; but to feek for the Course in the Head, and the Distance in the Side, and the Requisites in the Common Area,

A few Examples will render it very plain.

Suppose a Ship sails N.N.E. 4 Easterly 7 Miles. and the Difference of Latitude and Departure be required.

In the Column under Latitude and Departure, I feek for 2p. 3 (because the distance of the Rumb N.N.E. & E. is 2 p. from the Meridian) and in the Right hand Column for the Distance 7 Miles, and in the common Area I find 6,0041 for the Difference of Latitude, and 3.5987 for the Departure.

If the Course had been the same, and the Distance 70, it is but removing the Prick one place backwarder in the former Answers, and the thing is done So that in this Case the Difference of Latitude would be 60 041, that is 60 Miles and 704 of a Mile, and the Departure 35 987, that is 35 Miles and 38 of a Mile. In like manner, If the Distance had been 700 Miles, and the Course the same, then the Difference of Latitude would be 600.41, and the Departure 359.87.

If the Distance proposed does not confist of any Number of 10's, as suppose 753, then the proper Requifites may be thus found.

Take the dif. of Lat. answering to 700 600.41

85.77

And, say, as 100 to 53, so is 8577 the Difference 45.46, which therefore added to the Difference 45.46. rence of Latitude 600.41, answering to the Distance 700, gives 645 87, the Disterence of Latitude to the Distance 753, and Course as before, N. N. E. & E. after the same manner, and it will be as 100 to 53. So is 51.41 to 272.17, which added to 35987, gives 387.117, the Departure requi-

But the Difference of Lat. and Departure in the former Case, may be more readily found by divi ding the Distance into such Parts as may be found in the Table, and adding up the several Differences of Latitude and Departure in one Sum to find the Total: Thus,

Suppose the Course as before NNE. E. and Distance 753.

The dift of Lat. answering to 700 is , to 42.886 50 is 3 is July 3-573 The Dif. of Lat. answering to 753

After the same manner may be found,

The Departure belonging to 700 359.87 to 1.54Z

The same Difference of Latitude and Departure answering to 75, 5, by placing the Prick one place forwarder, that is, integal of 645.869, for the Difference of Latitude take 64.5869, and for the Departure, instead of 387.187: 38.7117, also by placing it two places forwarder, they lerve for the 1401 by placing of it three places forwarder

In like manner, If the Distance had been any Number greater than 1000, as suppose 86753, by diving itias in the former Example, into its component Parts 50000. 6000, 700. 50, 3, and summing up each particular difference of Latitude and Departure into one Sum, the proper Difference of Latitude and Departure will be had.

Keeping the Distance 753, as before the same difference of Latitude 645.87, and the Departure 387.117 will serve for any Course that makes an Angle with the Meridian of 23, as the NNW. 2W the SSE 3 E. or the SSW. 3 W. and the difference of Latitude in this Case would be the Departure also, the Departure would become the difference of Latitude for any Course that makes

an Angle of 5 p $\frac{1}{4}$ with the Meridian

As suppose a Ship Sails 753 Miles either NE. by E. $\frac{1}{4}$ E or N. W. by W. $\frac{1}{4}$ W. or S. E. by E. $\frac{1}{4}$ E. or S. W. by W. $\frac{1}{4}$ W. or

The Nature, Construction, and Use of the Table of Difference, &c. 120

ENEN. Se. the proper difference of Latitude the West Column; which done, add up the Coto each, or any of these will be the same with the lumns of difference of Latitude and departure, and Departure in the former Example 387.117, and the Departure in this 645.869, the same with the Alteration of the Latitude in the former

If the Course cannot be found exactly in the Table, then the difference between the differences Latitude and Departure, proper to the whole Degrees next above and below the Course must be tound, and the Proportional Increment investigated, as in the following Example.

Suppose a Ship sails North 38° 20' westerly 609 Then against 6 and under 38°, the dif. Lat is 472.81 Against 6, and under 39, the differ Lat. is 466.29

The difference to the Alteration of 1 deg. is 6.52

Therefore as 60 to 30, so is 652 to 3.26, which therefore substracted from 47.281, leaves 469.55 the difference of Latitude.

In like manner for the Departure.

Against 6, and under 380 the departure is 369 40 Against 6, and under 39 the Departure is 377.59.

which therefore added to 369.40, gives 373.495, for the departure required.

A Traverse

Admit a Ship from the Latitude of 48° 30' N. Sails NNW half W. 79 miles, then N W half W. 86, then N by E 2 E. 108, then N 48° East, 112, then E. 5° southerly 70, then East 50° Norther-

Having set down the Courses and Distances, as in the following Table, proceed to find out the dif-ference of Latitude and Departure for each (accorference of Latitude and Departure for each (accor ding to the directions already given) in the Table tion of Traveries, it would be needless to give an placing each in its proper Column, viz. If the Example of each particular Case in Plane-Sailing, Course be Northerly the difference of Latitude especially since be that is but moderately apprehenmust be placed in the North Column, if Southerly, five of what has been said, will find it not difficult in the South Column, if Easterly, the departure to do it himself, by the Directions given in Vol. 1. must be put in the East Column, if Westerly, in under the words Plain Sailing.

substract the lesser difference of Latitude from the greater, as also the leffer departure from the greater, and the Remainders will be the difference of that Latitude and departure the Ship has made.

The TABLE.

Courses	Dist	Dif.o	f Lat	Departure		
,		N	S.	E	w	
NNW, ‡W NW ‡W	79 86	69.67	1	_	37.24	
N by E 3 E	108	54.56 101.68	 	36.39	66.47	
N 48° É E 55°		74.94	6.10	83.23 69.73		
E 50° N North	8 ₄ 48	64.35 48.00		53.99		
	~		_			
	.	413.20 6.10		243•34 103.71	103.71	
Nort	 107.10		139.63	F inc		
	9		- 1		L. ing	

Hence it appears, that the Ship has departed from her first Meridian, 139.63 miles East rly, and Therefore as 60' to 30', so is 819 to 4.095, altered her Latitude 407.1 miles, which reduced hich therefore added to 369.40, gives 373.495, into degrees and minutes, makes 6° 47', which therefore added to the Latitude she came from 48° 30', because she sail'd from a North Latitude Northerly makes 55° 17', the Latitude the Ship is come into.

Entering the Table with the Difference of Latitude, thus deduced, viz. 407.01, and the Departure 139.63, I find the Course is greater than 15°, and less than 19, and the Distance greater than 400.00, and less than 500.00 and after working ly 84, then North 48; And it be required to find 400.00, and less than 500.00 and after working the Latitude the Ship is in, her direct Course and the necessary Proportion (by the reverse of the Method mode use of the first th Distance, and how much she has departed from thou made use of in the former Examples) the Course out North 18° 56' E. or E. by N. 70° 41' East down the Course and Distances, as

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Dormant.	N.	Vairy.
E.	Naiant.	Copy.
Embattelled.	Naissant.	Verdoy.
Enalyron.	Nebulofe.	Verry.
Endorfed.	Nombril Point.	Vert.
Endorse.	0.	Voided.
Engrailed.	Ogreffes.	Voider.
Entoyre.	Or.	W.
Enurny.	Ordinaries.	Waved.
Erafed.	Orle.	Wreath.
	P.	W.Caui.
Ermine.		
Erminees.	Pale.	•
Escutcheon of Pretence.	Pall.	·
Escutcheon.	Pallet.	l
F.	Paly.	<u> </u>
Field.	Paly-bendy.	ARCHI
	Paffant.	<i>F'</i>
Fer-du-Mouline.		
Folic.	Patee.	
	■	•

D.

E.

ARCHITECTURE.

A Bacus.
Abreuroirs.
Acroteriæ.

Adz.
Alcove.
Amphiproffyle.

Amphitheatre.
Anaglyptick Art.

Anchors.
Annulets.
Antæ.

Antes. Anticks. Antique.

Antipagments.
Apertions.
Apophyge.
Aquæduct.

Arches, Architecture. Architrave. Areostyle, Ashlar.

Astragal. Attick.

Back and Bottom Nails.

Ballister.
Ballustrade.
Bandelet.
Bank.
Barbican.

Base. Basil. Basilica. Bass-Relies.

Bailon.
Batten.

Battlements. Bend.

Beam.
Bearer.
Bed-moulding.

Binding Joists.
Boulting.
Brace.
Brads.

Breft. Sommers.

Bricks.
Building.
Butments.

Cantilivers.
Capital.
Carcafe.
Cantoures.
Cariatides.
Carfcade.

Carlcade. Casting of Drapery.

Cathetus.
Cavette.
Chamber-Beam.
Chambranle.

Channel of the Ionick.

Chapiters.

Chapitrals.
Cima.
Cimatium.
Colonnade.

Column. Compartition. Conge.

Console. Corbett.

Corinthian Order.

Cornich. Coronæ. Couch.

Coving Cornish. Crown Post. Culvertail.

Cupulo.
Cymatium.
Cyncture.

Dentils. Dipteron. Dome.

Dome.
Dorick Order.
Dormant Free.

Dormer. Double Aspect. Doucile.

Dove-tailing.
Dragon-Beams.
Drip.

Drip.
Drops.
Dye.
Dypteron.

Echinus.
Embrasure.
Epistyle.
Eves Lath.
Eye.

Face.
Fascia's.
Fastigium.
Fillet.
Flutes.
Flat-Crown.
Flyers.
Foliage.
Fornication.

Furring.
Furring.
Fufarole.
Fufh.

G. Gable End of a House.

Gain.
Girders.
Gorge.
Gothick

Gothick Manner. Grand Gasto. Ground Plates. Grotesque Work. Grouppe.

Gulte. Guttæ.

Hances. Hatching.

Heads. Height of the Eye in Perspective.

Ħ

Hexastyle.
Hips.
Hip-Roof.
Hypethre.
Hypethron.
Hyperthyron.
Hypetrachelion.

Ichnography. Imposts. Ionick Order. Isles.

Intercolumniation. Inter-Columns.

Larmiers.
Layman.
Ledgers.
Line of the Section.
Lift.

Listel.
Local Colours.
Lutheran Windows.
M.

Manner.
Maffes.
Membretto.
Metopa.
Mitre.
Model.
Modillions.
Module.
Monotryglyph.

Morefque & Wo Morifco & Wo Mortife. Mofaick Work.

Mofaick Work.
Munnions.
Mutule.
N.

Nave. Newel. Niche. Nucleus.

Obelisk.
Octoftyle.
Order.
Ordonance.
Orle.
Ornaments.
Orthography.

P.
Painting.
Pallier.
Pallification.
Paradigrammatice.
Parafta.

Pargetting.
Pedestal.
Peers.
Periptore.
Periok Order.
Perspective.

e. Lineal. Areal. Practical. Speculative.

Piazza's.

Piazza's. Piedouche. Pied-droit. Pilæ. Pillar. Pillasters. Pitch. Plancere. Plane. Plastice. Plat-form. Plinth. Plot-bund. Portico. Portrails. Prick Posts. Principal Posts. Prints. Profile. Projecture. Pronaos. Pseudoppiteron. Prycholtyle. Pulvinata. Punchins. Purlings. Q. Quarters. Quirk. Quoins. R. Rafters. Raising Pieces. Raked Table. Reason. Relief. Relievo. Reson. Repose. Riglet. Roman Order. Sapheta. Scamilli Impares. Scheme. Scenography. Scribing. Scotia. Scratch-Work. Scrowles. Sculpture. Section of a Building. Sell. Skene. Suffito. Stucco. Stereobata. Stercography. Stiles. Striæ. Striges. Strutt. Stylobata. Stylobaton.

Stylobatum.

Projecting.

Raked.

Symmetry.

Systyle.

Table.

Tænia.

Taille Douce. Tailloir. Talon. Taffels. Teint. Tenon. Tetrastyle. Thorus. Tige. Tondino. Tore. Tornice. Torus. Trabeation. Transom. Triglyph. Trimmers. Tringle. Trochyle. Trophy. Tuscan Order. Work. Tympan. V۵ Vessels. Vivo. Union. Voluta Water Table. Winding-Stairs.

Zacco. Zocco. Zocle. Zoperus.

History, Antient Customs, &c.

A Bacot.
Abacy. Abbat. Aborigines. Academy. Acholite. Acre of Land. Advent. Alba Firma. Ale-Tafter. Almoner. Alnager. Alterage. Amabyr. Amnesty. Amphora. Anachronism. Angaria. Angel. Angild. Annals. Annalia. Anniversary. Annualia. Anomaly. Archives. Arch-Deacon. Arch-Presbyter.

Arietum Levatio.

Banneret:
Bedrip.
Befantine.
Biffextile.
Board Half-Peny.
Bordarii.
Bordlode.
Bordlands.
Bofphorus.
Bouge.
Bowche.
Bredewyte.

C. Cade. Calcage: Caract. Carke. Carucate. Castellorum Operation Cert Money. Chamberlain, Chauntry Chorepiscopi. Chrism. Chrisom. Chyrographum. Clerk. Clove. Cocket. Coins. Confervator. Continent. Coronare Filios. Corfned. Cosmography. Custumarius. D.

Damnum.
Dane-Gelt.
Danger.
Day-Work of Land.
Deciners.
Decinniers.
Defend.
Denarii de Charitate.
Denarius.
Dom-Boc.
Domefday-Book.
Drenches.
Drenges.
Drengage.
E.

Dakir.

Ealdermen. Earl. Earth. Ebdomadarius. Ember-Week. Ember. Embring-Days. Englecery. Epact. Epocha. Episcopaleonus. Episcopalia. Esterling. Estovers. Evenings. Exaction Secular. Exhibition.

Faggot.

Hoke-Day.

1	F.
Faggot.	
Faldage.	
Faldfey.	
Fardles of Land	•
Farding.	
Fardingdeal.	
Fasting-Men.	
Feodary.	•
Firme.	
Florens.	
Folk-Land. Folk-Mote.	
Foot-Geld.	
Formella.	. '
Fortingles.	
Fossatorum Ope	eratio.
Fot Mell	
Framgild.	
Frezen Zone.	
	3 .
Gabel.	
Gainagium.	
Gallehalpens.	
Gar-sume.	
Gavel-Bread.	
Cester.	
Earth. Mede.	
Rep.	
Gavelling Men.	
Geld.	,
Gemote.	•
General.	
Gentleman.	•
Geographical M	liles.
Geography.	
George Noble.	71
Globe.	
Grass-hearth. Gross.	
Gule of August.	
	H . 1
Habentes Homi	nes.
Hadbote.	
Hail-work Folk	•
Hallage.	, - i - ;
Haly-Mote.	
Hambling.	
Ham-soken.	
Hand-borow.	
Hand-Grith. Hand-Habend.	
Hang-wite.	7
Hanse.	1
Harbinger.	• • • •
Harmitage.	
Haro.	
Haw.	
Headborow.	
Head-Pence.	···
Hebber-Thef.	•
Hebdomadius.	
Hedagium. Herald.	
Heraid. Hermitorium.	• \
Hey-bote.	• •
Hidage. Hide of Land.	
Hoblers.	
Hogen-hine.	. •
• .	

Homagium reddere. Honour. Courts. Honorary Service. Hospitallers. Hundredi Secta. Huse bote. Hyde-Land. I. Icenild. Ich Dien. Ikenild-Street. Lacerta. Lachrymatories. Lada. Lafords Wich. Laga. Lage Dayum. Lagen. Lagon. Lash-Bote. Lammas-Day. Land-Box. Land-Cheap. Land-Gable. Landirecta. Lanoniger. Lashlite. Last. Lastage. Lathe Latta. Lath-Reeve. Latrocinium. Laurets. Lawes. Lea of Yarn. Left-Silver. Levant.: Libera. Libertas Ecclefiastica. Librata Terra. Ligula. Lourgulary. Lundress. Lushburg. Lushborrow. \$ Lyff-Yeld. M. Macegrief. Mag-bote. Maile. Man-bote. Мавса. Manuali Beneficia. Manumission. Manu-opera. Manu-pastus. Manu-pes. Manus. Marcheta Mulierum. Marches. Maritagium habere. Mark. Marquess. Martyrology Matricula. Maund.

Metonick Year. Menfals. Mensalia. Merchan Lage. Merchetum. Metteshap. Mint. Mitred Abbots. Mitta. Molmutan Blaws. Moniers. Month. Monfoons. Moors. Mother Tongues. Moveable Feasts. Multa. Multura Episcopi. Multones Auri. Natural. Nones. Nycthemeron. Noble. Norroy. Nummata Terræ. O. Obedientia. Obit. Obituary. Oblata. Oblatæ. Oblationes Altarii. Funerales. Obolus. Ocean. Octaves. Oeconomicus. Offertorium. Olympyad. Ora. Ordeal. Originalia. Outfangthef. Pack of Wood. Palls. Pannage. Pavimenta Teffellata. Peny. Peny-Weight. Peninsula. Penfa. Pentecostalia. Perch. Period. Pefa. Pesage. Peter-Pence. Picage. Pleas of the Sword. Plebania. Plebanus. Plebiscitum. Plow-Land. Pocket of Wool. Poleine. Pollards. Port Reeve. Portiforium. .

Port-

Port-mannimote.
Port-mote.
Pork-foken.
Pound.
Precaria.
Preceptory.
Presbyterium.
Prepofitus Villz.
Preft-Money.
Profation Money.
Prodes Hommes.
Promontory.
Providence.
Provifor.

Quadragata Terræ.
Quadragefimals.
Quadrans.
Quadranta Terræ.
Quæfta.
Quarentine.
Quafi-modo-Sunday.
Quinquagefima.
Quintal.
Quinque Portus.

R. Rachat. Radechinistors. Radman. Repe Towel. Reasonable Aid. Rebellum. Recluse. Recta Prisa Regis. Rectatio. Rectitudo. Red Book of the Exchequer. Reeve. Refectory Referendary. Regarders of the Forest. Regius Profesior. Rehabiliation. Relief. Rents of Assize. Reposition of the Forest.

Rep-Silver.

Rome-Scut-

Runcinus.

Scutage

Rod-Knights.

Rural Deans.

Reve.

S. Sac. Saka. Saccus cum Brochia. Sack of Wool. Sagibaro. Salt Silver. Salute. Salus. Sanctuary. Sapler. Scarage. Scaragium. Scata. Sceppe. Schar-peny, Schire-mote. Schire-wyte.

Seme. Summa. Seneschal. Septuagesima. Sexar. Sheriff-Tooth. Shilling. Smoak-Ferthings Soveraign. Stable. Stand. Stallage. Starr. Star Chamber. Sterling Money. Synodales Testes Synodale Instrumentum.

Taberders. Tabitors. Tallage. Taxers. Terræ. Testamentales. Tessellata Pavimenta. Testons. Thane. Theave. Thrimſa. Tod of Wool. Trentels. Tricennalia. Trigentalia. Trinoda-necessitas.

Terra.

Tronage.
Tumbrell.
Troy-Weight.

Valvasor.
Vavasor.
Virgate.
Uncuth.
Urbicariæ Regiones.
Utsangthef.

Waga. Wardage. Wardecom. Ward-peny. Staff. Warrecta Terra. Warrectum. Waffel-Bowl. Water Ordeal. Watling-Street. Weald. Weight. Wedbedrip. Weights. Wherlicots. Whitson-Farthings. Wold.

Y. Years-Day. Mind. Yeoman.

L1111

ANATOMT.

A.

A Bdomen. Abductor Indicis. Oculi. Minimi digiti.

Pollicis.
Pollicis pedis.
Minimi digiti pedis.

Abductores.
Abducent Muscles.
Abomasus.
Abortion.
Abortive.
Acantha.
Acceleratores Urinæ.
Accessorius Willessi.
Acetabulum.
Acini-formis Tunica.
Acromion.
Acromphalon.
Acros.
Adducent Muscles.

Adductores.
Adductor Oculi.
Pollicis.

Pollicis pedis. Aden. Adeps. Adiposa Membrana. Vena.

Adipofi Ductus.
Adnata Tunica.
Aisteterium.
Albuginea Oculi.
Testis.

Album Oculi.
Aiopecy.
Alphus.
Aliformes Mufculi.
Proceffus.

Allantois. Allantoides. Almonds of the Ears. Alopex. Alvearium. Amnion. Amnios. Amphilestroides. Amphibranchia. Amphidæum. Anastomosis. Anatomy. Anchile. Anchyle. Ancon. Anconæus. Ancyroides. Andratomy. Androgyne. Androgynus.
Animal Secretion. Animation. Aniscalptor. Annuates Musculi.

Annular Cartilage.

Annularis Processus.

Annular Protuberance.

Antagonista.
Anthelix.

An Alphabetical, 1 ND E X

Anthelix. Antiasi Antiades. Anticardium. Antiperistaltick. Antithenar. Antitragus. Anus. Aorta. Aperiens Palpebra reclus. Aponeurosis. Apophysis. Appendicula Vermi-formis Aquæductus. Aqualiculus. Aqueous Humour. Aranea Tunica. Arcualia Osfa. Areola Papillaris. Arteria Bronchialis. Venosa. Vena. Artery. Arthrodia. Arthrofis. Articulation. Arytænoideus. Assimilation. Attollens Auriculam. Attollens Oculos. Narcs. Attollentes Musculi. Auditory Nerve. Auriculæ Cordis. Axillar Veins. Arteries. Axis. Azugos. Azygos. Balanus. Barrel. Bafilare Os. Bafilica Vena-Basio Glossum. Rafis. Bathmis. Belenoides. Bibitorius Mufculus. Biceps. Bile. Biventer. Bladder. Blood. Bones. Brachiæus Externus. Internus. Brain. Breafts. Bregma. Breve Vas. Brevis. Bronchus. Buccinator. Cæcum Intestinum. Calamus Scriptorius. Calcaneus. Calcis. Calva.

Canal. Canini Dentes. Caninus, Canthus. Capillary Vessels. Capreolaria Vasa. Capfulæ Communis. Atrabilariæ. Seminales. Cardiacus Plexus. Carina. Caro. Carotides. Carpus. Cartilage. Cartilago Enfiformis. Carunculæ. Myrtiformes. Oculi. Papillares. Cataclida. Cava Vena. Cellulæ Intestini. Cephalica. Cephalopharyngæi. Cercis. Cerea. Cerebellum. Cerebrum. Cervical Arteries. Cerumina. Chalaza. Choana. Choledochus Ductus. Chondrofyndesmus. Chorda Membrana. Tympani. Chorion. Chorides. Chrystalline Humour of Eye. Chyle. Chylification. Chyli Receptaculum. Chymus. Cicatricula. Cilia. Ciliare Ligamentum. Cion. Circulation of the Blood. Circumagentis Musculi. Claudent Muscles. Caviculæ. Cleidion. Clinoides. Clitoris. Clypeal Cartilage. Coat. Coccygis Os. Coccygæus. Coccyx. Cochlea. Cœcum Intestinum. Ocelia. Cœliack Artery. Cœlum. Colliciæ. Collum minus Uteri. Colon. Columnæ Cordis.

Columna Nafi. Oris. Columetta. Commissiona Crassionia Nervis æmula. Common Receptacle of the Chyle. Common Senfory. Complexus. Constion. Concha. Condyli. Condylomia. Congeneres Musculi. Conglobate. Conglomerate. Conjunctiva Tunica. Conniventes Glandulz. Conoides. Constrictor. Constrictores. Cor. Coracobrachialia. Coracoides. Cornea Tunica Oculi. Corona. Cornua Uteri. Cornicularis Processus. Coronale Os. Coronalis Sutura. Coronaria Vasa. Corone. Corpora Carnofa. Olivaria. Pyramidalia. Striata. Corpus Callofum. Glandulofum. Corrugant Muscles. Corrugator Supercilii. Coryphe. the Coftæ. Cotyle. Cotyledon. Coryledones. Coxæ Os. Coxendix. Cranium. Cremaster. Cribrofum Os. Cribrum Benedictum. Cricoarytenoides. Cricoides. Cricothyroides. Christa Galli. Cristæ. Crotaphick Artery. Cruor. Crura Medulla Oblongets. Crural Artery. Vein. Crureus. Crus. Chrystalline Humour. Chrystalloides Tunica. Cubical Artery, Cubi-forme. Cubit. Cubitæus Internus. Externus. Cubital Muscles. Cuboides_

Cuboides. Enarthrofis. Focile. Fodina. Cucullaris. Encathis. Fœtus. Cunei-forme Os. Encephalos. Offa. Folliculus Fellis. Encranlum. Foramen Lacrymale: Cutaneous Glands, Enfi-formis Cartilago. Vessels. Enthrodes. Arteriæ duræ. Cuticle. Epar. Matris Lacerum. Ephelæum. Ephiptium. Cutis. Fornix. Fovea Cordis. Cyema. Cymbæ-forme Os. Epidermis. Frænulum. Cynodesmus. Epigastrick Artery. Frænum. Cynodentes. Epigastrium. Frontalis. Cytticæ Gemelli. Frontis Os. Epiglottis. Epigonasis. Funiculus Intestinorum. Cytlis. Choledous. Epiphysis. Furcale Os. Epiplois Dextra. D. Furcella. Sinistra, Furcula Superior. Dartos. Postica. Dartus. Declivis (Musculus.) Epiploon. G. Deferentia. Epifion. Gall. Episphæria. Deltoides. Bladder. Depressor. Epistrophæus: Galactophori. Deprimens, Gargareon. Eromis. Erectores Penis. Auricularum, Gasterochnemium. Labii inferioris. Ethmoidalis. Gasterochnemius Externas. Labiorum, Ethmoides. Internus: Eustachian Tube. Oculi. Gastero Epiploica: Exanastomosis. Humilis. Gemellus. Extensor Carpi Radialis. Detrusor Urinæ. Gemini: Extensor Carpi Ulnaris. Diærefis. Geminous Arteries: Indicis, Gena Mala. Diaphragm. Primi Internodii. Diaphrattontes. Generation. Secundi Internodii. Genioglossum. Diaitole. Digastrick Muscles. Minimi Digiti. Geniohyoideus. Digastricus. Pollicis Pedis brevis. Genitura. longus. Digestion. Ginglimus. Digitorum Tensor. Externus Aurisa Glacialis Humor: Glandulæ Miliares. Extravasated. Dilatation. Dilatores Alarum. Eye. Myrtiformes, Diploe. -Lids. Sebaceæ. Distimilar Parts. Glands: Dodecadactylon. Fallopian Tubes: Glandula Pinealis: Dorsi Longissimus (Musculus.) Falx. Pituitaria. Farciminalis Tunica. Glandulæ Lumbares. Dorfum. Odoriferæ. Ductus Adiposi. Fascia Lata. Alimentalis. Fascialis Musculus, Renales. Bilarius. Glandulosum Corpus. Fatt. Glandulofa Tunica. Choledocus. Fauces. Glassy Humour of the Eye.
Tunick of the Eye. Femoreus. Epaticus. Chyliferus. Femur. Fenestra Ovalis. Glene. Cysticus, Rotunda. Glenoides. Pancreaticus. Fibra Auris. Globulus Nafi. Roriferus. Fibræ. Glottis. Salivales. Glutæi. Fibres. Thoracicus. Fibula. Glutæus Major. Umbilicalis. Filaments. Minor. I Irinarius. Medius. Fistula Lacrymalis. Duodenum. Pulmonis. Glutia. Dura Mater. Glutos. E. Sacra. Urinaria. Gracilis. Ear. Flesh. Graphoides. Elevator Labii Inferioris. Superioris. Flexor Carpi Radialis. Gula. Gullet. Labiorum. Ulnaris. Oculi. Secundi Internodii digiti. Gurgulio. Elevatores. Tertii Internodii. Guttal Cartilage. Elythroides. Pollicis pedis longus. Guts. Primi & Secundi Ossis Embryotomy. Pollicis. Hæmorrhoidal Veins: Emissary of a Gland. Focile Majus. Emporium. Heart. Emulgents. Minus. Helix. L1111 2 Hcpar. Emunctories.

U	I I acquerra	Mombrone Thinania
Hepar.	Lacertus.	Membrana Urinaria.
Hepatica Vena.	Lacrymæ.	Membranolus.
Hircus.	Lacrymale Punctum.	Memory.
Hirquus.	Lacunæ.	Mendofa Sutura.
Homoplata.	Lamdoides.	Meninges.
Humerus.	Laminæ.	Meninx.
Humilis.	Latissimus Dorsi.	Mesaraick Veins.
Humours of the Eye.	Leno.	Mesaræum.
Hyaloides.	Lentiform Prominences.	Mesentery.
Hydatoides.	Lepidoides.	Mesenterick Arteries.
	Levatores Ani.	Meso-Colon,
Hymen.		
Hyoides.	Lien.	Meso-Pleuri.
Hyothyroides.	Ligamentum.	Meta-Carpus.
Hyperoon.	Ciliare.	Meta-Condyli.
Hypochondrium.	Linea Alba.	Meta-Pedium,
Hypogastrick Artery.	Lingua.	Meta-Tarfus.
	Lingua.	
Hypogastrium.	Lingualis.	Miliares Glandulæ.
Hypofiloides.	Liquidum Nervorum.	Mitrales Glandulæ.
Hypotenar.	Liver.	Mola Gena.
Hypozoma.	Lobe.	Molares Dentes.
TTC11-15	L <u>-</u>	B
Hypofiloglossus.	Longanon.	Monocolum.
_ I.	Longissimus Pollicis,	Morfus Diaboli.
Janitor.	Femoris.	Motorii Musculi Oculi.
Jecur.	Longus (Musculus).	Mucilaginous Glands.
Uterinum.	Cubiti,	Mucro Cordis
		_
Jejunum Intestinum.	Radii,	Mucronatum Os.
Ile.	Tarfi,	Mufcle.
Ilium.	Colli.	Musculus Stapidis.
Ilia.	Lophia.	Musculus Tubz Novus Vai-
Iliac Vessels.	Lumbales Musculi.	
		falvæ,
Iliacus Internus.	Lumbaris Vena.	Auriculæ Anterior,
Ilium Os.	Artefia.	Tragi,
Incifivus.	Lumbrical Mufcles.	Ante-Tragius.
Incifores Dentes:	Lumbricales.	Muscle Vein.
Incifivi.	Lumbriculi Pedis.	Musculus Nauticus.
2		
Incus.	Lungs.	Myelos.
Indicator.	Luxator Extermis.	Myloglossum.
Indignatorius.	Lympha.	Mylohoideus.
Indurantia.	Lymphatick Vessels.	Myodes Platifma.
Indusium.	Lymphæducts.	Myologia.
Infimus Venter.	M.	Myrach.
Infra-Spinatus.	Malleolus Pedis.	Myrinx.
Infundibulum Cerebri.	Mamma.	N.
Renum.	Mammary Vessels.	Nafalis Musculus.
_	Mammæ-formes Processus.	Nafi Os.
Inguen.	·	
Inium.	Mandibula.	Nates Cerebri.
Inominata Tunica.	Marrow.	Navicularo Os.
Offa.	Marfupialis.	Nerve.
Inominatus Humor.	Masseters.	Neurology,
Inosculation.	Mastication.	
		Neurotomy.
Intercostal Arteries,	Mastoidei.	Nictitans Membrana.
Veffels.	Mater Dura.	Nothæ Costæ.
Intercostales Externi,	Tenuis.	Nucha.
Interni.	Matrix.	Nuckianæ Glandulæ.
Interforaminium.	Maxilla.	Nutrition.
Internus Auris,		
	Superior,	Nymphæ.
Interoffei Manus.	Inferior.	Nymphatomy.
Pedis.	Meatus Auditorius.	0.
Interscapularia.	Urinarius.	Obelæ.
Interspinales Colli.	Mediana Vena.	Obliquus (Musculus.)
Intestinales.		
	Mediastina.	Inferior,
Involucrum Cordis.	Medius Venter.	Superior,
Ischias Major,	Medulla Cerebri,	Major,
Minor.	Oblongata,	Acclivis,
Ischium.		Ascendens.
Ithmoidea Offa.	Spinalis,	2
	Offium.	Auris.
Jugale Os.	Medullary Vein.	Obturator Externus,
Jugular Veins.	Membrana.	Internus.
Jugulum. K.	Musculor. Communis	Occipitalis.
Kidneys.	Adiposa,	
L.		Occipitis Os.
	Carnofa,	Occip. Frontal.
Labyrinth,	Nictitans.	Oculus. Oculo-
•		
		•

Oculorum Motores. Odoniodes. Oesophagus. Oesophagæus. Olecranon. Olfactory Nerves. Olivaria Corpora. Omentum. Omoplata. Omphalmicus. Optick Nerve. Orbicular Bone. Orbicularis. Palpebra. Orbiter Externus. Internus. Organical Part. Organs. Os. Os Calcis. Mali. Unguis. Occipitri. Palari. Sphænoides. Tineæ. Ofcula. Ossa Parietalia. Tempora. Offeologia. Ovalis Fenestra Ovaria. Oviductus. Palati Os. Palato Salpingæus. Staphyllinus. Palatum. Palmaris Brevis, & Musculus. **Pa**lpebræ. Pancreas. Panniculus Carnofus. Papilla. Papillæ Intestinorum. Papillarum Processus. Paramesus. Parastatæ. Parencephalos. Parenchymata. Parenchymous. Parietal Bones. Paristmia. Parotides. Parvagum. Parvum & Crassum. Pathetick Nerves. Pectineus. Pectinis Os. Pectoralis. Pedium. Pecten. Pelvis. Aurium. Cerebri. Renum. Perforans Musculus. Digitorum. Pedum. Perforatus. Pedes.

15

Pericardium. Pericranium. Periophthalmium. Perinæum. Periodus Sanguinis. Periostium. Peristaltick Motion. Peristaphylinus. Peristerna. Periffonzum. Peritonæum. Perona. Peronæus Primus. Secundus. Petrofum Os. Phalanx. Pharyngetrum. Pharynx. Phyltrum. Phrenes. Phrenetick Veins. Phrenick Vessels. Pia Mater. Pinealis Glandulæ. Pinguedo. Pinna Auris. Pituitaria Glandula. Placenta Uterina. Plantaris. Planta Pedis. Pleura. Plexus Choroides. Nervosus. Reticularis. Pneumonica Vena. Pomum Adami. Pons Cerebri. Poplitæa. Poplitæus. Porta Vena. Porus Bilarius. Primæ Viæ. Pronator Radii Quadratus. Teres. Proftatæ. Proftomia. Psoas Magnus. Parvus. Pterigo Palatinus. Pharingæus.

Parvus.
Pterigo Palatinus.
Pharingæus.
Staphilinus Externus.
Internus.
Pterigium.
Pterygoideus.
Pteryftaphilini.

Pulmonaria Arteria.
Vena.
Pulmonary Veffels.
Pulmones.
Punctum Lachrymale.
Saliens.
Pupilla.

Pubis Os.

Puppis Vena. Pylorus. Pyramidales. Pyramidalis Mufculus. Pyri-formis Mufculus.

Quadratus Femoris. Genæ.

Quadratus Lumborum. Quadragemini. Rabdoides. Rachitæ. Radiales. Ramifications. Ramus Anterior. Posterior. Ranula. Ranulares. Rapha. Rasetta. Receptaculum Chyli. Receptacle of the Chyle. Recti Minores. Rectum Intestinum Rectus internus Major. Minor. Rectus Lateralis. Major.

Major.
Musculus,
Palebræ Superioris.
Recurrent Nerves.
Regio.
Renal Artery.
Respiration.
Rete Mirabile.
Reticularis Plexus.
Reticulum.
Retiformis Plexus.
Tunics.

Retina.
Retractores Alarum.
Retrahens Auriculam.
Right Muscles of the Head.
Rinæus.
Roriferus Ductus.
Rostriformes Procedus.
Rotator Femoris Major.

Rotator Femoris Major. Minor. Rotula. Rotundus.

Sec. 155

. Que. i

Sacculus Chyliferus. Cordis.

Saccus.
Sacer Musculus.
Sacro Lumbalis.
Sacrum Os.
Sagittalis Sutura.
Saliva.
Salvatella.
Sanguification.
Saphæna.
Sartorius.
Scaleni.
Scapha.
Scaphoides.
Scapularis Externus.
Internus.

Internus.
Sclerotica Tunica.
Scrobiculus Cordis.
Scutiforme Os.
Scutum.
Scyphos.
Seeing.
Secretion.
Secunding.
Segmoidales.

Sella Equina. 🗀

Somi-

Semi-Lunares Valvulæ.	Supercilium.	Tunica Vaginalis.	
Semi-Membranofus.	Supersætation.	Tympanum.	
Spinatus.	Superscapularis.	v.	
Tendinosus.	Supinator Radii Brevis.	Vaginalis Gulæ.	
Senforium Commune.	Longue.	Tunica.	
Septum Cordis.	Supra-Spinatus.	Valvula Major.	
Lucidum.	' Sca pularis.	Valves.	
Transversum.	Sura.	Valvulæ Conniventes.	
	Suralis.	Varicosum Corpus.	
Serratus Anticus Major	Sural Vein.		
Minor.		Vas breve. Vasa.	
Posticus Inferior.	Suspensor Testiculi.		
Superior.	Suspensorium.	Deferentia.	
Serum.	Sutura.	Lactea.	• • •
Sesamoidea Ossa.	Offium	Lymphatica	
Sigmeides.	Sweet-Bread.	Vasti Musculi.	
Similar Parts.	Synarthrofis.	Vastus	
Sinciput.	Synchondrofis.	Vastus Externus.	
Sinus.	Syneurofis.	Internus.	
Meningium.	Syntenosis.	Vein.	•
Offium.	Synthesis.	Venæ Lacteæ.	
Skeleton.	Synymenfis.	Lymphaticæ.	
Skin.	Systole.	Pneumonicæ.	
Soleus.	T _r	Præputii.	
Speculum Lucidum.	Talus.	Venter Infimus.	
Oculi.	Tarius.	Venters.	i
<u> </u>	Teeth.	Ventres.	, ,
Spermatick Vessels.			'
Sphænoidalis Sutura.	Temporalis Musc.	Ventricle.	•
Sphænoides.	Temporalia Offe.	Ventriculus.	•
Sphænopalatious.	Tenar.	Ventriculi Cerebri.	
Sphænopharingæus.	Tendon.	Cordis.	42
Sphenois.	'Tenfors.	Vermiculares.	- 1
Shænopterigo-Palatinus.	Terebrum.	Vermiformis Processus.	
Spagitides.	Teres Major.	Vertebræ.	
Sphincter.	Minor.	Vertex.	
Ani. The state of	Terfor.	Vesica Urinaria.	- ; -
.' Gulæ.	Teiles.	Veficula Follis.	
Veficæ.	Cerebri.	Veficulæ Seminales.	
Spina Dorfi.	Tetragonus.	Vespertilionum Alæ.	, r • '
Spinalis Collé.	Thalami Opticorum Nervorum.		
Medulla.	Thenor.	Vibriffæ.	
Spine.	Thorax.	Viscera.	
Spirits Animal.	Throng	Vision.	
Spleen.	Thymus.		•
	Thyroarytænoides.	Visorious Nervus.	
Splenetick Artesy.	Thyreodæte.	Vitrious Humours.	
Spongeoidea Vala.	Thyreostaphilinus.	Tunicle.	
Spuriæ.	Thyroideæ Gland.	Ulna.	
Stapes.	Tibia.	Umbelical Region.	
Sternohyoides. zwlucheld	Tibialis Anticus.	Veffels-	
Sternothyroides.	Posticus.	Umbelicus.	٠.
Sternum Os.	Tonfillæ.	Unguis.	
Stomach	Torcular Herophili.	Vocal Nerves.	
Stomachus.	Trachæa.	Volvulus.	
Stylo-Chondro-Hoidæus.	Tragus.	Vomer.	•
Styloceratohyoide Size it	Transversalis Colti.	Urachus.	
Styloeides.	Musculus.	Ureter.	
Stylogloffum.	Pedis.	Urethra.	
Stylohyoideus.	Penis.	Uterus.	•
Stylopharingæus.	Sutura.	Uva.	
Subcartilagineum.	Trapezius.	Uvea Membrana.	
Subclavian Vallala II		_	
Subclavian Vessels, II de la financia		Uvigena.	•
Subclavius.	Triangularis.	Uvula.	•
Subcutaneus. Applied Tapital of a	Triceps.	W.	
Sublimis.	Tricuspides.	Watry Humour.	
Sublinguales) orreil	Trigeminum.	X.	
Subscapularisnit. 12	Trochanter.	Xyphoides.	
Substantia Corticalis20	Trochlea.	Z.	
Succenturiati Renes.		Zootomy,	
Succus Pancreaticusc.		Zugomaticus.	
Sudor.	Tubæ Fallopianæ.	Zygoma.	
	1	Zygomaticum.	
Sunarthrofis		. 16	
Superbus Musculus, salabidates	Tubuli Lactiferi.		

Painting and Sculpture.

Ltitude of the Eye. Attitudes. Afpect Double.

Bass-Relief.

Buft.

Cariatides. Carnation. Cartons. Cement. Claro-Obscuro. Compartment. Contours. Casting of Drapery.

Composition.

Contrast. Crayons.

D.

Decorum. Degradation. Dessein.

Defign. Distemper.

Drapery. Distance of the Eye. Double Aspect.

Etching. Eafil-Pieces. Extremities.

Fresco.

F.

Grand Gusto. Grotesque Work. Grouppe. H.

Hatching. Height of the Eye.

Ichnography.

Layman. Line of the Section in Perspective.

Local Colours.

Manner. Maffes.

Moresque Work.

Ordonnance. Orthographick View,

Perspective.

Aerial. Lineal. Practical. Speculative.

R.

Plane. Plastice. Pourtraits. Prints. Profile.

Relief.

Repose.

Scenography. Symmetry. Sculpture. Stucco.

Taille Douce. Teint.

U.

Union.

Agriculture and Hortulane Terms.

A Blactation.
Ablaqueation. Abnodation. Agriculture. Ampelite. Averruncation.

Carbunculation.

Opticks and Perspective.

A Cidental Point.
Altitude of the Eye. Anacamptick#374 Anaclaticks. Angle of Incidence. Reflection. Refraction. Refracted.

Aperture. Apparent Place. Axis.

Broken Ray Burning Glass.

Camera Obscura. Catacausticks; or, Causticks by Restection. Catadioptrical Telescopes Cathetus.

of Incidence. of Reflection.

Caustick Curves. Common Axis... Ray.

Concave Glaffes. Cone of Rays. Confused Vision. Converging Rays.

Darkned Room. Tent. Dioptricks. Direct Ray Distance of the Eye, Distinct Base.

Vision.

Divergence Point. Diverging Rays. Double Aspect.

Faint Vision. Focus.

Virtual.

Front.

Line.

Height of the Eye. Horopter.

Horizontal Line.

Ichnography. Image. Incidence. Incident Point.

Ray. Inclination of a Ray.

Inflection.

Lens. Line Horizontal. Geometrical. Terrestrial. of the Front. Vertical. of the Station. Objective.

Section. Locus Apparens.

M. Magick Lantern. Mean Axis. Meniscus Glass. Microscope.

Object Glass. Obscura Camera. Opticks. Optick-Glasses.

Pyramid. Triangle.

Parallel Rays. Pencil of Rays. Plane of the Horopter. Reflection.

Refraction. Geometrical. Vertical.

Perspective. Lineal.

Aerial. Practical. Speculative.

Plane of the Projection. Point of Concourfe. Divergence.

Incidence. Principal. Pole of a Glass.

Presbitæ. Principal Ray. Point.

Prism.

Radiation. Rainbow. Ray Common.

Ray Direct
of Incidence.
Reflection.
Rays Convergent.
Divergent.
Parallel.
Reflection.
Reflected Ray.
Reflecting Telescope.
Refraction.
Refraction from the Perpendicular.
to the Perpendicular.

Scenography.
Sciography.
Sciopticks.
Senfible Point.
Species Vifibiles.
Scenographick Projection.
Similar Light.

Table.

Projecting. Raked. Telescopes.

Aerial.
Reflecting.

Vertex of a Glass.
Vertical Line.
Plane.
Virtual Focus.
Visible Species.
Vision.
Visual Angle.
Point.
Rays.

Botany, Natural History, and Meteorology, &c.

A Byss. Acidulæ. Acrospire. Æther. Æschynomenous Plants. Air. Ala. Alabastrum. Animals. Animalcula. Antheræ. Anthology. Apetalous. Apices. Aquatick. Aquatile. Arboreous. Arborist. Attire. Aurelia. Arista. Afparagus. Asperifoliate. Atmosphere.

Auripigmentum. Aurora Borealis. Awme.

Bacciferous.
Baccivorus Creature.
Birds.
Bivalves.

Blood.
Botanicks.
Botanist.
Botany.

Bulbous Roots. Bulbus.

C.

Calyx.
Capillamenta.
Capillary Plants.
Capitatæ Plantæ.
Capitulum.
Capræ Saltantes.
Capreolus.
Capreolatæ Plantæ.
Capfula Seminalis.
Capfulate Plants.
Carbunculation.
Carina.

Caro.
Castor and Pollux.
Cauliferous Herbs.
Caulis.

Chryfalis. Chives. Cirri. Claspers.

Compounded Flower. Coniferous Plants. Convolution.

Cor.

Corniculate Plants. Corpuscles. Croci.

Corymbus.
Corymbiferous.
Culmiferous.
Culmus.
Currents.

Damps in Mines.
Deciduous Flowers.
Defluvium.

Deterration.

Cyma.

Diaphaneity.
Difform Flowers.
Digitatum Folium,
Discus.
Diffimilar Leaves.

Dorfiparous Plants.
Draco-Volans.

Earth.
Earthquakes.
Ebbing and Flowing of the Sea.
Echinus.
Empalement.
Epiphyllospermous.
Equinus Barbatus.

Equivocal Generation.
F.

of Confishent Bodies. Faculz.

Ferrugineous Waters. Fishes.

Flower of a Plant.

Fluores.

Flux and Reflux of the Sea.

Foliation. Folliculus.

Formed Stones. Fossils.

Frontatum.
Frumentaceous.
Fundus Plantæ.

Gemma.
Geniculum.
Glans.
Gramineous Herbs.
Gregarious Birds.

Hail. Halo. Halo's. Harmitan. Hippeus.

Hurrican. Hypophyllospermous.

I.

L.

Ice.
Ignis Fatuus.
Imbricated.
Inoculation.
Imperfect Flowers.
Plants.

Infitio. Internodium. Iuba.

Juba. Julus.

Lampadias.
Lead.
Legumen.
Legumenous Plants.
Legumenous Plants.

Levant.
Load-stone.
Loculamentum.
Lonchites.
Locustæ.

M Maculæ Solares. Magnet

Magnet.
Magnetifm.
Malleolus.
Marchafite.
Medulla, Cor.
of a Plant.

Mercury. Metals and Minerals. Meteors.

Mimofæ Plantæ. Monopetalous Flower. Monfoons.

Monioons. Mudfuckers.

Natural History. Necydalus. Nervus. Nitre.

Nucamentum. Nuciferous Plants. Nucleus.

Nympha.

0.

Tornado.

0. Oculus. Officulum. Ý. Panicula. Papillionacéous Flower. Pappose. Pappus. Paraselene. Parasytical Plants. Parhelii. Particles. Pediculus. Pennata Folia. Pelagiæ. Petala. Petrifaction. Pinnata Folia. Piscivorous Animals. Pithias. · Plants. Plume. Polypetalous. Polypermæ. Pomiserous Plants. Herbs. Pruniferous Trees. Pryan Tin. Pudicæ Plantæ. Quadrupeds. R. Radicle. Rambow. Rays of Light. Roots of Plants. Rubigo. Sagitta. Salt. Scapus. Semets. Seminal Leaves. Sensitive Plants. Siliqua. Silver. Snow. Solidity. Sound. Spots in the Sun. Springs and Fountains. Stalactitæ. Stamina. Stamineous. Stellatæ Plantæ. Stile. Stolonesis. Stones. Strata. Striæ. Style. Suffrutex. Sulphur. T.

T. Tergifœtus.
Tetrapetalous.
Thermæ.
Thunder.
Thyrfus.
Tides.

Trees. Trunk Roots. Tuber. Tuberous. Tubuli Vermiculares. Turriones. Vasculiferous. Vegetables. Vermiculation. Verticillate Plants. Vern. Villi. Virgæ. Vitriol. Viviparous Animals. Umbeliferous Plants. Uniform Flowers. Water. Waves of the Sea. Wind.

L A W, Common, Civil, and Canon.

X.

Xiphias.

A. Bactors. Abalienation. Abate. Abator. Abrochment. Abdication. Abdicere. Abettors. Abeyance. Abisherifing. Abjuration. Abolition. Abrenunciation. Abridgment. Abrogate. Abrogation. Absolute. Abstention. Abuttals. Accedas ad Curiam, (a Writ.) Vice-Comitem, (a Writ)

Acceptance. Acceptilation. Accessary. Account. Accord. Acquietandis Plægiis. Acquietantia de Shiris & Hundredis. Acquittal. Acquittance. Action. of a Writ. upon the Cafe. mix'd. upon the Statute. Personal.

Mmmmm

Real.

Action Popular. Civil. Penal. Prejudicial. Ancestral. Actor Actuary. Addictio in Diem. Addiction. Addition. Ad Inquirendum, (a Writ.) Adjournment. Adjudge. Ad Jura Regis. Admeasurement. Administration. Administrator. Admittendo Clerico. Admittendo in Socium. Ad quod Damnum. Adramire. Ad Terminum qui præteriit. Ad Ventrem inspiciendum. Adventitia Bona. Advocates. Advocatione Decimarum. Advowell. Advower. Advowfon. Ætate Probanda, (a Writ.) Affeerors. Affiance. Affidavit. Afforest. Affray. Affrayment. Age. Ageprier. Agent and Patient. Aggreffor. Agild. Agist. Agisters. Agistors. Agnation. Aid. Aile. Alba Firma. Ale-Taster. Alien. Alienation. Alimony. Allegiance. Allegation. Allegiare. Aller fans jour. Alliance. Allocatione facienda. Allocation. Allodial. Allodium. Alterage. Alto & Baffo. Ambi-dexter. Amendment.

Amercement.

Amnesty.

Amortife.

Royal.

Ampli-

Amittere Legem Terræ.

Ampliation. Amy. Anarchy. Ancestor. Anchorage. Ancient Demesne. Angaria. Angild. Anhelote. Aniente. Anjour and Waste. Annates. Anniented. Annua Pensione. Annualia. Annuity. Anoviance. Antinomy. Apertura Feudi. Apostata Capiendo. Apostare Leges. Appeal. Appellant. Appellor. Appendants. Appertinences. Apportum. Apportionment. Apposale. Apprendre. Appropriare Communem. Honorem. Appropriation. Approvement. Approvers. Appurtenances. Arbitrator. Arbitrement. Arch Deacon. Arches. Arraign. Array. Arrentation. Arrearages. Arrest. Arrestandis. Arrestando. Arrested. Affart. Assault. Affets. Affign in Deed. } Assisa cadere. Magna. Judicium. Nocumentis. Continuando. Proroganda. de Mort d'Ancestor. Affize. d'Arrain Presentment. of Novel Diffeizin. of the Forest. of Bread and Beer. Affociation. Affoyle. Affumpfit. Attachimenta Bonorum. de Spinis & Bosco. Attachments.

Attachment of Privilege. Attachment Foreign. Attachment of Forest. Attaindure. Attaint. Attainted. Attainder by Process. Attendant. Attornato Faciendo sel Recipiendo. Attornment. Attorney. Audience Court. Averdupois. Audiendo & Terminando. Audita Querela. Auditor. Auditors. of the Receipts. Ave. Aventure. Average. Averiis captis in Withernam. Averment. Averpeny. Augmentation. Aumone. Avowec. Avowry. Authenticks. Auxilium Curiæ. Auxiliun ad Filium Militem faciendum. Auxilium petere. Regis. Vice-Comitum. Award. Ayde. Ayel. Aysiamenta. Baccerind Thief. Badger. Baile. Bailement. Bailiff. Bailiff Errant.
Bailiff Franchises. Bailiwick. Ballivo Amovendo. Ban. Bank. Bankrupt. Bannimus Bargain. Baron. Baron and Femme. Barr. Barlee. Barretor. Barretry. Barristers. Baffe Fee. Court. Tenure. Bafilical Constitutions. Batchellors. Battel. Battery.

Beadle.

Beaupleaders.

Benefices. Beneficio primo Eccles. habend. Benevolentia. Beneficiarum Cedendarum A&. Beneficium Divisoris. Ordinis. Besaile. Bigamy. Bilanciis Deferendis. Bilinguis. Bill. of Store. of Sufferance. Billa vera. Bishop. Black-mail. Black Rod. Blench. Blood-wit. Bloody-Hand. Bock-land. Bona Notabilia. Patria. Bonis non Amovendis. Bord-Lands. Borough English. Borow, Borough, or Burgh. Borow-Head. Bottomry. Bredwite.. Breve. Breve Perquirere. Breve Recto. Brevibus & Rotulis liberandis Bribers. Brief. Broad Half-peny. Brugbote. Bulse. Burbreach. Burgage. Burg-bote. : Burg-mote. Burglary. By-Laws. Canon Common Law. Civil Cape Parvum. Cape ad Valentiam. Capias. Capias conductos ad Profisc. Capias Profine. ad satisfaciend. Utlegatum. in Withernam de Homine. de Averiis. Caption. Cafu confimili. Casu proviso. Catallis Captis. Reddendis. Causa Matrimonii Prelocuti. Causam nobis fignifices. Cautione admittenda. Cepi Corpus. Certificate. Certification of Assize. of Novel Disseisin. de Recogn. Stapul. Certifi-

Clerk of the Treasury. Ceritficando de Recognitione. Court-Baron. of the Warrants, Certiorari. Court of Chivalry. Cocker. Cessavit. Delegates. Code. Ceffion. Codicil. Peculiars. Ceffionary. Requests.
Courtely of England. Cofferer. Ceffor. Cognatione. Challenge. Couteulaugh. Cognisance. Champarty. Cranage. Cognisee. Champion of the King. Cui ante Divortium. Cognifor. Chancellor of the Exchequer. in Vita. Chancellor of the Dutchy of Cognitionibus mittendis. Culprit. Collateral Affurance. Lancaster. Curator. Collatione facta uni post mor-Chance-Medly. tem alterius. Curia. avisare vult. Collatione Heremitagii. Chapel. claudenda. Collation. Chapters. Collegiate Churches. Collusion. Curfitor. Charta Pardonationi se Defend. Custode admittendo & amovendo. Charta Pardonationis Utlegariz. Colour of Office. Custodes Libertatis Angliz au-Charter. thoritate Parliamenti. Com-Barons. Party Commendam. Cultom. Land. Cuttoms and Services. Common. Chartis Reddendis. Custos Brevium. Common-Pleas. Chafe-Wax. Placitorum Coronæ. Communi Custodia. Chattels. Rotulorum. Communia Placita non tenenda. Chicanry. Spiritualium. in Soccaria. Chirographer. Temporalium.
Cutter of the Tallies. Compertorium. Chivalry. Computo. Church-Scot. Circuity of Action. Damage. Clear. Conjuratione. Civil. Confistory. Clamea admittenda in itinere Feafant. Conspiratione. Darreine. Constable. Atturnatum. Dative Tutelago. Constat. Clarigatio. Conflitum. Day. Claulum fregit. Days in Bank. Clerico admittendo. Constitutions. capto per Stat. Mercat. convicto Commiss. Eccles. Dean. Consultation. Rural. Contentment. De bene effe. infra Sacros Ordines, &c. Continual Claim. Debenture. Continuando Transgress. Debito. Contraband Goods. Controuler. Debet & Solet. of the Acts. Contract. Contra formam Collationis. Decem Tales. of Assize. Contra formam Feoffamenti. Deceptione. of the Cheque. Decies tantum. of the Crown. Contramandatio Placiti. Decimis folvendis. of the Crown in Chancery. Contributione facienda. Declaration. of the Errors in the King's-Controller. Decree. Bench. Conventio. Decretals. of the Errors in the Excheq. Convention. De Deoneranda pro Rato Porof the Errors in the Common Convict. tionis. Pleas Convocation. Dedi. of the Effoigns. Conusant. Dedimus Potestatem. of the Extracts. Coperceners. Copia Libelli deliberando. of the Hanaper. De Essendo quietum de Tolonio. of the Juries.
of the Wardrobe. Copy-hold. Deemsters. Coram non Judice. De Expensis Militum. of the King's Silver. of the Market. Corodio habendo. Default. Coronatore eligende. Defeizance. Marshal of the King's Coroner. Defendant. Corporation. House. Corpus cum Causa. Defendemus. of the Nichils. Deforcement. of the Outlawries. Corrector of the Staple. Deforceor. of the Parliament. Cosenage. Degrading. of the Peace. Coshering. of the Pell. Deforciatio. Covenants. Delegates. of the Petty-Bag. Covertures. of the Pipe. Delegation. Covine. Demain. of the Pleas: Counts. of the Privy-Seal. Counter-Plea. Demeine. Counting-House. Demandant. of Sewers. Demise. County-Court. of the Signet. Democracy. Mmmmm &

Democracy. Demurrer. Denizen. Deodand. Departer. Departure. Departure in Despight of the Court. Deposition. Depositum. Del rivation. De quibus sur Dissei. Deraigne. Derelicts. Descent. De son Tort Demesne. Desporick. Debt or Debts. Detinue. Devastaverint Bons Testatoris. Devenerunt. Diem claufit extremum. Dies Dacue. Dieu son Act. Digest. Dilapidation. Dimissory Letters. Disability. Discent. Disclaimer. Discontinuance,
Discontinuance of Possession of Plea or Process. Difmes. Disparage in. Dispanpered. Dispensation. Diffeisin. Disseisin upon Disseisin, Distress. Diftringuas. Divorce. Docket. Dominicum. Domo reparanda. Dote assignanda. Dote unde nihil habet. Double Plea. Quarrel. Dower. Ducestecum. Dum fuit intra atatom. Duin fuit non compos mentis. Duplex Querela. Duplicate. Duresse. E. Easements. Edict. Ejectione Custodiæ. firmæ. Eire or Eyre. Election de Clerk. Elopement. Emancipation. Emblements. Embraceur. Embracery. Emendatio.

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Emendatio Panis & Cerevifiz. Empannel. Emparlance. Emphyteusis. Emphyteata. Emptio, Venditio. Encheson. Encroachment. Enditement. Endorfe. Endowment. Enfranchise. Enquest. Entayle. Enterpleder. Entire Tenancy. Entrusion. de Gard. Entry. Entry ad Communem Legem. Entry ad Terminum qui præte-Entry causa Matrimonii prælocuti. Entry in Casu Proviso. Consimili. Entry sine assensu Capitali, Enure. Eques Auratus. Equity. Errant. Error. Escambio. Escape. Escheat. Escheator. Esnecy. Espicurnantia. Esplees. Essendi Quietum. Effoigne. Estrangers. Estray. Estreat. Estoppel. Estrepe. Etate probanda. Eviction. Examiners in Chancery. Exception. Exchange. Excbequer. Excommunicato Capiendo.
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R

A Dit.

Æquilibrium.

Agogice.

Ajutage.

Allay.

Alloy.

Altitude of Motion.

Allum Works.

A Manfa.

Ancony.

Anemo scope.

Automata.

Axis in Peritrochio.

B. Ballance. Ralliffa: Beats. Bevel. Blood-red Heat. Bloom. Blowing Houses. Bonny. Brass. Brazing. Buddle. Burning Glasses. Calculation of Clock-work. Case-hardning. Casualty. Catches. Centre. of Gravity. of Magnitude. of Oscillation. Cerus: Charge of Lead. Chemice. Chimes. Chiffels. Chronometron Perpendiculum. Chronoscope. Clamped. Clasp Nails. Clench Nails. Clepfydra. Clocks. Clock-work. Cock water. Cochlea. Coffer. Colaptice: Coldsheir Iron. Compass Dyal. Conatus recedendi a Centro motûs. Concave Glasses. Contrate Wheel. Coperas. Corvus. Count Wheel. Crown Wheel. Creeping Index. Cross-Staff. Cruifing Mill. Crootes. Cuneus. Ď. Daze. Deads. Declinatories. Detents.
Detent Wheel. Diadrome. Dialling in Mines. Dilving. Direction. Dog Nails Embolus. Engine. Engyscope.

Equable Motions.

I

Equilibrium. Estay Hatch. Etching. P. Fast Country Feather Edg'd. Finery. Flame-heat. Flat pointed Nails. Flight. Flying Pinion. Fodder of Lead. Foliate. Foliation. Founday. Fore-Staff. Frame. Friction. Furnace Almond. of Affay. G. Gage. Gard du Cord. Garde de Caut. Glass Drops. Gnomon. Gold Mines. Greut. Grove. Guard-cock. Gun-powder. H. Half Bloom. Hatch. Helioscopes. Hem. Heterodromus. Homodromus. Hook Pins. Hoop Wheel: Hydraulicks. Hydraulo-pneumatical Engines. Hydrostatical Ballance. Hygrometer. Hygroscope. Statical. Hypomochlion Jamb. Jett d'Eau. Inclined Planes. Incombustible Cloth. Latches. Launder. Lead. Lead Nails. Leaves of a Pinion in a Watch. Level. Lever. Lifting Pieces. Load. Lock Wheel. Loop. Lot or Lothe. M. Machine. Map. Maxy Mechanick Powers. Mechanicks. Nnnnn 2

Medals. Medalions. Mesolabium. Microcousticks. Microphones. Micrometer. Microscope. Mine Dial. Minium. Mosaick Work. Movement. Mount Egg. Nealing of Steel. Neper's Bones. Needle. −G Ogec. Ogive. Parting. País. Pendulum. Pendulums Royal. Peritrochium. Perpendiculum Chronometrum. Pevets. Pinion of Report. Pin-Wheel. Plane. of Gravity. Plasm. Pneumatick Engine. Polyacousticks. Polyscopes. Polyspastum.
Portable Barometer. Port Nails. Potans. Potence. Powers. Mechanick. Projectiles (their Laws.) Proplasm. Protracting Pin. Protractor. Printing.
Pryan Tin. Pulley. Quadran t. Triangular. Quadrat. Quantity of Motion. Quarters in a Clock: Quick-Silver. Ratch. Ratchet. Red-feer. Reducing Scale. Refining. Reflecting Telescope: Regulator. Rhabdology. Rim in a Watch. Ring Dyal. Rota Aristotelica. Satellite Instrument. Scales. Sinic Sector.

Sinical Quadrant. Siphon Sliding Rules. Spring Arbor.
Spring Box. Square. Statical Baroscope. Staticks. Station-Staff. Steel. Stentrophonick Tube. Striking Wheel. Succula. Suculæ. Surveying Scale. Swing Wheel. Syphon. Syringe.

Terella.
Tin Work.
Theodolite.
Thermofcope.
Three-legg'd Staff.
Tongue-Grafting.
Train on a Watch.
Training a Load.
Travelling Barometer.
Trocholicks.
Turns.
Tympanum.

Verditer.
VibrationVitriol.
Uniform Motion.
W.
Warning Wheel.

Vectis.

Warning Wheel.
Watch-Work.
Way-wifer.
Weed.
Wedge.
Weight of feveral Bodies.
Weights of divers Countries.
Welding-heat.
Wheel Barometer.
White-heat.
Wind Gun.

CONICKS.

A.
A Bicista.
Acute Angled Section of a Cone.
Ambigenal Hyperbola.
Anguineal Hyperbola.
Applicates.
Applicate Ordinates.
Aiymptotes.
Axis.
Conjugatus.
B.

Base. Binocle. Centre of an Ellipsis.
of an Hyperbola.
Centre of Gravity of an Hyperbola.
Ellipsis.

Circumscrib'd Hyperbola.
Cone.
Conick Sections.
Conjugate Diameter.
of the Hyperbola.

of the Hyperbola.
Conoid.
Elliptical.
Parabolical.
Hyperbolical.

Contrary legg'd Hyperbola.
Converging Hyperbola.
Cruciform Hyperbola.
Cubical Paraboloid.
Cufpidated Hyperbola.

D.
Deficient Hyperbola.
Diameter of a Conick Section.
Conjugate.

Diverging Hyperbola.

Double Point.

E. Eccentricity Double. Ellipsis.

Equilateral Hyperbola.

Figure.
Focus of an Ellipfis.
Hyperbola.
Parabola.
H

Helicoid Parabola.
Hyperbola.
Hyperbolick Space.
Hyperbolicum Acutum.
Hyperbolical Cylindroid.
Hyperboli-form Figures.

Intactæ.
Intercepted Axis.

L.
Latus Rectum.
Primarium.
Tranfverfum.
N.

Nedared Hyperbola.

Opposite Cones. Sections.

Ordinate. Figures. P.

Parabola.
Paraboloids.
Parabolick Spiral.
Pyramido

Pyramidoid.
Cuneus.
Conoid.
Spindle.
Primarium Latus.
Punctated Hyperbola.

Pure Hyperbola.
Q.
Quadratrix of the Hyperbola.

R. Rectangular Section of a Cone.

Redundant Hyperbola.

Scalenous Cone. Section Conick. Sectiones Sequentes. Semi-cubical Paraboloid. Similar Sections.

Sub-contrary Position.

Section of a Cone.

Sub-Normal. Sub-Tangent.

Tangent of a Conick Section. Tranverse Axis.

Truncated Cone. Trident.

DIALLING.

A.

Quator.
Almacanters.
Altitude.
Amplitude.
Ana-Lemma.
Aftronomical Hours.
Azimuth.
B.
Babylenife Hours.
C.
Centre of a Dial.

Colures.
D.

Declination of a Plane.
the Sun.
Declinatory.

Declining Dials.
Dial.
Dialling.
Dial Planes.
Direct Dials.
Double Horizontal Dial.

Ecliptick.
Equinoctial Colure.
Dial.
Etect Declining Dials.
Planes.

Etect Direct Planes.

East and West Planes. North or South Planes.

F. Furniture of Dials. G.

Gnomon.
Gnomonicks,
H.

Height of the Pole. Horizon.

Horizontal Dials. Line.

Hour Circles.
Lines.

Hour of the Day.

Incli-

I. Inclination of a Plane. Jewish Hours. Latitude of a Place. Line Horizontal. Horary. Substilar. Equinoctial. Longitude. Meridian Line. N. Nadir. Nodus. O. Oblique Plane. Parallels of Altitude. Latitude. Declination. Plane of a Dial. Plane Horizontal. Polar Dials. Pole of the World. Prime Vertical Dials. Projection of the Sphere. Projective Dialling. R. Reclination of a Plane. Reclining Dials. Reflecting Dials. Reflective Dialling. Refracted Dials. South Direct Dials. Stile. Style. Substile. Substilar Line. Trigon. v. Vertical Plane. Circles. Point. Line. Zenith.

> Chirurgery, Pharmacy, and Names of Diseases.

A.
A Baptiston.
Ablation.
Abluent Medicines.
Abscesses.
Abscreent.
Abstergent.
Abstersion.
Acantabolus.
Access.
Accession.
Access.
Achor.
Aclys.
Acme.

Acopum. Acolmy. Acrasy. Acrify. Acros. Acute Diseases. Additaments. Aduft. Ægylops. Ætiology. Agripnia. Agrypno-coma. Alba Pituita. Albugo. Alcola. Aloephanginæ. Alexipharmicks. Alexiterial. Alkermes. Alocticks. Allogotrophy. Alopecy. Alphus. Altering Remedics. Alvus. Amaracinon. Amaurofis. Ambe. Ambliopia. Amblotick. Amethysta. Amonton. Amphismela. Amputation. Amulet. Amygdalate. Ana. Anabrochismus. Anabrofis. Anacharfis. Anacatharticks. Anacollema. Anadofis. Analepticks. Anaploroticks. Anafarca. Anastomatick. Anch ylops. Ancyloblepharum: Ancylogiofium. Aneurilm. Anigloffus. Angina.
Anhelation. Anodynes. Anepfy. Anorexy. Antaphroditick. Antarthriticks. Antasthmaticks. Anthelminticks. Anthracofis. Anthrax. Antidiaphoreticks. Antiarthriticks. Antidote, Antiepilepticks. Antiemeticks. Antihypnoticks. Antinephriticks. Antipafis.

Antipharmacum. Antipilepticks.
Antifcorbuticks. Antispasmodicks. Apepfy. A peritives. Apheresis. Aphroditanum. Aphrogeda. Appetitus Caninus. Apthæ. Apnæa. Apochylisma. A pocrousticks. Apophlegmatical. Apoplexy. Aporrheæ. Aporrhea's. Apoileme. Apozeme. Appenfa. Apyrexy, Archeus. Ardor Urinæ. Areotick Medicines. Argema. Armarium Unguentum. Aromaticks. Aromatization. Aromatick Volatile Sale. Arteriotomy. Arthritis. Planetica. Vaga. Arthritick. Afaphy. Afcaris. Ascarides. Ascites. Ascitick. Afphatum. Afphyxia. Aflatium. Affodes Febris. Afthma, Athemora. Athymia. Atony. Atra Bilis. Atreus. Atrophy. Attenuating, Attenuation. Attonitus Stupor. Attracting. Attractive Auriscalpium. B.

Bacilli.
Bamma.
Batrachus.
Bechicks.
Benign Difeases.
Bezoar Animale.
Bezoardicks.
Biolychnium.
Blisters.
Bochet.
Bolus.
Borborygm.

Bothrion.

An Alphabetical 1 N D E X

Bothrion.
Bradypefy.
Bronchocele.
Bronchotomy.
Buccellation.
Bulimos.

Caballine Aloes.
Cacatoria Febris.
Cachecticus.
Cachexy.
Cacochymy.
Cacoethes.
Cafarian Section.

Birth.
Callous.
Callus.
Cancer.
Canina Fames.
Capillation.
Carbunculus.
Carcinodes.
Carcinoma.
Cardiaca.
Cardiacum.
Cardialgia.
Cardiagmos..
Cardiagmos..

Carpia,
Carus.
Catacatharticks,
Catagma.
Catagmatick.
Catalepfis.
Cataplasma.
Cataphora.
Cataphora.
Catoptosis,
Cataract.

Catarrhus.
Cathartick.
Catheter.
Cathetarifmus.
Cathypnia

Cathypnia. Catoche. Cauledon. Caufodes.

Caufus. Caufficks. Cauterifation.

Cauterium. Cele.

Cenchrias. Ceneangia. Cephala. Cephalaa.

Cephalalgia. Cephalgica.

Cephalick Medicines. Cephalophonia.

Cerchnos.

Chalastick Medicines.

Chalybeats.
Chemofis.
Chlorofis.
Cholera Morbus.
Cholegogues.
Chordaplus.
Chorea Sancti Vitis.

Chymofis. Chirurgery.

Cicatrizantia.

Cicatrix.

Cicatrizing Medicines.

Cirfocele. Circos. Citta. Claretum. Clarification.

Clavus. Clydon. Clyfma. Clyftus.

Coagulate. Codia. Cœliac Passion.

Cœlonia.
Cohobate.
Co-indications.

Colature. Colcothar.

Colick.
Coliquans Fibris.
Colliquation.
Collution.
Collyrium.

Coloboma. Colpus.

Coma Somnolentura.

Vigil.
Comitalis Morbus.
Complication.
Condenfantia.
Condylomia.
Confections.
Congeal.

Confolidating Medicines.

Confolidation.
Confumption.
Contagion.
Continent.
Continual Fever.
Contra Fiffura.
Contra-indications.
Contufion.

Contunon.
Convolvulus.
Conus Fuforius.
Convultion.
Cophofis.
Copos.
Copell.
Copro-critica.
Cordialia.

Cornachine Powder. Cornea Lunæ. Corrofio Chymica.

Corrofive Medicines.
Corrodentia.
Coryza.
Cofmeticks.
Crama.
Cranes Bill.

Crapula.
Craticula.
Cream of Tartar.
Cribration.
Crimnoides.

Crifis.
Criftæ.
Criterion.
Crithe.

Crucible. Crudity.

Crusta lactea. Crustula.

Crymodes. Chryforchis, Cucupha.

Cucurbite. Cucurbitini Lumbrici.

Cucurbitula. Cutaneous Diseases. Cylisci.

Cylindrus.
Cyllofis.
Cyllum.
Cynache.
Cynantropia.
Cynicus Spafmus.
Cynodes Orexis.
Cynorexis.

Cyphoma.
Cyphofis.
Cyrtoma.
Cyrtofis.
Cyrtofos.

Dacryodes.
Darfis.
Daffyman.
Debility.
Decant.
Declention.
Decupelation.
Decufforium.
Defenfatives.
Deflagration.
Defluction.
Deglutition.

Dejection.
Deleterial Medicines.
Deletery Medicines.
Deliquation.

Deliquium Animi. Delirium.

Delirium.
Dentarpaga, InstrDentiducum.
Dentifrice.
Dentition.
Deobstruent.
Deopilative.

Dephlegmated.
Depilatory.
Depuration.
Deficentorium.
Deficcation.
Deficcatives.
Defipumation.

Defipumation.
Destribution.
Detergent.
Deterfives.
Deuteropathia.
Diabetes.
Diabrofis.
Diachisma.
Diacoprægia.
Diacriss.

Diadoche.

Diatetica.

Diagnosticks-

Diagrydium.

Diagrydium. Dialemma. Diapasma. Diapedesis. Diaphoresis. Diapthora. Diaplasis. Diaplasma. Diapnoe. Diapyema. Diapystica. Diaria Febris. Diarrhæa. Diarthrofis. Diathesis. Dicophyia. Dicrotus. Didymi. Dies Critici. Digester. Digestion. Digestive Medicines. Dilatorium. Dilute. Dinus. Dioptra. Diorthofis. Diota. Diploc. Dipfacus. Diflocation. Discussion. Dispensatory. Distolution. Distillation. Districhiasis. Diuresis. Diureticks. Dogmatical Medicine. Dole. Dracunculus. Drastick Medicines. Dropfy.
Ducllists. Dulcify. Dyfesthesia Dyscracy. Dysentery. Dysepylotica. Disorexia. Dyspathy. Dyspepsy. Dysphonia. Dyspnæa.

Dyspherapeutæ. Dysthriachyfis. Dystichia. Dystochia. Dysuria.

Earth.
Ecbolia.
Ecchoprotica.
Ecchyloma.
Ecchymoma.
Ecchymofis.
Eccope.
Eccrimocritica.
Eccrifis.
Eclegma.

Eclipsis. Eclyfis. Ecmastica. Ecphracticum. Ecphraxis. Ecphythesis. Ecpyema. Ecpyesma. Ecplexis. Ecrithmus. Ecthlipfis. Ecthlima. Ecthymata. Ecthymosis. Ectilotica. Ectropium. Eczemata. Edulcoration. Effervescence. Egestion. Elaboratory. Elaterium. Electica. Electuary. Eleosaccharum. Elephantiasis Arabum. Græcorum.

Elevator. Elevatorium. Elixation. Elixir Proprietatis. Elminthes. Elodes. Elongation. Embrocation. Embryothlastes. Embryulcus. Emetick, Tartar. Emmenagogues. Emmotion. Emollientia. Empasma. Empericks. Emphracticks. Emphraxis. Emphysema. Emphyton. Empirical. Emplastrum. Emplasticks. Emplattomena. Emprosthotonus. Empyema. Empyreuma. Emrods. Emulfion. Enæmon. Enzorema. Encauma. Encharaxis. Enchymons. Enchysma. Encope. Endeixis.

Endemical.

Endemious.

Energetical.

Engizoma.

Engonios.

Enneatical Days.

Enema.

Energy.

Enneatical Years. Enarthofis. Enterenchyta. Enterocele, Enteromphalus. Epaphalesis. Ephelis. Ephellides. Ephelcis. Ephemera. Ephialtes. Ephidrofis. Epiala. Epicarpium; Epicauma. Epicerastica. Epicharsis. Epicrafis. Epicyema. Epidemick. Epilepfy. Epigonatis. Epiparoxysmus. Epiphora. Epiplasma. Epilocele. Epiplomphalum. Epilarcidium. Episemafia. Epispasticks. Epitheme. Epneumatofis. Epomphalum, Epulis. Epuletick Medicines Erodentia: Erpes. Errhines. Eryfipelasi Eryfipelatodes. Erythremata. Eschar. Escharotick. Effere. Esurine Salts. Euchymiæ. Eucrasia. Euexia. Eupepfia. Euphoria.

Exacerbation
Exercise
Exanthemata.
Exarticulation
Exception
Excition.
Excortication
Excretion.
Excretion.
Excretion.
Excretion.
Excretion.
Excretion.
Exomphalos.
Exopthalmia.
Exoltrofis.
Expectoration.

Eupnoe.

Euporia.

Eularcos.

Eustomachos.

Euthanasia.

Eutropia.

Extafy.
Extergent.
Extirpation.
Extract.
Extraction.
Extraction.
Extuberances.
Exulceration.

Facies Hypocratica. Fæces. Falling Sickness. Fames Canina. Fasciation. Fasciculus. Fastidium Cibi. Favus. Feaver. Febrifuge. Fæculæ. Fermentation. Ferruginous. Ferucæ. Fibula. Ficus. Filtration. Fiffura Offis. Fistula. Fluor Albus. Fluxion. Fluxus Chylosus. Focus. Fomentation. Fontanellæ. Forceps. Forfex.

Formulæ.

Frontale.

Fugile.
Fungus.
Furfuration.

Furfures.

Furunculus.

Fractura Offis.

Fotus.

Galea. Galenick Medicines. Ganglion. Gangrene. Gargarism. Gasteronaphia. Gastrotomy. Glandula Guidonis. Glans. G laucoma. G laucosis. Gloffocomium. Gomphos. Gomphofis. Gonagra. Gravedo. Graphus. Gumma Gallicum. Gutta Rosacea. Serena.

G.

Hælofis.

Gynecia.

Gymnasticks.

Gynæcomastum.

Hæmalops.
Hæmatons.
Hæmodia.
Hæmoptyfis.
Hæmorrhagia.
Hæmorrhoides.
Hectica.
Hegemonicæ.
Helcydra.
Helminthagogues.
Helo's.
Hemeralopia.
Hemicrania.

Helo's.
Hemeralopia.
Hemicrania.
Hemipagia.
Hemiplegia.
Hemiplexia.
Hemitritæus.
Hepatick Medicines.
Aloes.
Hepaticus Morbus.
Hepiala.

Herculeus Morbus.

Herma.
Herpes.
Heterocrania.
Hidroa
Hidropofus.
Hidrotick.
Hippus.
Homotona.
Hoplochryfma.

Hordeatum.
Hordeolum.
Horrifica Febris.
Humectation.
Humours.
Hybona.
Hydatides.
Hydragogues.

Hydroa. Hydrocele. Hydrocephalum. Hydromel. Hydromphalum. Hydrophobia. Hydropica.

Hydrops. ad Matulam.

Hydroticks. Hygeia. Hygeina. Hygrocircocele. Hypercatharfis. Hyperchrysis. Hyperephidrisis. Hyperfarcofis. Hypnoticks. Hypochondriaca. Hypochondriacus. Hypochyma. Hypothysis. Hypocratis Manica. Hypoglossis. Hypophyalmia. Hypophoræ. Hypophysis. H ypogon. Hyposarca. Hypofarcidium. Hypospathysmus.

Hyposphagma.
Hypostasis Urinæ.
Hysteralgia.
Hysterica.
Passio.

Hysteromotocia.
Hysterotomia.

Jaundice.
Ichor.
Ichoroides.
Icterus.
Idiocrafy.
Idiopathy.
Idiofyncrafy.
Ignis Perficus.
Sacer.

Sylvestris.
Ignition.
Iliac Passion.
Ilingus.
Impetigo Celsi.
Plinii.

Inceration. Incineration. Incorporate. Incraffating. Incubus. Indication. Indications. Inedia. Inflammation. Infusion. Ingredients. Injection. Infania. Infessus. Infolation. Intercus. Intermissio Febrium. Intermius Morbus.

Intermius Morb
Intertigo.
Ionthus.
Ifchæma.
Ifchyas.
Ifchuretica.
Ifchuria.
Itinerarium.
Julap.

Labia Leporina.
Laconicum.
Laconicum.
Lambative.
Lancette.
Laqueus.
Laryngotomia.
Laflitudo Ulcerofa.
Lavamentum.
Laudanum.
Lavatives.
Lenientia.
Lenta Febris.
Lentigines.
Lepra Arabum.
Græcorum.

Græcorum
Leprofy.
Leptuntica.
Lethargus.
Leuce.
Leucoma.

Leucophlegmatia.

Lichen.

Lienteria. Linctus. Lipothymia. Lithyasis. Lithontripticks. Lithotomia. Local Medicines. Loch. Lochia. Lohoch. Lordofis. Lues Venerea. Deifica. Lumbago. Luxation. Lupia. Lupus. Lycanthropia, Lygmos. Lynx. Lypyria. Macula Hepatica. Volatica. Magdaleones. Magma. Malacía. Malactica. Malagma. Malignus Morbus. Maltha Code. Malum Mortuum. Mania. Manica Hippocratis. Manipulus. Manus Christi. Marasmodes. Marisca. Marmorata Aurium. Masticatory.
Materia Medica. Meconium. Medicine. Mela. Melancholy. Meliceria. Mellicratum. Melopes. Melos Meningophylox. Menopegia. Metaptofis. Metastasis. Metrenchyta. Miasma. Milliaris Herpes. Miserere mei. Mitella. Mira. Modiolus. Mola Carnea. Morbus Regius. Mucilage. Mydriafis. Mylpha. Miocephalon. Miopia. : Myrmecia:

Lichen.

Narcosis. Narcoticks, Nasalia. Nascalia. Natta. Nausea. Necrofis. Nephelæ. Nephriticks. Nephritis. Nephiros. Neurodes. Neuroticks. Noli me Tangere. Nomæ. Non-natural Things, Nofocomium. Novacula. Nubeculæ. Nuciofitas. Nux. Nyctalopia. Nymphomania. Octhodes. Odoxyſmus. Odontalgia. Oedema. Oligotrophus. Oligotrophy. Omphalocele. Onyx. Ophiafis. Opthalmicks. Opiates. Opisthotonus. Opthalmy. Orexis. Orgalmus. Oroboides. Orthopnæa. Oscillation. Ostocopi. Otalgia. Otenchyta. Otica. Outacousticon. Ovum. Oxelæum. Oxycratum. Oxýdercica. Oxymell. Oxyregmia. Oxyrrhodinum, Ozæna.

P.
Pachuntick Medicines.
Palindrome.
Palliative.
Palmus.
Palpitation.
Palfy.
Panacæa.
Panchymagogues.
Pandalea.
Pandemius.
Pandiculation.
Papulæ.
Paracentefis.
O o o o

Paralysis. Paraphymofis. Paraplegia. Paraphrenitis. Paraphrofine. Paralynanche. Paronychia. Paroxysm. Parylis. Pathills. Pathognomick: Pathology. Pectorals. Pediculosus Morbus. Pelidnus. Pemphigodes Febrisa Periamma. Periaptum. Pericarpium. Peripneumony. Pernio. Perminima. Peffary. Peffulus. Pessus. Pestilential Fever. Pestoloides. Petechialis. Petigo. Phacia. Phacos. Phagedæna. Phagedenick Water. Phalacrofis. Phalangofis. Pharmaceutick. Pharmacopœia. Pharmacum. Pharmacy. Philonium. Phimosis. Phleboragia: Phlebotomy. Phlegmagogues. Phlegmon. Phlegmonodes Febris. Phlogofis. Phlyclæna. Phrenefis. Phrenitis. Phricodes. Phtharticum. Phthiriafis. Phthifis. Phygethlon. Phymæ. Physemæ. Physiognomicks. Pica. Picatio. Picra. Pituita. Pityroides. Pladarofis. Platisma. Plerotica. Plethora.

Parachynance.

Paracmastica.

Pleurify.

Pleuritis.

Pleurify.
Plica.
Pneumatocele.
Pneumatodes.
Pneumatoniphalus.
Pneumatofis.
Podagra.
Polypus.
Pomphlygodes.
Porocele.
Porotica.
Probe.
Procatarctica.
Procidentia Ani.
Uteri.

Prodromus Morbus. Proegumena. Prognofis. Prolapsus Uteri. Prolepticus. Prophæfis. Prophylactica. Proptosis. Prosphysis. Prostesis. Protopathia. Prunellæ Sal. Prospthalmia. Psammismus. Psyctica. Ptarmica. Pterygium. Ptisana. Ptylofis. Pugillus. Pulpa. Pulius. Pulses, their several kinds.

Pyrotica.

Quartane Ague.

Quinfey.

Quintefcence.

Quotidian Ague.

R.

Pulverization.

Purgation.

Rachitis.
Radical Moisture.
Rarefacientis.
Raspatorium.
Recidivus Morbus.
Recrement.
Regius Morbus.
Relaxantia.
Repellent Medicines.
Refina.
Res-Non-Naturales.
Revulsion.
Rhachitis.

Rhagades.
Rhegma.
Rheumatifm.
Rhexis.
Rhinenchites.
Rhyos.
Rhyptica.
Rhythmus.
Ros.

Vitrioli. Rofines. Rosa. Rubrica. Ructation. Rugitus. Ryas.

S.
Sacculi Medicinales.
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